CM SAF Review Board Report for the CLAAS-4 CDRs/ICDRs Requirements Review (RR 4.6)

Doc.No. : EUM/DSA/REP/24/1403930
Issue : v1 e-signed
Date : 22 April 2024
WBS/DBS :

EUMETSAT
Eumetsat-Allee 1, D-64295 Darmstadt, Germany
Tel: +49 6151 807-7
Fax: +49 6151 807 555
http://www.eumetsat.int

Signature Table

	Name	*Function*	*Signature*	*Date*
Book-captain:	Cleber Balan	SAF Process and Management Support Engineer		
Reviewed by:	Lothar Schüller	SAF Network Manager on behalf of the RR Review Board		
Approved by:	Lothar Schüller	SAF Network Manager on behalf of the RR Review Board		

Distribution List

Name	*Organisation*
EUMETSAT SAF Network Secretariat (Frédéric Gasiglia, Lothar Schüller, Cleber Balan)	EUMETSAT Secretariat
External Participants as listed under Section 2.2 via CM SAF Project Manager - Rainer Hollmann (Rainer.Hollmann@dwd.de)	EUMETSAT CM SAF

Change Record

Version	*Date*	*DCR* No.* *if applicable*	*Description of changes*
V1	22 April 2024	-	First version after acceptance of final documents and agreement on recommendations and review conclusion.

Table of Contents

Table of Tables

1 INTRODUCTION

1.1 Purpose

This document presents the outcome of the Requirements Review (RR) on the following CLAAS-4 CDRs and ICDRs, which took place on 07 March 2024:

Product Name	CDR ID	ICDR ID
Fractional Cloud Cover (CFC)	CM-21016	CM-5012
Joint Cloud property Histogram (JCH)	CM-21024	CM-5022
Cloud Top level (CTO)	CM-21034	CM-5032
Cloud Phase (CPH)	CM-21044	CM-5042
Liquid Water Path (LWP)	CM-21054	CM-5052
Ice Water Path (IWP)	CM-21064	CM-5062
Reflected Solar Flux (RSF)	CM-21302	CM-5321
Outgoing Longwave Radiation (OLR)	CM-21332	CM-5331

Table 1: Products Under Review

1.2 Document Structure

This document is composed by three sections. Section 1 introduces the purpose and scope of this document and section 2 describes the details of the review organisation. Section 2.5 presents the Reviewers' comments. The conclusion of the review is presented in section 3. Appendix A presents the consolidated requirements as outcome of this review. Appendix B contains the review board membership. Appendix C presents the submitted comments. Appendix D presents the email exchange between the review participants and the acceptance of the updated documents finalising the review process.

2 REVIEW PROCESS

The review was implemented according to the organisation note (reference: SAF/CM/CDOP4/DWD/RR46/ON, v1.0) distributed on 05 February 2024 and recalled in sub-sections 2.1 to 2.4.

2.1 Objectives

Objective 1: to assess the requirements of the CDR and ICDR and to provide a recommendation to the CM SAF SG on a decision concerning the consolidation of the requirements as baseline for the development and implementation of the algorithm.

2.2 Participants

- Review Board Membership (See Appendix B)
  - Johannes Quaas (Universität Leipzig) - Chairman
  - Christine Chiu (Colorado State University)

- EUMETSAT Secretariat Support
  - Cleber Balan (SAF Process and Management Support Engineer)

- CM SAF Project Team
  - Marc Schröder (DWD)
  - Rainer Hollmann (DWD)
  - Jan Fokke Meirink (KNMI)
  - Martin Stengel (DWD)
  - Nicolas Clerbaux (RMIB)

2.3 Review Material

2.3.1 Review Items (Documents under review)

Document	*Version*
Input of project team for RR: SAF/CM/CDOP4/DWD/RR46/ON	1.0

Table 2: Documents under review

The reviewed documentation was made available at the following location:

ftp://safrev:safrev@ftp.eumetsat.int/SAFCLM/CDOP4/RR46/RR46_Docs_Under_Review

2.3.2 Reference Documentation

Document	*Version*
CM SAF CDOP 4 Product Requirement Document	4.2

Table 3: Reference Documents

The reference documentation was made available at the following location:

ftp://safrev:safrev@ftp.eumetsat.int/SAFCLM/CDOP4/RR46/RR46_Ref_Docs

2.4 Schedule

EVENT / PHASE	*DATE/PERIOD*
All documents under review and for reference are available at EUMETSAT for further distribution	02.02.2024
Review Process	
Reviewers' analysis and, if possible, email submission of comments/RIDs	02.02.2024 to 29.02.2024
Response by Project Team to reviewer comments	07.03.2024
Review Board Meeting (hybrid)	31.03.2024
Steering Group (SG)	
Presentation to Steering Group Steering Group approval	Email Email

Table 4: Review Schedule

2.5 Review discussion

The following participants were present at the Requirements Review meeting on 07 March 2024:

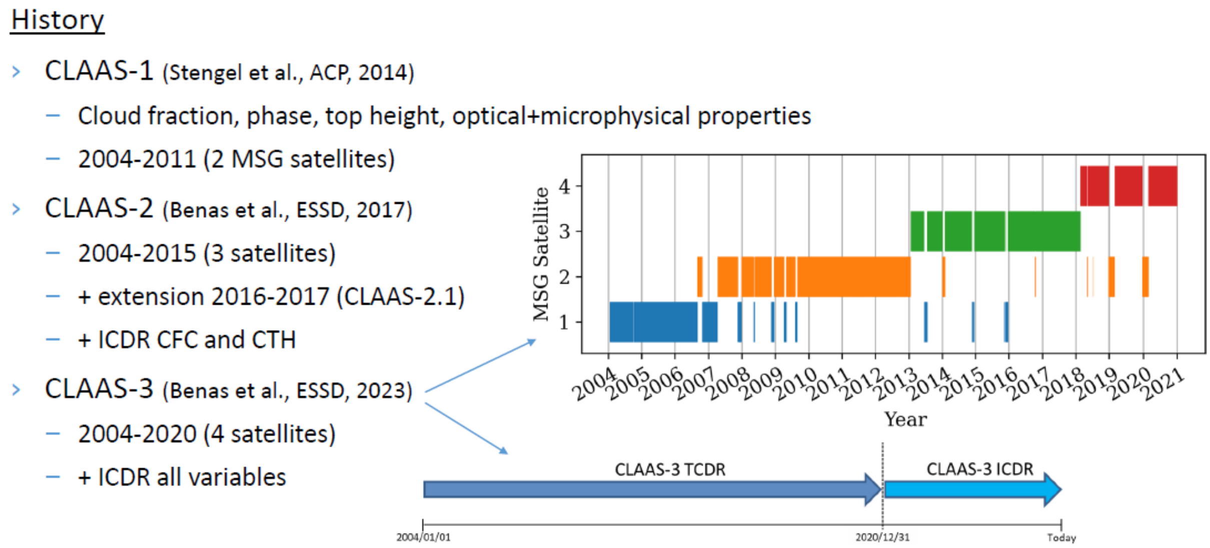
- Johannes Quaas (Universität Leipzig)
- Christine Chiu (Colorado State University) - Excused
- Cleber Balan (EUM Secr.)
- Marc Schröder (DWD)
- Martin Stengel (DWD)
- Jan Fokke Meirink (KNMI)
- Nikos Benas (KNMI)

- Nicolas Clerbaux (RMIB)
- Tom Akkermans (RMI)
- William Moutier (RMI)

The CM SAF gave a presentation with the background history of the CLAAS releases and the key improvements coming with CLAAS-4 release (Seeding_CLAAS-4__RR_presentation_byPT.pdf):

FTP://safrev:safrev@ftp.eumetsat.int/SAFCLM/CDOP4/RR46/RR46_Presentations

Historical view of CLAAS versions



Improvements since CLAAS-3

One of the major improvements that will come with CLAAS-4 is the use of the SEVIRI FDR from EUMETSAT Secretariat with a re-calibration of the VIS and NIR1.6 channels. It was noted by the PT that the FDR data has not been made available yet, however the Team is in close contact with EUMETSAT Secretariat expecting to get the data in the next weeks/months. The production of the CLAAS-4 is in any case planned in 2025, so this dependency will most likely not impact the CM SAF plans.

The Board made a very positive overall comment about the work done and plans of the CM SAF to provide this new climate data record (CLAAS-4) to the users.

Product Requirement Tables

EUMETSAT Secretariat pointed out a few points that need to be addressed in the requirements tables of the ICDRs for the finalisation of the report:

- Missing "Generation frequency", "Verification method" and "comments" indicating the connection to the CDR products;
- Revision of "Timeliness" for the generation of the ICDRs;

Background on Requirements Definition

A question was raised on which basis the proposed requirements were formulated and in particular if there was a user consultation. The CM SAF indicated that there was no active user consultation, however the requirements were deduced from the best knowledge of the team for the target user applications and the ability to meet the scientific requirements.

User uptake

The CM SAF Team informed that in the past there were user interactions about the CLAAS products that can indicate the user uptake. The CM SAF Team agreed to try extracting some of this information for the finalisation of the RR (see Conclusion in section 3). It was noted the list of peer reviewed publications (Table 8 of RR Document) showing where and which CM SAF CLAAS cloud products have been used since the 1st beta release in 2011. Given the time needed for scientific analysis, paper drafting and the review process, publications using CLAAS-3 are not yet available.

2.6 Status of past actions

Action	Actionnee	Description	Due Date	Related RID	Status at RR CLAAS-4
PCR 3.7 01	PT	PT to consider for the future CPP retrieval adding (heavy) aerosol flags for a L3 product in order to allow a distinction between high aerosol loads, clouds and aerosol/cloud mixtures.	RR CLAAS-4	[005]	Some ideas and PT is still considering. PPS tries to distinguish clouds from aerosols. PT to further discuss for an agreement at PCR whether to include the provision of flag as a commitment. **Action Open**
PCR 3.7 04	PT	PT to check the potential user needs for the next version of CLAAS (CLAAS-4) for an hourly L3 product.	RR CLAAS-4	[014]	It is very unlikely that users will have interest in a L3 hourly product. **Action closed**
PCR 3.7 05	PT	PT to consider for CLAAS-4, using dynamic databases of surface albedo and emissivity (e.g. based on SEVIRI- (and FCI-), SNPP and NOAA20 VIIRS, CAMEL, etc.) as an alternative to MODIS.	RR CLAAS-4	[024/025]	PT confirms that the use of dyminaci databases for surface albedo and emissivity will be used as an alternative to MODIS. **Action Closed**
PCR 3.7 06	PT	PT to explore some specific cases (e.g. forest fires, dust, snow/ice, etc.) for CLAAS-4 in order to optimize the treatment of problematic pixels in the cloud property retrievals.	RR CLAAS-4	[010]	Proposed to postpone to PCR. **Action open**
RR 3.7 002 / CDOP3_SG4_A11	PT	SG tasked the PT to implement the action from RR 3.7 CLAAS-3: - PT to consider including night-time cloud optical and microphysical products for the CLAAS-4.	RR 4.6 on CLAAS-4	[002]	PT considered (see presentation) inclusion of nighttime cloud optical and microphysical products to CLAAS-4, but that retrievals are too uncertain to be useful.

