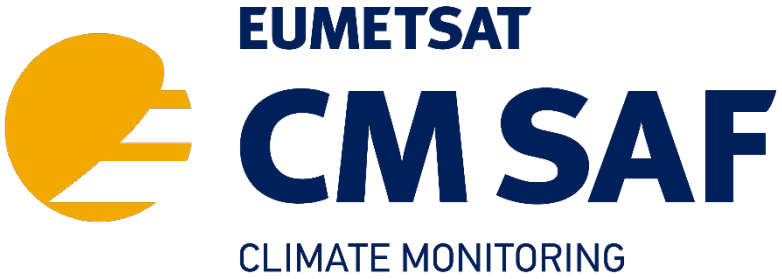
EUMETSAT Satellite Application Facility on Climate Monitoring



Product User Manual

Microwave and near-infrared imager TCDR

Combined high resolution global TCWV from microwave and near infrared imagers (COMBI)

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Reference	Title	Code
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RD 5	ESA Meris Product Handbook	Issue 3.0, 1 August 2011.
RD 6	MODIS Level 1B Product User's Guide. MOD_PR02	V6.1.0 (TERRA)/V6.1.1 (AQUA), NASA/Goddard Space Flight Center, Greenbelt, MD 20771, February 27, 2009.
RD 7	J. Xiong, G. Toller, J. Sun, B. Wenny, A. Angal, and W. Barnes: MODIS Level 1B Algorithm Theoretical Basis Document	Version 4, June 14, 2013.
RD 8	NASA GSFC LAADS Distributed Active Archive Center.	see https://ladsweb.modaps.eosdis.nasa.gov/

Reference	Title	Code
RD 9	Sentinel-3 OLCI Technical Guide: Level-1 Algorithms and Products.	see https://sentinels.copernicus.eu/web/sentinel/technical-guides/sentinel-3-olci/level-1-algorithms-products
RD 10	Product User Manunal Microwave Imager Radiance FCDR R4 - SSMIS	CCIWV.REP.010, version 2.1, 3 February 2021, available at: https://climate.esa.int/media/documents/Water_Vapour_cci_D2.3_E3UB_Part1_-_CDR-1__CDR-2_v2.1.pdf

Table of Contents

1 The EUMETSAT SAF on Climate Monitoring 6

2 Introduction 8

2.1 Purpose and scope 8

2.2 Background 8

3 Product definition 10

3.1 Overall characteristics 10

3.2 Practical considerations 11

3.3 Summary from validation 12

3.4 Assumptions and Limitations 13

4 Data format description 15

4.1 Data file contents 15

5 Acknowledgment 19

6 Data ordering via the Web User Interface (WUI) 20

6.1 Product ordering process 20

6.2 Contact User Help Desk staff 20

6.3 User Problem Report 20

6.4 Service Messages / log of changes 20

7 Feedback 21

7.1 User feedback 21

7.2 Specific requirements for future products 21

7.3 User Workshops 21

8 Copyright and Disclaimer 22

8.1 Copyright 22

8.2 Acknowledgement and Identification 22

8.3 Re-distribution of CM SAF data 22

9 References 23

10 Glossary 24

List of Tables

Table 4-1: Attributes assigned to non-scalar variables. For some variables only a subset of attributes is assigned. 16

Table 4-2: Global NetCDF attributes. 17

List of Figures

Figure 3-1: Global maps of daily TCWV in units of kg/m^2 from the combined microwave and near-infrared imager data record: 1 July 2007 (top left), 1 July 2010 (top right), and 1 July 2015 (bottom). Grey areas mark regions that are not observed by the satellites. 11

Figure 3-2: Climatology of the clear-sky bias for local time, LT=10. The analysis is based on hourly ERA5 data records for local overpass time of MERIS (considered time period 2002–2011) (from RD 4). 14

1 The EUMETSAT SAF on Climate Monitoring

The importance of climate monitoring with satellites was recognized in 2000 by EUMETSAT Member States when they amended the EUMETSAT Convention to affirm that the EUMETSAT mandate is also to “contribute to the operational monitoring of the climate and the detection of global climatic changes". Following this, EUMETSAT established within its Satellite Application Facility (SAF) network a dedicated centre, the SAF on Climate Monitoring (CM SAF, https://www.cmsaf.eu/).