		N.B.: This action is out of control of the CDOP 3 SG. Action does not pre-empt any decision on the portfolio of CDOP 4			**Action closed**
DRR 3.7 / ORR 001	PT	PT to assess that in 2011-2012 and after 2018 (especially in night-time), cloud fraction irregularities are not present in the next version of CLAAS (CLAAS-4).	RR CLAAS-4	[032]	Action postponed to DRR when the validation of the product is available. **Action Open**

Table 5: Actions table from past reviews

2.7 Status of past actions

The Review Board submitted 15 RIDs/Comments which the Project Team answered accordingly (see RIDs list in Appendix C). Only comments characterized as “Minor” and “Editorial” were submitted:

Uncertainty requirements for CM-21302 and CM-21332 (Table 6) [RID 008]

The Reviewer pointed out that it seems that the uncertainly requirements for CM-21302 (CLAAS-4 Reflected Solar Flux TCDR) and CM-21332 (CLAAS-4 Outgoing Longwave Radiation TCDR) seem to have been largely based on the literature, but there are no considerations regarding:

1) how the uncertainty reported in the literature is translated to different scales (since the original products seem to have different grid scales compared to the proposed ones in the RR document); and
2) why is it expected that all-sky and clear-sky reflected shortwave fluxes have the same uncertainty? Clear-sky estimates require extra steps, which should be more uncertain, although there might be compensating errors due to the lack of clouds.

The CM SAF Team clarified that the requirements are defined mostly based on use in the fields of process studies and of cloud radiative effect estimation. For these applications a spatial resolution of the order of 10x10km proved to be well suited, e.g. the EarthCARE mission implements an assessment domain of 10x10km^2. Still, for CLAAS-4 it is proposed to process the full spatial resolution allowed by SEVIRI (3km) for the level-2 processing (i.e. to estimate instantaneous RSF and OLR fluxes). The main motivation here is the consistency with the cloud products and the increase of the frequency of cloud free conditions.

Regarding Clear-sky vs all-sky: The PT acknowledged that clear-sky fluxes will have additional error sources due to the cloud screening process and possible sub-pixel cloud contamination not detected by the cloud mask. However, this additional (relative) error is partly compensated by the lower absolute values of the clear-sky flux with respect to the all-sky fluxes. The main reason to set similar accuracy/stability requirements for the clear-sky and all-sky fluxes is that they are expected to be used together to estimate cloud radiative effect. For this application it makes sense to set identical requirement.

The explanation was agreed to be included in the RR document accordingly.

CERES SYN-1deg [RID 009]

It was recognised that flux records are not independent of CERES projects due to ADM (Angular Distribution Models), which is not a big concern. However, comparing to CERES SYN-1deg might not be the best approach in terms of independence. It was confirmed by the PT that CERES SYN-1deg product makes use of the geostationary satellites (among which Meteosat) for the diurnal cycle, which are then scaled so that they match the polar orbiting CERES observations. In that sense, the Meteosat-based CLAAS4 flux products are indeed not completely independent from CERES SYN1deg, a product that is used for validation. However, the PT plans to use a range of different validation reference products, including CERES EBAF (which does not make use of GEO observations), HIRS OLR, ERA5, etc. making sure that we don't only rely on CERES SYN1deg. The PT agreed to mention this issue in the text, as an additional justification on the use of different reference products for validation.

More technically, the CERES SYN products do not use only Meteosat 0° but also GOES-East (for longitude < -32.5° East) and Meteosat Indian Ocean (for lon > 20°-30° West). Therefore, the CERES-SYN / CLAAS-4 comparison is still meaningful out of the central band of longitude that could indeed be subject to the circular issue.

Possibility of flag for low cloud presence in multi-layer cloud situations [RID 015]

It was acknowledged that geostationary satellites have the unique advantage to study cloud evolutions. When tracking low clouds, it sometimes gets to the point that it is not possible to know if low clouds are still there due to the overlaying high clouds. A question was raised whether there would be the possibility to include a flag, showing the possibility of low cloud presence in multi-layer cloud situations. The CM SAF Team explained that it is generally not possible to identify low-level cloud layers in passive imagery if there are overlying cloud layers. In that sense, active sensors (like those on CALIPSO and CLOUDSAT satellites) have better capabilities to detect multilayer cases. The PT discussed the possibility to include this also for CM SAF algorithms but since progress in this field has not shown clear improvements (except for very idealized cases) it has not been committed. However, the PT will follow the developments here for future editions.

Stability of CFC retrievals [RID 003]

A consideration was made on the possibility to include targets on stability, since indeed trend analysis may be a particularly interesting application of the CLAAS dataset. However, it is not evident that a target of 2% / decade in CFC may allow for trend identification. The threshold value of 5% / decade seems to be too large to be useful in many regions. However, 0.5 %/decade indeed would be very good.

The PT is of the opinion that the numbers specified in the PRT are reasonable compromises between what is feasible and what is not feasible. Firstly, to calculate climate trends over 20 years is maybe already too ambitious. Longer time series would probably be required to increase the accuracy of trends. Secondly, it is very hard to validate whether the trends are reasonable or not, since the PT rarely has access to suitable reference data. One could compare with MODIS and AVHRR data but there is already the problem of rather poor diurnal sampling in comparison with SEVIRI. More accurate measurements (e.g. from CLOUDSAT/CALIPSO) exists but then the time period of observations (and also the geographical sampling) is much smaller. Also, observations from these satellites (including satellites with MODIS) will not be available for the last years of CLAAS-4. In conclusion, to even sharpen the target requirements (e.g. to improve it to 0.5 % per decade) is risky and not recommendable even if it would be desired. In addition, the PT is focused more on the trend as an average over the MSG disk rather than to extend it also to regions. To PT considers that validate regional trends seems quite difficult.

It was clarified that the percentage is the absolute percentage and reaching a 0.5% is too ambitious. Furthermore, a 20 years data record for trends analysis seams feasible although ideally would be 30-34 years. The Board accepted the values as proposed by the PT considering that for larger regions it is possible to attain a better stability.

Stability of broadband fluxes [RID 004]

The Reviewer considered that the proposed stability requirements seemed unambitious given the goal of analysing trends and recommended a target of 0.3 Wm-2 decade-1 would be very good, and optimal in fact rather some 0.1 Wm-2 decade-1. The PT explained that the stability of the CDOP 2 MVIRI/SEVIRI dataset (i.e., the predecessor of the CLAAS-4 TOA dataset) has been evaluated by calculating the de-seasonalized bias with the most recent CERES EBAF dataset. While improvements compared to CDOP 2 are expected, the proposed values seem unfortunately not feasible.

LWP with microwave as reference [RID 005]

The PT confirmed that a computation of all-sky LWP (i.e. LWP multiplied by CFC) at the coarser microwave sensor resolution was already done in comparisons with AMSR2 and MAC-LWP in the CLAAS-3 validation report. Clarification was agreed to be included in the updated version of the RR Document.

Remaining Editorial and Minor Comments

Overall, no major issues have been detected and the Review Board accepted the proposed requirements for the CLAAS-4 CDRs/ICDRs with the agreed clarifications in the updated RR document, v1.1, provided on 28 March 2024:

ftp://safrev:safrev@ftp.eumetsat.int/SAFCLM/CDOP4/RR46/Updated_docs (copy/paste to file explorer to access file)

(see Appendix C for acceptance emails)

3 CONCLUSION

Regarding "***Objective 1: to assess the requirements as defined in the PRD 4.0 and to provide a recommendation to the SG on a decision concerning the consolidation of the development and implementation of the algorithm***"; the Board did not identify any major issues with respect to the development of the CLAAS-4 CDRs/ICDRs (**Table 2**).

CLAAS-4 main improvements with respect to CLAAS-3:

- Extension of the CDR for a 21 years temporal coverage (2004–2024);
- Provision of ICDR extending the CDR continuously and consistently featuring the transition from Meteosat-11 SEVIRI to Meteosat-12 FCI;
- CLAAS-4 will use the SEVIRI FDR from EUMETSAT Secretariat with a re-calibration of the VIS and NIR1.6 channels and additionally re-calibrated IR measurements;
- New CPH (Cloud Phase) algorithm based on an Artificial Neural Network as part of the SEVIRI_ML software package (https://github.com/danielphilipp/seviri_ml) developed in the ESA CCI+ Clouds project (https://climate.esa.int/en/projects/cloud/);
- Introduction of TOA upwelling shortwave and longwave broadband fluxes that are consistent with the cloud properties derived;

It was recognised that, in general, CLAAS-4 can serve various applications as identified in the last CM SAF user workshop and scientific papers:

- Understanding regional climate mechanisms;
- Quantification of atmospheric processes;
- Evaluation/Improvement of climate NWP models;
- Used as boundary condition to calculate surface radiative fluxes;

Short summary on user interaction for CLAAS

Through the CM SAF help desk, the CM SAF PT operates a user interaction platform for all 'entry level' questions on CM SAF products including CLAAS products. Beyond that, CM SAF scientists establish and maintain interactions with individual users on a continuous basis on both the users' needs and CM SAF's products guidance, which sometimes includes tailoring the products to specific needs. Examples of recent user interactions of this kind are:

(i) The provision and utilization of (independent) cloud top temperature and cloud top phase for studying cloud glaciation processes. This was done together with the Karlsruhe Institute of Technology and yielded a scientific publication (Han et al., 2023, ACP, doi:10.5194/acp-23-14077-2023). Furthermore, this user interaction highlighted the need for providing accurate cloud top phase information (i.e. in the mixed-phase temperature range) including uncertainty.

(ii) Interaction with two German users on climatologically mean cloudiness for administrative divisions in Germany. CLAAS data was thus further processed to provide mean cloudiness for states and counties. This also led to the finding that in-land lakes and land areas show slightly different cloud cover (in a 2 decades mean). It will be further investigated if this is a natural feature or not.

As part of an interaction with the power user Leibniz Institute for Tropospheric Research, the generation of cloud property histograms have been investigated. This user further appreciated the availability of level-2 data for the entire record. This interaction included discussions on best practices to provide large amounts of data.