The consortium of CM SAF currently comprises the Deutscher Wetterdienst (DWD) as host institute, and the partners from the Royal Meteorological Institute of Belgium (RMIB), the Finnish Meteorological Institute (FMI), the Royal Meteorological Institute of the Netherlands (KNMI), the Swedish Meteorological and Hydrological Institute (SMHI), the Meteorological Service of Switzerland (MeteoSwiss), the Meteorological Service of the United Kingdom (UK MetOffice) and the Centre National de la recherche scientifique (CNRS) of France. Since the beginning in 1999, the EUMETSAT Satellite Application Facility on Climate Monitoring (CM SAF) has developed and will continue to develop capabilities for a sustained generation and provision of Climate Data Records (CDRs) derived from operational meteorological satellites.

In particular the generation of long term data records is pursued. The ultimate aim is to make the resulting data records suitable for the analysis of climate variability and potentially the detection of climate trends. CM SAF works in close collaboration with the EUMETSAT Central Facility and liaises with other satellite operators to advance the availability, quality and usability of Fundamental Climate Data Records (FCDRs) as defined by the Global Climate Observing System (GCOS). As a major task the CM SAF utilizes FCDRs to produce records of Essential Climate Variables (ECVs) as defined by GCOS. Thematically, the focus of CM SAF is on ECVs associated with the global energy and water cycle.

Another essential task of CM SAF is to produce data records that can serve applications related to the new Global Framework of Climate Services initiated by the WMO World Climate Conference-3 in 2009. CM SAF is supporting climate services at national meteorological and hydrological services (NMHSs) with long term data records but also with data records produced close to real time that can be used to prepare monthly / annual updates of the state of the climate. Both types of products together allow for a consistent description of mean values, anomalies, variability and potential trends for the chosen ECVs. CM SAF ECV data records also serve the improvement of climate models both at global and regional scale.

As an essential partner in the related international frameworks the CM SAF assumes the role as main implementer of EUMETSAT’s commitments in support to global climate monitoring. This is achieved through:

- Application of highest standards and guidelines as lined out by GCOS for the satellite data processing,
- Processing of satellite data within an international collaboration benefiting from developments at international level and pollinating the partnership with own ideas and standards,

- Intensive validation and improvement of the CM SAF climate data records,
- Taking a major role in data record assessments performed by research organisations such as WCRP (World Climate Research Programme),
- Maintaining and providing an operational and sustained infrastructure that can serve the community within the transition of mature CDR products from the research community into operational environments.

A catalogue of all available CM SAF products is accessible via the CM SAF webpage, www.cmsaf.eu. Here, detailed information about product ordering, add-on tools, sample programs and documentation is provided.

2 Introduction

2.1 Purpose and scope

This Product User Manuals (PUM) provides general information on the the combined, global near-infrared and microwave imager based TCWV data record (COMBI), with the main objective to guide the utilisation of this product. The CDR is doi-referenced: https://doi.org/10.5676/EUM_SAF_CM/COMBI/V001.

The COMBI product combines near-infrared (NIR) based retrievals over land, coasts and sea-ice and CM SAF HOAPS data over open ocean. The NIR algorithm development and the combination of NIR and HOAPS based products has been developed and carried out within the ESA CCI Water Vapour project (WV_cci). The CM SAF HOAPS v4 ATBD (RD 1) is applicable, and the newly developed Level 2 to Level 3 processing implemented and applied by CM SAF is described in the ESA WV_cci ATBD (RD 2). The validation was carried out within WV_cci and the associated report is available from CM SAF (RD 3). Further background information is given in section 2.2.

As the Product User Guide available from ESA WV_cci covers all four products generated within WV_cci and because CM SAF specific access and user service details need to replace CCI specific sections, a new, stand alone Product User Manual is provided to users.

After this introduction, the following topics are covered:

- Product definition including Assumptions and Limitations
- Data format description
- Data ordering
- Feedback mechanisms

Acknowledgements are given in section 5.

2.2 Background

Within the ESA DUE GlobVapour project a global TCWV data record was generated by making use of the complementary spatial coverage of NIR and microwave imager (MW) observations (Lindstrot et al., 2014): SSM/I observations were used to generate TCWV data over the global ice-free ocean while MERIS observations were used over land, coastal areas and sea-ice (the latter two with reduced quality). The product covers the period 2003-2008 with daily and 0.05° and 0.5° temporal and spatial resolutions, respectively.

Within the ESA funded project "Advanced Clouds, Aerosols and WAter vapour products for Sentinel-3/OLCI - CAWA" the MERIS retrieval was improved and adapted to allow utilisation of measurements from OLCI. The OLCI retrieval was further improved within the EUMETSAT funded project "Improvement in Copernicus Sentinel-3 OLCI Water Vapour Product - COWa".

The product portfolio of EUMETSAT CM SAF includes a MW based TCWV product that is defined over the global ice-free ocean (0.5°x0.5°, 6-hourly composites and monthly means). This product is one element of the Hamburg Ocean Atmosphere Parameters and Fluxes from Satellite Data (HOAPS) product suite. HOAPS was originally developed at the University of Hamburg and the Max-Planck-Institute for Meteorology and has been successfully transferred

into the sustained operational environment of CM SAF. Currently HOAPS 4 is available from CM SAF and covers the period 1987-2014.

Within ESA WV_cci the NIR based TCWV retrievals were further improved and in addition to MERIS also MODIS and OLCI data were used as input. Within ESA WV_cci these NIR data were combined with TCWV data from EUMETSAT CM SAF HOAPS, similar to the GlobVapour example. Within WV_cci the product was validated and documented, i.e., among others, ATBD (for NIR retrieval and microwave imager and NIR data combination), PUG (product user guide) and PVIR (product validation and inter-comparison report) were finalised.

Efforts within ESA CCI are dedicated towards scientific development while the SAF network is dedicated to sustain ATBDs and data records. Thus, the combined global product consists of the NIR based ESA WV_cci TCWV data covering land, coast and sea-ice and of HOAPS TCWV data from EUMETSAT CM SAF covering the global ice-free ocean and is released as an official EUMETSAT CM SAF product.

3 Product definition

3.1 Overall characteristics

The global total column water vapour (TCWV) data record combines microwave and near-infrared imager based TCWV over the ice-free ocean as well as over land, coastal ocean and sea-ice, respectively. The data record relies on microwave observations from SSM/I, SSMIS, AMSR-E and TMI, partly based on a fundamental climate data record (Fennig et al., 2020) and on near-infrared observations from MERIS (3rd reprocessing, RD 5), MODIS-Terra (collection 6.1, RD 6, RD 7, RD 8) and OLCI (1st reprocessing, RD 9). Details of the retrieval are described in Andersson et al. (2010), Graw et al. (2017) and RD 1 for the microwave imagers as well as in Lindstrot et al. (2012), Diedrich et al. (2015) and RD 2 for the near-infrared imagers. The water vapour of the atmosphere is vertically integrated over the full column and given in units of kg/m². Both, the microwave and near-infrared data streams are processed independently and combined afterwards without changing the individual TCWV values and their uncertainties. The combined data record is provided in two versions with different spatial resolutions (0.5°x0.5° and 0.05°x0.05°), with the near-infrared based data being averaged and the microwave-based data being oversampled to match the lower, respectively higher spatial resolution. The product is available as daily and monthly means and covers the period July 2002 – December 2017.
Three example plots of global daily TCWV are shown in Figure 3-1. Besides the spatial distribution of TCWV the changes in grey areas indirectly exhibit changes in the observing system: the grey areas over land appear reduced in size between July 2007 and July 2010 because MODIS has a wider swath than MERIS. In July 2015 grey areas occur over subtropical oceans due to the loss of TMI.