Requirements Traceability Summary

The CLAAS-4 CDRs requirements are mainly based on CLAAS-3, i.e., a main objective is to ensure a continuous service to CM SAF users, among others by implementing FCI. The PT confirmed that there was not an dedicated user consultation event (e.g., online user survey) with the CM SAF users on the establishing of the requirements for CLAAS-4. However, it is noted that the PT is in continuous exchange with users by being highly responsive to user request via the CM SAF user help desk and via questions/requests directed towards host institutes as well as through direct exchange. The PT is confident that the values proposed at this requirement review are the most appropriate for the acknowledged user applications (above).

In terms of uncertainty requirements, CLAAS-4 will use the same target values as CLAAS-3 for the following parameters: **Fractional cloud cover (CM-21016), Joint cloud histogram (CM-21024), Cloud top level (CM-21034), Cloud phase (CM-21044), Ice water path (CM-21064).**

An exception is made for **Liquid water path (CM-21054)** and **Ice water path (CM-21064)** L2 precision requirement, which turned out to be challenging in CLAAS-3 and which is proposed to weaken to 100 g/m² but still very much in line with [GCOS-154].

Reflected solar flux (CM-21302) and **Outgoing longwave radiation (CM-21332)** are new products in CLAAS-4 and the implemented requirements are partially adopted from existing CM SAF TOA Radiation MVIRI/SEVIRI data record Edition 1 products (CM-23311 and CM-23341), CM-21301 (TOA Reflected solar Radiative Flux) and CM-21331 (TOA Emitted Thermal Radiative Flux), CM-11312 (AVHRR GAC ToA Reflected Shortwave Flux TCDR R1) and CM-11342 (VHRR GAC ToA Outgoing Longwave Radiation TCDR R1), which were defined by taking into account a review of known (typical) usage of the products (i.e., proxy for user needs).

Usage of the CLAAS-4 products from the members of the Board

The provision of Broadband fluxes estimates was welcomed by the Board, it will enhance the usefulness of the product for climate studies such as the assessment of how the cloud microphysical state and its changes relate to the Earth radiation budget. A unique selling point of the CLAAS product is its usefulness for cloud tracking and analysis of evolution of the properties along the cloud life cycle.

The PT was suggested to start thinking further about how to maximize the number of users by providing a “bundle type” of data products. For example, coordination with aerosol products for ship-track analysis and aerosol-cloud interaction studies in general; subsets tailored around sites of ground-based cloud observation networks (e.g., US DOE/ARM, EU ACTRIS); databases of CLAAS-4 across various cloud organizations.

Recommendation 02: The Board recommends to the CM SAF Steering Group to take the following decision and corresponding action:

- **DECISION**: SG approves and baselines the following CLAAS-4 CDRs/ICDRs requirements tables (as per Requirements Review Document, *v1.1, dated 31.03.2024, ref: SAF/CM/DWD/RR46 and Appendix A*) with the following changes:
  - Fractional Cloud Cover (CFC):
    - **CM-21016**: CLAAS-4 Fractional Cloud Cover TCDR
    - **CM-5012**: SEVIRI-FCI Fractional Cloud Cover ICDR
  - Joint Cloud property Histogram (JCH):
    - **CM-21024:** CLAAS-4 Joint Cloud Histogram TCDR
    - **CM-5022**: SEVIRI-FCI Joint Cloud histogram ICDR
  - Cloud Top level (CTO):
    - **CM-21034**: CLAAS-4 Cloud Top Level TCDR
    - **CM-5032**: SEVIRI-FCI Cloud Top Level ICDR
  - Cloud Phase (CPH):
    - **CM-21044**: CLAAS-4 Cloud Phase TCDR
    - **CM-5042**: SEVIRI-FCI Cloud Phase ICDR
  - Liquid Water Path:
    - **CM-21054**: CLAAS-4 Liquid Water Path TCDR
    - **CM-5052**: SEVIRI-FCI Liquid Water Path ICDR
  - Ice Water Path (IWP):
    - **CM-21064**: CLAAS-4 Ice Water Path TCDR
    - **CM-5062**: SEVIRI-FCI Ice Water Path ICDR
  - Reflected Solar Flux (RSF):
    - **CM-21302**: CLAAS-4 Reflected Solar Flux TCDR
    - **CM-5321:** SEVIRI-FCI Reflected Solar Flux ICDR **- NEW**
  - Outgoing Longwave Radiation (OLR):
    - **CM-21332:** CLAAS-4 Outgoing Longwave Radiation TCDR
    - **CM-5331:** SEVIRI-FCI Outgoing Longwave Radiation ICDR **- NEW**

- **ACTION**: PT to implement the requirements changes as per Requirements Review Document, v1.1, dated 31.03.2024, ref: *SAF/CM/DWD/RR/4.6 and Appendix A* into a new Product Requirements Document (PRD) version and to send it to SG for approval.

In terms of planning, the CM SAF Team informed the current development plan to have the Product Consolidation Review (4.6) in Q4 2024 and the Delivery/Operational Readiness Review (DRR/ORR) in Q4 2025.

This objective is considered successfully achieved.

APPENDIX A CONSOLIDATED REQUIREMENTS

A.1 CM-21016: CLAAS-4 FRACTIONAL CLOUD COVER TCDR

CM-21016	CLAAS-4 Fractional Cloud Cover TCDR	CFC_R5_CLAAS_4_TCDR

Type
Dataset

Input Satellite Data
Operational Satellite:FCI
Operational Satellite:SEVIRI

Application Areas
Climate Modelling and Evaluation

Dissemination Information

Distribution format
L2:NetCDF4
L3:NetCDF4

Generation frequency

Generation timeliness

Spatio-temporal Information

Spatial Coverage
L2:METEOSAT full disk (includes Europe, Africa, Atlantic Ocean)
L3:METEOSAT full disk (includes Europe, Africa, Atlantic Ocean)

Spatial Resolution
L2:HORIZONTAL: native satellite pixel resolution ~(3 km)²
L3 dm and mm: HORIZONTAL: (0.05)²
L3 mmdc: HORIZONTAL: (0.25)²

Temporal Resolution
L2:Instantaneous: 10/15min
L3:Daily:Mean
L3:Monthly:Mean
L3:Monthly:Mean diurnal-cycle

Temporal Coverage
1/1/2004
12/31/2024

Uncertainty Characteristics			Optimum	Target	Threshold
CFC-Instantaneous	ACCURACY	bias	1 %	5 %	10 %
CFC-Instantaneous	PRECISION	KSS	>0.8	>0.6	>0.5
CFC-Instantaneous	STABILITY	decadal	0.5	2 %	5 %
CFC-Daily Mean	ACCURACY	bias	1 %	5 %	10 %
CFC-Daily Mean	PRECISION	bc-RMS	5 %	10 %	20 %
CFC-Daily Mean	STABILITY	decadal	0.50 %	2 %	5 %
CFC-Monthly Mean	ACCURACY	bias	1 %	5 %	10 %
CFC-Monthly Mean	PRECISION	bc-RMS	5 %	10 %	20 %
CFC-Monthly Mean	STABILITY	decadal	0.5 %	2 %	5 %
CFC-Monthly Mean DC	ACCURACY	bias	1%	5 %	10 %
CFC-Monthly Mean DC	PRECISION	bc-RMS	5 %	10 %	20 %
CFC-Monthly Mean DC	STABILITY	decadal	0.5 %	2 %	5 %

Verification:
L2 validation against Calipso / EarthCARE
L3 validation against SYNOP plus evaluation against MODIS

Comment:
Naive Bayesian probablistic cloud masking with statistics depending on surface types
Additional data layers:
L3: CFC for high, middle and low clouds, CFC for daytime and nighttime

A.2 CM-5012: SEVIRI-FCI FRACTIONAL CLOUD COVER ICDR

CM-5012	SEVIRI-FCI Fractional Cloud Cover ICDR	CFC_METEO_R1_ICDR

Type
Product

Input Satellite Data
Operational Satellite:~~SEVIRI~~ FCI

Application Areas
Cimate Monitoring

Dissemination Information

Distribution format
L2:NetCDF4
L3:NetCDF4

Generation frequency
1 day , 1 month

Generation timeliness
10 days (95%)
15 days (100%)

Spatio-temporal Information

Spatial Coverage
L2:METEOSAT full disk (includes Europe, Africa, Atlantic Ocean)
L3:METEOSAT full disk (includes Europe, Africa, Atlantic Ocean)

Spatial Resolution
L2:HORIZONTAL: native satellite pixel resolution ~$(3\ km)^2$
L3 dm and mm: HORIZONTAL: $(0.05)^2$
L3 mmdc: HORIZONTAL: $(0.25)^2$

Temporal Resolution
L2:Instantaneous: 10min
L3:Daily:Mean
L3:Monthly:Mean
L3:Monthly:Mean diurnal-cycle

Temporal Coverage
1/1/2025 onwards

Uncertainty Characteristics

			Optimum	Target	Threshold
CFC-Instantaneous	ACCURACY	bias		10 %	
CFC-Instantaneous	PRECISION	KSS		>0.5	
CFC-Daily Mean	ACCURACY	bias		10 %	
CFC-Daily Mean	PRECISION	bc-RMS		20 %	
CFC-Monthly Mean	ACCURACY	bias		10 %	
CFC-Monthly Mean	PRECISION	bc-RMS		20 %	
CFC-Monthly Mean DC	ACCURACY	bias		10 %	
CFC-Monthly Mean DC	PRECISION	bc-RMS		20%	

Verification:
Validation against SYNOP plus comparison against MODIS

Comment:

A.3 CM-21024: CLAAS-4 JOINT CLOUD HISTOGRAM TCDR

CM-21024	CLAAS-4 Joint Cloud Histogram TCDR	JCH_R4_CLAAS_4_TCDR

Type
Dataset

Input Satellite Data
Operational Satellite:FCI
Operational Satellite:SEVIRI

Application Areas
Climate Modelling and Evaluation

Dissemination Information

Distribution format
L3:NetCDF4

Generation frequency

Generation timeliness

Spatio-temporal Information

Spatial Coverage
L3:METEOSAT full disk (includes Europe, Africa, Atlantic Ocean)

Spatial Resolution
L3 mh:HORIZONTAL:$(0.25)^2$

Temporal Resolution
L3:Monthly:Histogram

Temporal Coverage
1/1/2004
12/31/2024

Uncertainty Characteristics			Optimum	Target	Threshold
JCH-Monthly Histogram	ACCURACY	bias	n/a	n/a	n/a

Verification:
L3 comparisons with MODIS

Comment:
The JCH product aggregates information from CTO (CM-21034), cloud optical thickness (in CM-21054 and CM-21064), and CPH (CM-21044). Its accuracy depends on the accuracy of these products. JCH is restricted to satellite and solar zenith angle < 84°

A.4 CM-5022: SEVIRI-FCI JOINT CLOUD HISTOGRAM ICDR

CM-5022	SEVIRI-FCI Joint Cloud histogram ICDR	JCH_METEO_R1_ICDR

Type
Product

Input Satellite Data Operational Satellite: FCI	*Application Areas* Cimate Monitoring

Dissemination Information

Distribution format L3:NetCDF4	*Generation frequency* 1 month
	Generation timeliness 10 days (95%) 15 days (100%)

Spatio-temporal Information

Spatial Coverage L3:METEOSAT full disk (includes Europe, Africa, Atlantic Ocean)	*Spatial Resolution* L3 mh:HORIZONTAL:$(0.25)^2$
Temporal Resolution L3:Monthly:Histogram	*Temporal Coverage* 1/1/2025 onwards

Uncertainty Characteristics			Optimum	Target	Threshold
JCH-Monthly Histogram	ACCURACY	bias	n/a	n/a	n/a
JCH-Monthly Histogram	PRECISION	bc-RMS	n/a	n/a	n/a
JCH-Monthly Histogram	STABILITY	decadal	n/a	n/a	n/a

Verification:
Comparison against MODIS

Comment:

A.5 CM-21034: CLAAS-4 CLOUD TOP LEVEL TCDR

CM-21034 CLAAS-4 Cloud Top Level TCDR CTO_R4_CLAAS_4_TCDR

Type
Dataset

Input Satellite Data
Operational Satellite:FCI
Operational Satellite:SEVIRI

Application Areas
Climate Modelling and Evaluation

Dissemination Information

Distribution format
L2:NetCDF4
L3:NetCDF4

Generation frequency

Generation timeliness

Spatio-temporal Information

Spatial Coverage
L2:METEOSAT full disk (includes Europe, Africa, Atlantic Ocean)
L3:METEOSAT full disk (includes Europe, Africa, Atlantic Ocean)

Spatial Resolution
L2: HORIZONTAL: native satellite pixel resolution ~(3 km)²
L3 dm and mm:HORIZONTAL: (0.05)²
L3 mmdc: HORIZONTAL: (0.25)²

Temporal Resolution
L2:Instantaneous: 10/15min
L3:Daily:Mean
L3:Monthly:Mean
L3:Monthly:Mean diurnal-cycle

Temporal Coverage
1/1/2004
12/31/2024

Uncertainty Characteristics			Optimum	Target	Threshold
CTH-Instantaneous	ACCURACY	bias	270 m	800 m	1600 m
CTH-Instantaneous	PRECISION	bc-RMS	800 m	2400 m	4800 m
CTH-Instantaneous	STABILITY	decadal	90 m	270 m	530 m
CTH-Daily Mean	ACCURACY	bias	270 m	800 m	1600 m
CTH-Daily Mean	PRECISION	bc-RMS	530 m	1600 m	3200 m
CTH-Daily Mean	STABILITY	decadal	90 m	270 m	530 m
CTH-Monthly Mean	ACCURACY	bias	270 m	800 m	1600 m
CTH-Monthly Mean	PRECISION	bc-RMS	530 m	1600 m	3200 m
CTH-Monthly Mean	STABILITY	decadal	90 m	270 m	530 m
CTH-Monthly Mean DC	ACCURACY	bias	270 m	800 m	1600 m
CTH-Monthly Mean DC	PRECISION	bc-RMS	530 m	1600 m	3200 m
CTH-Monthly Mean DC	STABILITY	decadal	90 m	270 m	530 m
~~CTP-Daily Mean~~	~~ACCURACY~~	~~bias~~	~~15 hPa~~	~~45 hPa~~	~~90 hPa~~
~~CTP-Daily Mean~~	~~PRECISION~~	~~bc-RMS~~	~~30 hPa~~	~~90 hPa~~	~~180 hPa~~
~~CTP-Daily Mean~~	~~STABILITY~~	~~decadal~~	~~5 hPa~~	~~15 hPa~~	~~30 hPa~~
~~CTP Instantaneous (none)~~	~~ACCURACY~~	~~bias~~	~~15 hPa~~	~~45 hPa~~	~~90 hPa~~
~~CTP Instantaneous (none)~~	~~PRECISION~~	~~bc RMS~~	~~45 hPa~~	~~235 hPa~~	~~270 hPa~~
~~CTP Instantaneous (none)~~	~~STABILITY~~	~~decadal~~	~~5 hPa~~	~~15 hPa~~	~~30 hPa~~
~~CTP Monthly Mean~~	~~ACCURACY~~	~~bias~~	~~15 hPa~~	~~45 hPa~~	~~90 hPa~~
~~CTP Monthly Mean~~	~~PRECISION~~	~~bc RMS~~	~~30 hPa~~	~~90 hPa~~	~~180 hPa~~
~~CTP Monthly Mean~~	~~STABILITY~~	~~decadal~~	~~5 hPa~~	~~15 hPa~~	~~30 hPa~~
~~CTP-Monthly Mean DC~~	~~ACCURACY~~	~~bias~~	~~15 hPa~~	~~45 hPa~~	~~90 hPa~~
~~CTP-Monthly Mean DC~~	~~PRECISION~~	~~bc-RMS~~	~~30 hPa~~	~~90 hPa~~	~~180 hPa~~
~~CTP Monthly Mean DC~~	~~STABILITY~~	~~decadal~~	~~5 hPa~~	~~15 hPa~~	~~30 hPa~~

Verification:
L2: validation against CALIOP/EarthCARE

L3: comparisons to MODIS and CALIOP L3

Comment:
Artificial Neural Netwok (ANN) method trained with CALIPSO-CALIOP data
Additional data layers:
L2 and L3: CTO includes cloud top pressure (CTP), cloud top height (CTH) and cloud top temperature (CTT)
L3: logarithmically averaged CTP (in addition to linear average)
L3: CTO for daytime and nighttime, CTO for liquid and ice clouds

A.6 CM-5032: SEVIRI-FCI CLOUD TOP LEVEL ICDR

CM-5032	SEVIRI-FCI Cloud Top Level ICDR	CTO_METEO_R1_ICDR

Type
Product

Input Satellite Data
Operational Satellite:~~-~~FCI

Application Areas
Cimate Monitoring

Dissemination Information

Distribution format
L2:NetCDF4
L3:NetCDF4

Generation frequency
1 day , 1 month

Generation timeliness
10 days (95%)
15 days (100%)

Spatio-temporal Information

Spatial Coverage
L2:METEOSAT full disk (includes Europe, Africa, Atlantic Ocean)
L3:METEOSAT full disk (includes Europe, Africa, Atlantic Ocean)

Spatial Resolution
L2:HORIZONTAL native satellite pixel resolution ~(3 km)²
L3 dm and mm:HORIZONTAL: (0.05)²
L3 mmdc: HORIZONTAL: (0.25)²

Temporal Resolution
L2:Instantaneous: 10min
L3:Daily:Mean
L3:Monthly:Mean
L3:Monthly:Mean diurnal-cycle

Temporal Coverage
1/1/2025 onwards

Uncertainty Characteristics			Optimum	Target	Threshold
CTH-Instantaneous	ACCURACY	bias		1600 m	
CTH-Instantaneous	PRECISION	bc-RMS		4000 m	
CTH-Daily Mean	ACCURACY	bias		1600 m	
CTH-Daily Mean	PRECISION	bc-RMS		3200 m	
CTH-Monthly Mean	ACCURACY	bias		1600 m	
CTH-Monthly Mean	PRECISION	bc-RMS		3200 m	
CTH-Monthly Mean DC	ACCURACY	bias		1600 m	
CTH-Monthly Mean DC	PRECISION	bc-RMS		3200 m	
~~CTP Daily Mean~~	~~ACCURACY~~	~~bias~~		~~90 hPa~~	
~~CTP Daily Mean~~	~~PRECISION~~	~~bc RMS~~		~~180 hPa~~	
~~CTP Instantaneous~~	~~ACCURACY~~	~~bias~~		~~90 hPa~~	
~~CTP Instantaneous~~	~~PRECISION~~	~~bc RMS~~		~~270 hPa~~	
~~CTP-Monthly Mean~~	~~ACCURACY~~	~~bias~~		~~90 hPa~~	
~~CTP Monthly Mean~~	~~PRECISION~~	~~bc RMS~~		~~180 hPa~~	
~~CTP Monthly Mean DC~~	~~ACCURACY~~	~~bias~~		~~90 hPa~~	
~~CTP Monthly Mean DC~~	~~PRECISION~~	~~bc RMS~~		~~180 hPa~~	

Verification:
Comparison against MODIS

Comment:

A.7 CM-21044: CLAAS-4 CLOUD PHASE TCDR

CM-21044	CLAAS-4 Cloud Phase TCDR	CPH_R4_CLAAS_4_TCDR

Type
Dataset

Input Satellite Data
Operational Satellite:FCI
Operational Satellite:SEVIRI

Application Areas
Climate Modelling and Evaluation

Dissemination Information

Distribution format
L2:NetCDF4
L3:NetCDF4

Generation frequency

Generation timeliness

Spatio-temporal Information

Spatial Coverage
L2:METEOSAT full disk (includes Europe, Africa, Atlantic Ocean)
L3:METEOSAT full disk (includes Europe, Africa, Atlantic Ocean)

Spatial Resolution
L2:HORIZONTAL: native satellite pixel resolution ~(3 km)^2
L3 dm and mm:HORIZONTAL: (0.05)^2
L3 mmdc: HORIZONTAL: (0.25)^2

Temporal Resolution
L2:Instantaneous: 10/15min
L3:Daily:Mean
L3:Monthly:Mean
L3:Monthly:Mean diurnal-cycle

Temporal Coverage
1/1/2004
12/31/2024

Uncertainty Characteristics			Optimum	Target	Threshold
CPH-Instantaneous	ACCURACY	bias	1 %	5 %	10 %
CPH-Instantaneous	PRECISION	KSS	>0.8	>0.6	>0.5
CPH-Instantaneous	STABILITY	decadal	0.5 %	2 %	5 %
CPH-Daily Mean	ACCURACY	bias	1 %	5 %	10 %
CPH-Daily Mean	PRECISION	bc-RMS	5 %	10 %	20 %
CPH-Daily Mean	STABILITY	decadal	0.5 %	2 %	5 %
CPH-Monthly Mean	ACCURACY	bias	1 %	5 %	10 %
CPH-Monthly Mean	PRECISION	bc-RMS	5 %	10 %	20 %
CPH-Monthly Mean	STABILITY	decadal	0.5 %	2 %	5 %
CPH-Monthly Mean DC	ACCURACY	bias	1 %	5 %	10 %
CPH-Monthly Mean DC	PRECISION	bc-RMS	5 %	10 %	20 %
CPH-Monthly Mean DC	STABILITY	decadal	0.5 %	2 %	5 %

Verification:
L2: validation against CALIOP/EarthCARE
L3: comparisons to MODIS and CALIOP L3