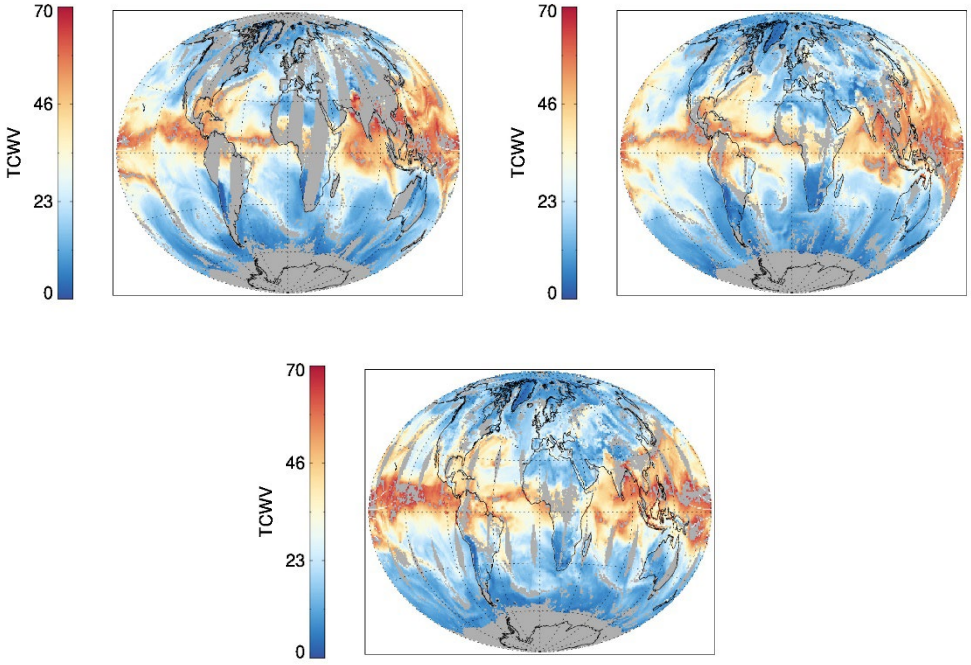

Figure 3-1: Global maps of daily TCWV in units of kg/m^2 from the combined microwave and near-infrared imager data record: 1 July 2007 (top left), 1 July 2010 (top right), and 1 July 2015 (bottom). Grey areas mark regions that are not observed by the satellites.

3.2 Practical considerations

Data from NIR observations are at first aggregated and gridded onto a plat carrée longitude/latitude grid of 0.5° and 0.05° on a daily basis and per satellite. Every grid cell contains the average TCWV, the average uncertainty, the standard deviation within the grid cell and number of valid observation. For the overlapping periods of MERIS-MODIS and MODIS-OLCI the results of both instruments are merged by a weighted sum. The weights are the respective counts of valid L2 retrievals. Additionally monthly averages are provided, created by a temporal aggregation of the daily products.

L2 data from CM SAF HOAPS is available from SSM/I onboard F08, F10, F11, F13, F14, and F15 satellites, SSMIS onboard F16, F17 and F18 satellites, AMSR-E and TMI observations. In view of the differences in sampling, L2 TCWV are first gridded onto a plat carrée longitude/latitude grid of 0.5° on hourly basis and per satellite. Then, for each hourly bin averages over all available satellites are carried out. Finally, the daily average is computed based on the hourly bins. This way it is ensured that all hourly bins and satellites have the same weight during averaging. In each case the averaging is carried out over all valid observations. In order to generate a HOAPS based L3 product at 0.05° the 0.5° product is oversampled.

The combination of the microwave imager based TCWV data over ocean and the NIR based observations over land, sea-ice and coasts utilises the spatial complementarity of both products. Within HOAPS a land/sea mask (static) and a sea-ice mask (per month) are generated. While the sea-ice mask is variable in time valid HOAPS values are 50 km or more

away from the coast. The masks are described in the HOAPS ATBD (RD 1). These masks are used to identify grids that are filled with microwave imager (open ocean) or with NIR (land, coasts and sea-ice) data.