Comment:
~~Multispectral thresholding or~~ Artificial Neural Network trained with CALIPSO-CALIOP
Additional data layers:
L2 and L3: extended cloud phase with more categories,
L3: CPH for daytime and nighttime

A.8 CM-5042: SEVIRI-FCI CLOUD PHASE ICDR

CM-5042	SEVIRI-FCI Cloud Phase ICDR	CPH_METEO_R1_ICDR

Type
Product

Input Satellite Data
Operational Satellite:-FCI

Application Areas
Cimate Monitoring

Dissemination Information

Distribution format
L2:NetCDF4
L3:NetCDF4

Generation frequency
1 day , 1 month

Generation timeliness
10 days (95%)
15 days (100%)

Spatio-temporal Information

Spatial Coverage
L2:METEOSAT full disk (includes Europe, Africa, Atlantic Ocean)
L3:METEOSAT full disk (includes Europe, Africa, Atlantic Ocean)

Spatial Resolution
L2:HORIZONTAL: native satellite pixel resolution ~$(3\ km)^2$
L3 dm and mm:HORIZONTAL: $(0.05)^2$
L3 mmdc: HORIZONTAL: $(0.25)^2$

Temporal Resolution
L2:Instantaneous: 10min
L3:Daily:Mean
L3:Monthly:Mean
L3:Monthly:Mean diurnal-cycle

Temporal Coverage
1/1/2025 onwards

Uncertainty Characteristics			Optimum	Target	Threshold
CPH-Instantaneous	ACCURACY	bias		10 %	
CPH-Instantaneous	PRECISION	KSS		>0.5	
CPH-Daily Mean	ACCURACY	bias		10 %	
CPH-Daily Mean	PRECISION	bc-RMS		20 %	
CPH-Monthly Mean	ACCURACY	bias		10 %	
CPH-Monthly Mean	PRECISION	bc-RMS		20 %	
CPH-Monthly Mean DC	ACCURACY	bias		10 %	
CPH-Monthly Mean DC	PRECISION	bc-RMS		20 %	

Verification:
Comparison against MODIS

Comment:

A.9 CM-21054: CLAAS-4 LIQUID WATER PATH TCDR

CM-21054 | CLAAS-4 Liquid Water Path TCDR | LWP_R4_CLAAS_4_TCDR

Type
Dataset

Input Satellite Data
Operational Satellite:FCI
Operational Satellite:SEVIRI

Application Areas
Climate Modelling and Evaluation

Dissemination Information

Distribution format
L2:NetCDF4
L3:NetCDF4

Generation frequency

Generation timeliness

Spatio-temporal Information

Spatial Coverage
L2:METEOSAT full disk (includes Europe, Africa, Atlantic Ocean)
L3:METEOSAT full disk (includes Europe, Africa, Atlantic Ocean)

Spatial Resolution
L2:HORIZONTAL: native satellite pixel resolution ~(3 km)²
L3 dm and mm:HORIZONTAL: (0.05)²
L3 mmdc: HORIZONTAL: (0.25)²

Temporal Resolution
L2:Instantaneous: 10/15min
L3:Daily:Mean
~~L3:Monthly norm.:Histogram~~
L3:Monthly:Mean
L3:Monthly:Mean diurnal-cycle

Temporal Coverage
1/1/2004
12/31/2024

Uncertainty Characteristics

			Optimum	Target	Threshold
LWP-Instantaneous	ACCURACY	bias	5 g/m²	10 g/m²	20 g/m²
LWP-Instantaneous	PRECISION	bc-RMS	40 g/m²	100 g/m²	200 g/m²
LWP-Instantaneous	STABILITY	decadal	1 g/m²	6 g/m²	3 g/m²
LWP-Daily Mean	ACCURACY	bias	5 g/m²	10 g/m²	20 g/m²
LWP-Daily Mean	PRECISION	bc-RMS	10 g/m²	20 g/m²	40 g/m²
LWP-Daily Mean	STABILITY	decadal	1 g/m²	3 g/m²	6 g/m²
LWP-Monthly Mean	ACCURACY	bias	5 g/m²	10 g/m²	20 g/m²
LWP-Monthly Mean	PRECISION	decadal	10 g/m²	20 g/m²	40 g/m²
LWP-Monthly Mean	STABILITY	decadal	1 g/m²	3 g/m²	6 g/m²
LWP-Monthly Mean DC	ACCURACY	bias	5 g/m²	10 g/m²	20 g/m²
LWP-Monthly Mean DC	PRECISION	bc-RMS	10 g/m²	20 g/m²	40 g/m²
LWP-Monthly Mean DC	STABILITY	decadal	1 g/m²	3 g/m²	6 g/m²

Verification:
L2: validation against passive microwave LWP (e.g. AMSR2)
L3: comparison with passive microwave data records, comparison with MODIS

Comment:
Nakajima-King approach
~~contains separate products for aerosol above cloud scenes~~

Additional data layers:
L2 and L3: cloud optical thickness (COT) and particle effective radius from wavelengths 1.6 and 3.9 µm (CER), cloud droplet number concentration (CDNC) and cloud geometrical thickness (CGT)
L2 and L3: scene heterogeneity (H_{σ})
L3: logarithmically averaged COT (in addition to linear average)
L3: LWP averaged over all sky (in addition to cloudy sky average)

A.10 CM-5052: SEVIRI-FCI LIQUID WATER PATH ICDR

CM-5052 | SEVIRI-FCI Liquid Water Path ICDR | LWP_METEO_R1_ICDR

Type
Product

Input Satellite Data
Operational Satellite: ~~-~~FCI

Application Areas
Cimate Monitoring

Dissemination Information

Distribution format
L2:NetCDF4
L3:NetCDF4

Generation frequency
1 day , 1 month

Generation timeliness
10 days (95%)
15 days (100%)

Spatio-temporal Information

Spatial Coverage
L2:METEOSAT full disk (includes Europe, Africa, Atlantic Ocean)
L3:METEOSAT full disk (includes Europe, Africa, Atlantic Ocean)

Spatial Resolution
L2:HORIZONTAL: native satellite pixel resolution ~(3 km)²
L3 dm and mm:HORIZONTAL: (0.05)²
L3 mmdc: HORIZONTAL: (0.25)²

Temporal Resolution
L2:Instantaneous: 10min
L3:Daily:Mean
L3:Monthly:Mean
L3:Monthly:Mean diurnal-cycle

Temporal Coverage
1/1/2025 onwards

Uncertainty Characteristics			Optimum	Target	Threshold
LWP-Instantaneous	ACCURACY	bias		20 g/m²	
LWP-Instantaneous	PRECISION	bc-RMS		200 g/m²	
LWP-Daily Mean	ACCURACY	bias		20 g/m²	
LWP-Daily Mean	PRECISION	bc-RMS		40 g/m²	
LWP-Monthly Mean	ACCURACY	bias		20 g/m²	
LWP-Monthly Mean	PRECISION	bc-RMS		40 g/m²	
LWP-Monthly Mean DC	ACCURACY	bias		20 g/m²	
LWP-Monthly Mean DC	PRECISION	bc-RMS		40 g/m²	

Verification:
Comparison against MODIS

Comment:

A.11 CM-21064: CLAAS-4 ICE WATER PATH TCDR

CM-21064 CLAAS-4 Ice Water Path TCDR IWP_R4_CLAAS_4_TCDR

Type
Dataset

Input Satellite Data
Operational Satellite:FCI
Operational Satellite:SEVIRI

Application Areas
Climate Modelling and Evaluation

Dissemination Information

Distribution format
L2:NetCDF4
L3:NetCDF4

Generation frequency

Generation timeliness

Spatio-temporal Information

Spatial Coverage
L2:METEOSAT full disk (includes Europe, Africa, Atlantic Ocean)
L3:METEOSAT disk (CM SAF definition)

Spatial Resolution
L2:HORIZONTAL: native satellite pixel resolution ~(3 km)²
L3 dm and mm:HORIZONTAL: (0.05)²
L3 mmdc: HORIZONTAL: (0.25)²

Temporal Resolution
L2:Instantaneous: 10/15min
L3:Daily:Mean
~~L3:Monthly:Histogram~~
L3:Monthly:Mean
L3:Monthly:Mean diurnal-cycle

Temporal Coverage
1/1/2004
12/31/2024

Uncertainty Characteristics			Optimum	Target	Threshold
IWP- Instantaneous	ACCURACY	bias	10 g/m²	20 g/m²	40 g/m²
IWP- Instantaneous	PRECISION	bc-RMS	80 g/m²	200 g/m²	400 g/m²
IWP- Instantaneous	STABILITY	decadal	2 g/m²	6 g/m²	12 g/m²
IWP-Daily Mean	ACCURACY	bias	10 g/m²	20 g/m²	40 g/m²
IWP-Daily Mean	PRECISION	bc-RMS	20 g/m²	40 g/m²	80 g/m²
IWP-Daily Mean	STABILITY	decadal	2 g/m²	6 g/m²	12 g/m²
IWP-Monthly Mean	ACCURACY	bias	10 g/m²	20 g/m²	40 g/m²
IWP-Monthly Mean	PRECISION	bc-RMS	20 g/m²	40 g/m²	80 g/m²
IWP-Monthly Mean DC	ACCURACY	bias	10 g/m²	20 g/m²	40 g/m²
IWP-Monthly Mean DC	PRECISION	bc-RMS	20 g/m²	40 g/m²	80 g/m²
IWP-Monthly Mean DC	STABILITY	decadal	2 g/m²	6 g/m²	12 g/m²

Verification:
L2: validation against DARDAR (Cloudsat/CALIPSO)
L3: comparison with MODIS

Comment:
Nakajima-King approach
Additional data layers:

L2 and L3: cloud optical thickness (COT) and particle effective radius from wavelengths 1.6 and 3.9 µm (CER)
L2: scene heterogeneity (Hσ)
L3: logarithmically averaged COT (in addition to linear average)
L3: IWP averaged over all sky (in addition to cloudy sky average)

A.12 CM-5062: SEVIRI-FCI ICE WATER PATH ICDR

CM-5062 SEVIRI-FCI Ice Water Path ICDR IWP_METEO_R1_ICDR

Type
Product

Input Satellite Data
Operational Satellite: FCI

Application Areas
Cimate Monitoring

Dissemination Information

Distribution format
L2:NetCDF4
L3:NetCDF4

Generation frequency
1 day , 1 month

Generation timeliness
10 days (95%)
15 days (100%)

Spatio-temporal Information

Spatial Coverage
L2:METEOSAT full disk (includes Europe, Africa, Atlantic Ocean)
L3:METEOSAT full disk (includes Europe, Africa, Atlantic Ocean)

Spatial Resolution
L2:HORIZONTAL: native satellite pixel resolution ~(3 km)^2
L3 dm and mm:HORIZONTAL: (0.05)^2
L3 mmdc: HORIZONTAL: (0.25)^2

Temporal Resolution
L2:Instantaneous: 10min
L3:Daily:Mean
L3:Monthly:Mean
L3:Monthly:Mean diurnal-cycle

Temporal Coverage
1/1/2025 onwards

Uncertainty Characteristics			Optimum	Target	Threshold
IWP-Instantaneous	ACCURACY	bias		40 g/m²	
IWP-Instantaneous	PRECISION	bc-RMS		400 g/m²	
IWP-Daily Mean	ACCURACY	bias		40 g/m²	
IWP-Daily Mean	PRECISION	bc-RMS		80 g/m²	
IWP-Monthly Mean	ACCURACY	bias		40 g/m²	
IWP-Monthly Mean	PRECISION	bc-RMS		80 g/m²	
IWP-Monthly Mean DC	ACCURACY	bias		40 g/m²	
IWP-Monthly Mean DC	PRECISION	bc-RMS		80 g/m²	

Verification:
Comparison against MODIS

Comment:

A.13 CM-21302: CLAAS-4 REFLECTED SOLAR FLUX TCDR

CM-21302	CLAAS-4 Reflected Solar Flux TCDR	RSF_R1_CLAAS_4_TCDR

Type
Dataset

Input Satellite Data
Operational Satellite:FCI
Operational Satellite:SEVIRI

Application Areas
Climate Modelling and Evaluation

Dissemination Information

Distribution format
L2:NetCDF4
L3:NetCDF4

Generation frequency

Generation timeliness

Spatio-temporal Information

Spatial Coverage
L2:METEOSAT full disk (includes Europe, Africa, Atlantic Ocean)
L3:METEOSAT full disk (includes Europe, Africa, Atlantic Ocean)

Spatial Resolution
L2:HORIZONTAL: native satellite pixel resolution ~(3 km)^2
L3:HORIZONTAL:(0.05)^2

Temporal Resolution
L2:Instantaneous:10/15min
L3:Hourly:Mean
L3:Daily:Mean
L3:Monthly:Mean
L3:Monthly:Mean diurnal-cycle

Temporal Coverage
1/1/2004
12/31/2024

Uncertainty Characteristics			Optimum	Target	Threshold
RSF-Instantaneous	PRECISION	bc-RMS	8 W/m²	16 W/m²	32 W/m²
RSF-Hourly Mean	PRECISION	bc-RMS	8 W/m²	16 W/m²	32 W/m²
RSF-Monthly Mean DC	PRECISION	bc-RMS	4 W/m²	8 W/m²	16 W/m²
RSF-Daily Mean	PRECISION	bc-RMS	4 W/m²	8 W/m²	16 W/m²
RSF-Monthly Mean	PRECISION	bc-RMS	2 W/m²	4 W/m²	8 W/m²
RSF-Monthly Mean	STABILITY	decadal bias	0.3 W/m²/dec	0.6 W/m²/dec	2 W/m²/dec

Verification:
L2: with collocated/simultaneous/coangular observations from CERES-SSF, GERB-L2
L3: with gridded products CERES-EBAF, CERES-SYN1deg

Comment:
Requirements refer to:

- At 1 standard deviation (spatial RMS on gridded bias, i.e. RMSD)
- At 1°x1° scale
- Taking only VZA<60°

-No ‘accuracy’ requirements are given because the absolute radiometric level (global mean bias) is considered ‘tuned’ and not independent from our reference datasets (e.g. CERES).
-Additional data layers: clear-sky RSF (for all L2 and L3 products), for which the same requirements are applied
-For products with a strong diurnal cycle (RSF L2 and L3 hourly and MMDC) the requirement refers to average illumination conditions.

-NB-to-BB based on GERB/CERES, Empirical ADMs from CERES

A.14 CM-5321: SEVIRI-FCI REFLECTED SOLAR FLUX ICDR

CM-5321	SEVIRI-FCI Reflected Solar Flux ICDR	RSF_R1_METEO_ICDR

Type
Product

Input Satellite Data
Operational Satellite: ~~SEVIRI~~ FCI

Application Areas
Cimate Monitoring

Dissemination Information

Distribution format
L2:NetCDF4
L3:NetCDF4

Generation frequency
1 day , 1 month

Generation timeliness
40 days (95% of data)
45 days (100% of data)

Spatio-temporal Information

Spatial Coverage
L2:METEOSAT full disk (includes Europe, Africa, Atlantic Ocean)
L3:METEOSAT full disk (includes Europe, Africa, Atlantic Ocean)

Spatial Resolution
L2:HORIZONTAL: native satellite pixel resolution ~$(3\ km)^2$
L3:HORIZONTAL:$(0.05°)^2$

Temporal Resolution
L2:Instantaneous:10min
L3:Hourly:Mean
L3:Daily:Mean
L3:Monthly:Mean
L3:Monthly:Mean diurnal-cycle

Temporal Coverage
1/1/2025 onwards

Uncertainty Characteristics			Optimum	Target	Threshold
RSF-Instantaneous	PRECISION	bc-RMS		32 W/m²	
RSF-Hourly Mean	PRECISION	bc-RMS		32 W/m²	
RSF-Monthly Mean DC	PRECISION	bc-RMS		16 W/m²	
RSF-Daily Mean	PRECISION	bc-RMS		16 W/m²	
RSF-Monthly Mean	PRECISION	bc-RMS		8 W/m²	

Verification:
Comparison against CERES-SYN1deg

Comment:
see comments CM-21302 (RSF CDR)

A.15 CM-21332: CLAAS-4 OUTGOING LONGWAVE RADIATION TCDR

CM-21332	CLAAS-4 Outgoing Longwave Radiation TCDR	OLR_R1_CLAAS_4_TCDR

Type
Dataset

Input Satellite Data
Operational Satellite:FCI
Operational Satellite:SEVIRI

Application Areas
Climate Modelling and Evaluation

Dissemination Information

Distribution format
L2:NetCDF4
L3:NetCDF4

Generation frequency

Generation timeliness

Spatio-temporal Information

Spatial Coverage
L2:METEOSAT full disk (includes Europe, Africa, Atlantic Ocean)
L3:METEOSAT full disk (includes Europe, Africa, Atlantic Ocean)

Spatial Resolution
L2:HORIZONTAL: native satellite pixel resolution ~(3 km)^2
L3:HORIZONTAL:(0.05)^2

Temporal Resolution
L2:Instantaneous:10/15min
L3:Hourly:Mean
L3:Daily:Mean
L3:Monthly:Mean
L3:Monthly:Mean diurnal-cycle

Temporal Coverage
1/1/2004
12/31/2024

Uncertainty Characteristics			Optimum	Target	Threshold
OLR-Instantaneous	PRECISION	bc-RMS	4 W/m²	8 W/m²	16 W/m²
OLR-Hourly Mean	PRECISION	bc-RMS	4 W/m²	8 W/m²	16 W/m²
OLR-Monthly Mean DC	PRECISION	bc-RMS	2 W/m²	4 W/m²	8 W/m²
OLR-Daily Mean	PRECISION	bc-RMS	2 W/m²	4 W/m²	8 W/m²
OLR-Monthly Mean	PRECISION	bc-RMS	1 W/m²	2 W/m²	4 W/m²
OLR-Monthly Mean	STABILITY	decadal bias	0.3 W/m²/dec	0.6 W/m²/dec	2 W/m²/dec

Verification:
L2: with collocated/simultaneous/coangular observations from CERES-SSF, GERB-L2
L3: with gridded products CERES-EBAF, CERES-SYN1deg, HIRS-OLR

Comment:
Requirements refer to:

- At 1 standard deviation (spatial RMS on gridded bias, i.e. RMSD)
- At 1°x1° scale
- Taking only VZA<60°

No ‘accuracy’ requirements are given because the absolute radiometric level (global mean bias) is considered ‘tuned’ and not independent from our reference datasets (e.g. CERES). Additional data layers: clear-sky RSF (for all L2 and L3 products), for which the same requirements are applied.
NB-to-BB based on GERB/CERES, Theoretical ADMs

A.16 CM-5331: SEVIRI-FCI OUTGOING LONGWAVE RADIATION ICDR

CM-5331	SEVIRI-FCI Outgoing Longwave Radiation ICDR	OLR_R1_METEO_ICDR

Type
Product

Input Satellite Data
Operational Satellite: ~~SEVIRI~~ FCI

Application Areas
Cimate Monitoring

Dissemination Information

Distribution format
L2:NetCDF4
L3:NetCDF4

Generation frequency
1 day , 1 month

Generation timeliness
40 days (95% of data)
45 days (100% of data)

Spatio-temporal Information

Spatial Coverage
L2:METEOSAT full disk (includes Europe, Africa, Atlantic Ocean)
L3:METEOSAT full disk (includes Europe, Africa, Atlantic Ocean)

Spatial Resolution
L2:HORIZONTAL: native satellite pixel resolution ~$(3\ km)^2$
L3:HORIZONTAL:$(0.05°)^2$

Temporal Resolution
L2:Instantaneous:10min
L3:Hourly:Mean
L3:Daily:Mean
L3:Monthly:Mean
L3:Monthly:Mean diurnal-cycle

Temporal Coverage
1/1/2025 onwards

Uncertainty Characteristics			Optimum	Target	Threshold
OLR-Instantaneous	PRECISION	bc-RMS		16 W/m²	
OLR-Hourly Mean	PRECISION	bc-RMS		16 W/m²	
OLR-Monthly Mean DC	PRECISION	bc-RMS		8 W/m²	
OLR-Daily Mean	PRECISION	bc-RMS		8 W/m²	
OLR-Monthly Mean	PRECISION	bc-RMS		4 W/m²	

Verification:
Comparison against CERES-SYN1deg

Comment:
see comments CM-21332 (OLR CDR)

APPENDIX B CM SAF RR 4.6 REVIEW BOARD

Johannes Quaas
Institute for Meteorology Universität Leipzig Stephanstrasse 3 D-04103 Leipzig Germany Tel: +49 341 97 32852 Email: johannes.quaas@uni-leipzig.de
Christine Chiu
Department of Atmospheric Science Colorado State University 1371 Campus Delivery Fort Collins, CO 80523 USA Tel: +1 (970) 491-8410 Email: Christine.Chiu@colostate.edu

APPENDIX C RID TRACKING LIST FOR REVIEW BOARD PROCESS

CM SAF
CLAAS-4 CDRs/ICDRs Requirements Review (RR 4.6)

Review Items Discrepancies (RIDs) Tracking List

for Review Board Process

RB Decisions (codes)

- **W** Withdrawn — The RID is withdrawn by the Author, on the basis of additional information/clarifications provided.
- **C** Closed by answer — RID Closed by Discussion, having the Project Team provided sufficient evidence on the adequacy of the provided information.
- **CR** Closed by Reference — The RID disposition is provided in the referred other RID.
- DU Document Update — The affected Document must be updated/modified as agreed or as a result of a recommendation approved by SG.
- **CA** Closed with Action — An action is agreed to address the detected problem. Actions can be Urgent (U) or Normal Work (N).
- **SG** To the SG for decision — No Agreement is reached on the implementation of RID recommendation. A Steering Group decision is required. Or the RID is passed to the SG for Information/Evaluation.

RIDS Categories

- **Major**
- Minor
- Editorial

Note: for the Close-out Date for dispositioned RIDs see General Comments/Recommendations of the RB Report

RIDs Tracking List (sorted by document)

RID DETAILS	Identified Problem / Recommendation	Author Response	Reviewer Feedback / RID Status / Disposition	Action / Recommendation
RID ID: OBJ1_RR_Chiu_006.txt RID Title: consistency between two records Category: Minor Doc. Title: Requirements Input of project team for RR: SAF/CM/CDOP4/DWD/RR46 Page: 10 Section: 3.1 Paragraph:	Problem Description: It is mentioned that two flux products will be included in CLAAS-4 with some overlap in time. Has the team studied how these two records compare to each other? Would users get confused if fluxes from the two records are very different? Recommended Solution:	In Section 3.1 on page 10, the history of the products are described. I guess the two flux products that you mention, are the two precursors of the current data record released during CDOP2 (SEVIRI/GERB and MVIRI/SEVIRI). But in CLAAS-4 there is only one time period to be considered. In case you were wondering about a comparison between CLAAS-4 and those historical products: yes, this will be covered during the validation phase.	Reviewer Feedback: Closed by answer. RID Status: C - Closed by answer RID Disposition: Closed by answer.	
RID ID: OBJ1_RR_Chiu_007.txt RID Title: Spatial resolution of CM-21302, 21332 Category: Editorial Doc. Title: Requirements Input of project team for RR: SAF/CM/CDOP4/DWD/RR46 Page: 20 Section: Paragraph:	Problem Description: It is mentioned that "the goal requirement of 10 km", but the tables listed in the end of the document are all based on a "3 km" resolution. Is "10 km" a typo? If I miss something here, it may be good to make the sentence a bit clearer. Recommended Solution:	The "goal requirement of 10 km" refers to the GCOS goal requirement. It's simply mentioned as a reference, but not adopted in our own requirements: that's why this 10km is not listed in the tables at the end of the document.	Reviewer Feedback: Closed by answer. RID Status: C - Closed by answer RID Disposition: Closed by answer.	

RID DETAILS	Identified Problem / Recommendation	Author Response	Reviewer Feedback / RID Status / Disposition	Action / Recommendation
RID ID: OBJ1_RR_Chiu_008.txt RID Title: Table 6 Category: Minor Doc. Title: Requirements Input of project team for RR: SAF/CM/CDOP4/DWD/RR46 Page: Section: Paragraph:	Problem Description: I understand these requirements may have been set largely based on the literature, but I don't quite see the considerations regarding: 1) how the uncertainty reported in the literature is translated to different scales (since the original products seem to have different grid scales compared to the proposed ones in this document); and 2) why we should expect that all-sky and clear-sky reflected shortwave fluxes have the same uncertainty? Clear-sky estimates require extra steps, which should be more uncertain to me, although there might be compensating errors due to the lack of clouds. A bit of clarification would be good. Recommended Solution:	The requirements are defined mostly based on use in the fields of process studies and of cloud radiative effect estimation. For these applications a spatial resolution of the order of 10 km x 10km proved to be well suited, e.g. the EarthCARE mission implements an assessment domain of 10x10km. Still, for CLAAS-4 we propose to process the full spatial resolution allowed by SEVIRI (3km) for the level-2 processing (i.e. to estimate instantaneous RSF and OLR fluxes). The main motivation here is the consistency with the cloud products and the increase of the frequency of cloud free conditions. clearsky vs allsky: Yes, indeed, as you mention the clear-sky fluxes will have additional error sources due to the cloud screening process and possible sub-pixel cloud contamination not detected by the cloud mask. However, this additional (relative) error is partly compensated by the lower absolute values of the clearsky flux with respect to the allsky fluxes. The main reason to set similar accuracy/stability requirements for the clear sky and all sky fluxes is that they are expected to be used together to estimate cloud radiative effect. For this application it makes sense to set identical requirement.	Reviewer Feedback: Closed with doc update. RID Status: DU - Document Update RID Disposition: Closed with doc update	
RID ID: OBJ1_RR_Chiu_009.txt RID Title: CERES SYN-1deg Category: Minor Doc. Title: Requirements Input of project team for RR: SAF/CM/CDOP4/DWD/RR46 Page: 25 Section: Paragraph:	Problem Description: I understand that flux records are not independent of CERES projects due to ADM, which is not a big concern. I am not sure it is OK to compare to CERES SYN-1deg though. Isn't that product "adjusted" against geo observations? This leads to a circular issue for me. Thoughts to address this issue would be good to be provided here. Recommended Solution:	Indeed, the CERES SYN-1deg product makes use of the geostationary satellites (among which Meteosat) for the diurnal cycle, which are then scaled so that they match the polar orbiting CERES observations. In that sense, the Meteosat-based CLAAS4 flux products are indeed not completely independent from CERES SYN1deg, a product that is used for validation. However, we have a range of different validation reference products, including CERES EBAF (which doesn't make use of GEO observations), HIRS OLR, ERA5, etc. making sure that we don't only rely on CERES SYN1deg. We can also mention this issue in the text, as an additional justification why we use all these different reference products to validate. Also, more technically, the CERES SYN products don't use only Meteosat 0° but also GOES-East (for lon < -32.5° Esat) and Meteosat Indian Ocean (for lon > 20°-30° West). Therefore, the CERES-SYN / CLAAS-4 comparison is still meaningful out of the central band of longitude that could indeed be subject to the circular issue.	Reviewer Feedback: Closed with doc update. RID Status: DU - Document Update RID Disposition: Closed with doc updat	

RID DETAILS	Identified Problem / Recommendation	Author Response	Reviewer Feedback / RID Status / Disposition	Action / Recommendation
RID ID: OBJ1_RR_Chiu_010.txt RID Title: comparison for Level 3 Category: Editorial Doc. Title: Requirements Input of project team for RR: SAF/CM/CDOP4/DWD/RR46 Page: 25 Section: 4.1 Paragraph:	Problem Description: Just wondering why there is no comparison for Level 3 products. Recommended Solution:	Level 3 products will be evaluated against CERES-SYN ed4.2, CERES EBAF ed 4.2, and CM SAF historical datasets. This is described on end of page 24 and top of page 25. "The main validation data source to evaluate TOA RSF and OLR products, both for all-sky and clear-sky conditions, will be CERES (Wielicki et al., 1996; Loeb et al., 2016). The processing error (a.k.a. regional uncertainty) of the newly produced CLAAS-4 gridded Level-3 TOA radiation products (monthly, daily, hourly, monthly mean diurnal cycle) will be assessed by the (spatial) bc-rmsd between gridded CLAAS-4 TOA flux and gridded reference product, defined for each time step (monthly, daily,..). Reference data records include CERES EBAF ed4.2 (Loeb et al., 2018; Kato et al., 2018), CERES SYN-1deg ed4.2 (Doelling et al., 2013; Doelling et al., 2016) and HIRS-OLR v01r02 (Lee, 2014; Lee et al., 2014). In addition, our products will be compared with historical CM SAF SEVIRI/GERB and MVIRI/SEVIRI products. CERES EBAF will only be used for monthly comparison as is it not available at higher temporal resolution."	Reviewer Feedback: Closed by answer. RID Status: C - Closed by answer RID Disposition: Closed by answer	
RID ID: OBJ1_RR_Chiu_011.txt RID Title: applications for TOA radiation Category: Editorial Doc. Title: Requirements Input of project team for RR: SAF/CM/CDOP4/DWD/RR46 Page: 31 Section: 5.2 Paragraph:	Problem Description: It would be good to elaborate on "Quantification of atmospheric processes" a bit. Recommended Solution:	We propose to elabore on the possible use of the products for "Quantification of atmospheric processes" by adding the following literature review: "The CLAAS TOA fluxes are expected to be particularly suitable to study cloud feedback mechanisms and climate forcing e.g. by aerosols. For instance, based on Meteosat data, Bertrand et al (2003) have studied the radiative forcing due to a Mount Etna eruption. They reported significant volcanic cloud forcings (instantaneous TET forcing of 80 W/m² and TRS forcing of -230 W/m²) which are of similar magnitude as "standard cloud" forcing. How desert dust could alter the Earth radiation budget is another field of investigation where Meteosat observations are especially well-suited, see e.g. Haywood et al. (2005) and Slingo et al. (2006). In this last work, the authors show how TOA radiation budget data can be combined with ground measurements to assess the impact of mineral dust on the atmsopheric radiation divergence. For a major Saharan dust storm in March 2006, they observed an increase of TRS by 100 W/m² and a decrease of OLR by 30 W/m² at midday. As another example, the evolution of deep convective system is addressed by Futyan and Del Genio (2007). In this work the GERB-like TET is used to identify and track convective systems, not as direct input for earth radiation budget. The cloud forcing is another application. It is therefore expected that the datasets requirements are well suited to study many atmospheric processes briefly described here."	Reviewer Feedback: Thanks. Perhaps just modify the sentence to "Quantification of radiative forcing and studies of atmospheric processes such as cloud feedback mechanisms". Closed with doc update. RID Status: DU - Document Update RID Disposition: Closed with doc update as per Reviewer feedback.	

RID DETAILS	Identified Problem / Recommendation	Author Response	Reviewer Feedback / RID Status / Disposition	Action / Recommendation
RID ID: OBJ1_RR_Chiu_012.txt RID Title: application for radiation properties Category: Editorial Doc. Title: Requirements Input of project team for RR: SAF/CM/CDOP4/DWD/RR46 Page: 32 Section: 5.2 Paragraph:	Problem Description: "For those 4 application areas" - do you mean three there? Recommended Solution:	The four main applications are: - Understanding regional climate mechanisms - Quantification of atmospheric processes - Evaluation/Improvement of climate NWP models - Used as boundary condition to calculate surface radiative fluxes The text will be updated to make it clearer.	Reviewer Feedback: OK. Closed with doc update. RID Status: DU - Document Update RID Disposition: Closed with doc update in the text and also the PRD tables.	
RID ID: OBJ1_RR_Chiu_013.txt RID Title: Table 18, 19, 20, 21 Category: Minor Doc. Title: Requirements Input of project team for RR: SAF/CM/CDOP4/DWD/RR46 Page: Section: Paragraph:	Problem Description: Compared to the previous documents, the uncertainty for LWP/IWP instantaneous estimates has been doubled. Such large uncertainties may not be very useful for users. Recommended Solution:	The proposed target bc-rmsd value for level-2 LWP is 100 g/m2. This is indeed twice as large as for CLAAS-3. However, it is identical to the breakthrough (B) value proposed in GCOS-245, and therefore appears to be a reasonable choice. For IWP we propose (as before) twice as large values as for LWP to reflect the much larger retrieval uncertainties. We did find a typo in the text on page 19: '... still very much in line with [GCOS-154].' should be '... still very much in line with [GCOS-245].'.	Reviewer Feedback: Closed by answer. RID Status: DU - Document Update RID Disposition: Closed with doc update to fix typo.	
RID ID: OBJ1_RR_Chiu_014.txt RID Title: CMA Category: Editorial Doc. Title: Requirements Input of project team for RR: SAF/CM/CDOP4/DWD/RR46 Page: Section: Paragraph:	Problem Description: I don't know what CMA stands for. Probably something about cloud mask Axxx??? Recommended Solution:	Yes, it is just short for the cloud mask. We have to add it to the list of abbreviations.	Reviewer Feedback: Closed with doc update. RID Status: DU - Document Update RID Disposition: Closed with doc update.	

RID DETAILS	Identified Problem / Recommendation	Author Response	Reviewer Feedback / RID Status / Disposition	Action / Recommendation
RID ID: OBJ1_RR_Chiu_015.txt RID Title: is it possible to have this flag? Category: Minor Doc. Title: Requirements Input of project team for RR: SAF/CM/CDOP4/DWD/RR46 Page: Section: Paragraph:	Problem Description: As mentioned in the document, geostationary satellites have the unique advantage for us to study cloud evolutions. When tracking low clouds, it sometimes gets to the point that we don't know if low clouds are still there due to the overlaying high clouds. Is it possible to add a flag, showing the possibility of low cloud presence in multi-layer cloud situations? The line of work has been published (e.g.,doi:10.1029/2011JD015883), but I don't know how robust it is. Thanks for your consideration in advance. Recommended Solution:	It is generally not possible to identify low-level cloud layers in passive imagery if there are overlying cloud layers. In that sense, active sensors (like those on CALIPSO and CLOUDSAT satellites) have better capabilities to detect multilayer cases. But there is a grey zone where some information is available also in passive imagery and that is when thin cirrus clouds are present above low-level clouds. The spectral signature then differs somewhat from the signature of single-level cirrus over land or ocean surfaces and if the difference is large one can set a multilayer cloud flag (which is indeed tried in some other cloud algorithms). We have discussed the possibility to include this also for our algorithms but since progress in this field hasn't shown clear improvements (except for very idealized cases) we have not committed to this in the current situation. However, we will follow the developments here for future editions.	Reviewer Feedback: OK. Closed by answer. RID Status: C - Closed by answer RID Disposition: Closed by answer.	
RID ID: OBJ1_RR_Quaas_001.txt RID Title: TOA broadband fluxes backwards extension Category: Minor Doc. Title: Requirements Input of project team for RR: SAF/CM/CDOP4/DWD/RR46 Page: 14 Section: 4.1 Paragraph:	Problem Description: It is very commendable to improve the retrieval of top-of-atmosphere broadband radiation. It will be very useful to the community that these fluxes will be made available for native spatial and very high temporal resolution. It is also excellent that a full decade will be derived. An even longer period would still be more useful to the community, given the large changes in top-of-atmosphere imbalance seen from other sensors (CERES) but at much lower resolution in space and even more so in time. Recommended Solution: The PT might consider to even extend further back in time (ideally so that the full period starting 2004 is covered), if this proves to be feasible.	Our apologies, the text was not perfectly clear. As suggested, the CLAAS-4 dataset will cover the full MSG period (i.e. 2004-2024). In the requirement document we wanted to indicate that this is going to add 10 years with respect to the latest MSG TOA radiation release which was limited to 2015.	Reviewer Feedback: Closed with doc update RID Status: DU - Document Update RID Disposition: Closed with doc update	

RID DETAILS	Identified Problem / Recommendation	Author Response	Reviewer Feedback / RID Status / Disposition	Action / Recommendation
RID ID: OBJ1_RR_Quaas_002.txt RID Title: Spatial resolution for cloud- and broadband radiation retrievals Category: Editorial Doc. Title: Requirements Input of project team for RR: SAF/CM/CDOP4/DWD/RR46 Page: 16 Section: 4.2.1 Paragraph:	Problem Description: It is excellent that the target resolutions are much finer than defined by GCOS. Indeed, not just CORDEX, but increasingly also global climate simulations are conducted at kilometre resolution. One main incentive to do so is that this matches the native resolution of many satellite products. If CM SAF now provides such high-resolution products, this is highly valuable. It is unclear from the text whether cloud and radiation resolutions are the same (5 km vs. 0.05°). Recommended Solution: It might be clarified in the description whether the resolutions are the same or otherwise a reason could be provided.	We can confirm that the horizontal resolution of cloud and radiation products is the same. This is clear from the detailed requirements per product listed in Appendix A.	Reviewer Feedback: Closed with doc update RID Status: DU - Document Update RID Disposition: Closed with doc update	
RID ID: OBJ1_RR_Quaas_003.txt RID Title: Stability of CFC retrievals Category: Minor Doc. Title: Requirements Input of project team for RR: SAF/CM/CDOP4/DWD/RR46 Page: 18 Section: 4.2.1 Paragraph: Fractional cloud cover	Problem Description: It is very good to include targets on stability, since indeed trend analysis may be a particularly interesting application of the CLAAS dataset. However, it is not evident that a target of 2% / decade in CFC may allow for trend identification. Recommended Solution: The threshold value of 5% / decade seems to be too large to be useful in many regions. However, 0.5 %/decade indeed would be very good.	We think the numbers specified here are reasonable compromises between what is feasible and what is not feasible. Firstly, to calculate climate trends over 20 years is maybe already too ambitious. Longer time series would probably be required to increase the accuracy of trends. Secondly, it is very hard to validate if trends are reasonable or not since we generally seldom have access to suitable reference data. One could compare with MODIS and AVHRR data but already there we have the problem of rather poor diurnal sampling in comparison with SEVIRI. More accurate measurements (e.g. from CLOUDSAT/CALIPSO) exists but then the time period of observations (and also the geographical sampling) is much smaller. Also, observations from these satellites (including satellites with MODIS) will not be available for the last years of CLAAS-4. In conclusion, to even sharpen our target requirements (e.g. to improve it to 0.5 % per decade) is risky and not recommendable even if it would be desired. In addition, we are probably focused more on the trend as an average over the MSG disk rather than to extend it also to regions. To validate regional trends seems quite difficult.	Reviewer Feedback: To be discussed RID Status: C - Closed by answer RID Disposition: Percent is meant as absolute percent. It was recognized that reaching a 0.5% stability is too ambitious. It makes sense to look to 20years for trends although ideally would be 30-34 years. Looking to larger regions it is possible to attain a better stability. Closed by discussion .	

RID DETAILS	Identified Problem / Recommendation	Author Response	Reviewer Feedback / RID Status / Disposition	Action / Recommendation
RID ID: OBJ1_RR_Quaas_004.txt RID Title: Stability of broadband fluxes Category: Minor Doc. Title: Requirements Input of project team for RR: SAF/CM/CDOP4/DWD/RR46 Page: 22 Section: 4.2.1 Paragraph: Reflected solar flux and outgoing longwave flux	Problem Description: The stability requirements may be somewhat too unambitious given the goal of analysing trends. Recommended Solution: If at all possible, a target of 0.3 Wm-2 decade-1 would be very good, and optimal in fact rather some 0.1 Wm-2 decade-1.	The stability of the CDOP-2 MVIRI/SEVIRI dataset (i.e., the predecessor of the CLAAS-4 TOA dataset) has been evaluated by calculating the deseasonalized bias with the most recent CERES EBAF dataset. While improvements compared to CDOP-2 are expected, the proposed values seem unfortunately not feasible. Indeed, considering all various inputs impacting TOA values (i.e., mainly calibration stability of SEVIRI but also cloud physical properties, cloud mask, etc.), achieving a stability between the current optimal and target values will already be a challenge.	Reviewer Feedback: Closed by answer RID Status: C - Closed by answer RID Disposition: Closed by answer	
RID ID: OBJ1_RR_Quaas_005.txt RID Title: LWP with microwave as reference Category: Minor Doc. Title: Requirements Input of project team for RR: SAF/CM/CDOP4/DWD/RR46 Page: 24 Section: 4.2.2 Paragraph: Liquid water path	Problem Description: The PT is right to mention the caveats of the microwave LWP retrievals, but also right in that they nevertheless are a useful reference. Recommended Solution: Unless already done so, it might be considered to compute all-sky LWP (i.e. LWP multiplied by CFC) at the coarser microwave sensor resolution.	This was already done in comparisons with AMSR2 and MAC-LWP in the CLAAS-3 validation report. Each AMSR2 grid cell (we used AMSR2 LWP regridded to 0.25x0.25 deg), roughly corresponds to 9x9 SEVIRI pixels. Thus, for every valid AMSR2 LWP value, an average CLAAS-3 all-sky LWP was estimated, with the requirement that all CLAAS-3 pixels are either liquid cloud or clear sky (i.e., no ice was allowed). The MAC-LWP dataset contains all-sky LWP values and these were used to evaluate both monthly mean and monthly mean diurnal cycles of CLAAS-3 LWP. For monthly means comparisons were made with CLAAS-3 all-sky LWP, which is stored as a separate field (apart from in-cloud LWP). For monthly mean diurnal cycle comparisons, CLAAS-3 values were computed by multiplying the in-cloud LWP with the cloud fraction (CFC) and its liquid portion (CPH). These comparisons were only done for regions where the frequency of ice clouds is negligible.	Reviewer Feedback: Closed with doc update RID Status: DU - Document Update RID Disposition: Closed with doc update	

APPENDIX D CM SAF RR ACCEPTANCE EMAILS AND DISCUSSION

From: Johannes Quaas Sent: Mon 22/04/2024 21:22

Dear Cleber,

Yes, this all looks good to me, and I am happy to finalise!

Johannes

From: Christine Chiu Sent: Apr 22, 2024, at 9:12 AM

Dear Johannes, dear Christine,

Here is the final Requirement Review document provided by the CM SAF and also the draft Review Board report.

Can you please confirm that you are happy with the changes in the RR document and also that you agree to finalise the review process?

Thanks in advance,
Best Regards,
Cleber

From: Cleber Balan Sent: Mon 22/04/2024 17:12

Dear Johannes, dear Christine,

Here is the final Requirement Review document provided by the CM SAF and also the draft Review Board report.

Can you please confirm that you are happy with the changes in the RR document and also that you agree to finalise the review process?

Thanks in advance,
Best Regards,
Cleber