The following quantities are provided per L3 bin, assuming that N samples of a quantity x, here TCWV, are averaged

- Standard deviation of x:

$$\sigma_{x\,std} = \sqrt{\frac{1}{N}\sum_{1}^{N}(x_i - \langle x \rangle)^2}$$

- Mean uncertainty of x:

$$\langle \sigma_{x\,i} \rangle = \frac{1}{N}\sum_{1}^{N}(\sigma_{x\,i})$$

- Square root of the mean of the squared uncertainty (propagated uncertainty) of x:

$$\sqrt{\langle \sigma^2_{x\,i} \rangle} = \sqrt{\frac{1}{N}\sum_{1}^{N}\sigma^2_{x\,i}}$$

Following Stengel et al. (2017), the propagated uncertainty of L3 products can be calculated by:

$$\sigma^2_{x\,natural} = \sigma^2_{x\,std} - (1-c)\langle \sigma_{x\,i} \rangle^2$$

$$\sigma^2{}_x = \frac{1}{N}\sigma^2_{x\,natural} + c\langle \sigma_{x\,i} \rangle^2 + (1-c)\frac{1}{N}\langle \sigma^2_{x\,i} \rangle$$

The first equation gives the natural variability of the observed variable. The most critical term is the correlation *c* between the spatially and temporally averaged retrievals because this quantity is typically not known and not provided. When estimates of the correlation become available, the total uncertainty can be estimated using the provided information on uncertainty (adapted from RD 10).

3.3 Summary from validation

The validation relies on analysing results from comparisons to various satellite, reanalysis, ground-based and *in situ* data records (RD 3). It was demonstrated that the combined global TCWV data record is well within threshold product requirements and frequently meet the target product requirements. Global comparisons were carried out against AIRS, ERA5 and GOME Evolution. Relative to AIRS mean bias, cRMSD and stability are +0.47 kg/m^2, 1.66 kg/m^2 and

+0.08 kg/m^2/decade, respectively. Separate results for land and ocean only coverages and more details are given in RD 3.

It is noted that the quality over inland water bodies, coastal areas and sea-ice is lower. Depending on the user application, it might be prudent to filter the data accordingly. It was also observed that the transition between MODIS and OLCI based TCWV over land between March and April 2016 is associated with a break point when compared to AIRS and ERA5. Thus, the OLCI period from April 2016 onwards should be excluded from climate change analysis. The NIR based TCWV data over land exhibits a high stability when OLCI data is removed and only clear-sky data is considered. Over ocean a small break point was observed when compared to the merged microwave data record from REMSS. However, the stability is still better than the target product requirement, though not significantly.

3.4 Assumptions and Limitations

Generally, the quality of the NIR TCWV retrieval algorithm over land strongly depends on the reliability of the cloud mask. For example, MERIS and OLCI do not provide measurements in the thermal infrared, the screening of optically thin cirrus clouds is difficult. A dry bias is to be expected, where the cloud detection fails to detect cirrus clouds or sub pixel clouds. For other satellite instruments, such as MODIS, cloud-mask-products are more reliable.

The NIR-based TCWV retrieval is applicable only for daylight and clear-sky sampling and above land surfaces. Additionally, the SNR decreases in the NIR for low surface reflectances. More importantly, the physical basis of the NIR retrieval; that the solar light is essentially reflected at the surface and thus transmitted through the full atmosphere, does not hold for very dark surfaces. Water surfaces outside the glint is black in the NIR and hence the solar light is reflected at aerosols in the boundary layer and not transmitted through the full atmosphere. Depending on their height, aerosol could or could not shield the water vapor absorption and lead to high ambiguity and uncertainty (from RD 2).

The HOAPS retrieval over ocean is only applicable over the ice-free open sea. TCWV cannot be retrieved reliably for scenes affected by heavy precipitation. If the a-priori information exhibits significant mismatches with the underlying “real” weather scene, the 1D-Var may not converge. If no a-priori profile could be constructed for the underlying weather scene the 1D-Var is not run for that scene. The current implementation of the 1D-Var does not utilise covariances of errors between different channels. Deblonde (2002) assumes that the instrument and forward model errors are not correlated between channels (RD 1).

The gridded products are potentially affected by sampling biases. While the uncertainty arising from temporal sampling (NIR, HOAPS) and from non-sampling under strong scattering conditions (HOAPS) are assumed to be small, the bias between all-sky observations and clear-sky observations (as is the case for NIR TCWV data) can be fairly large. Such a bias was analysed but is not included as uncertainty information in the product (RD 4). Figure 3-2 shows the spatial distribution of the clear-sky bias estimated using ERA5 data (see RD 4 for details).

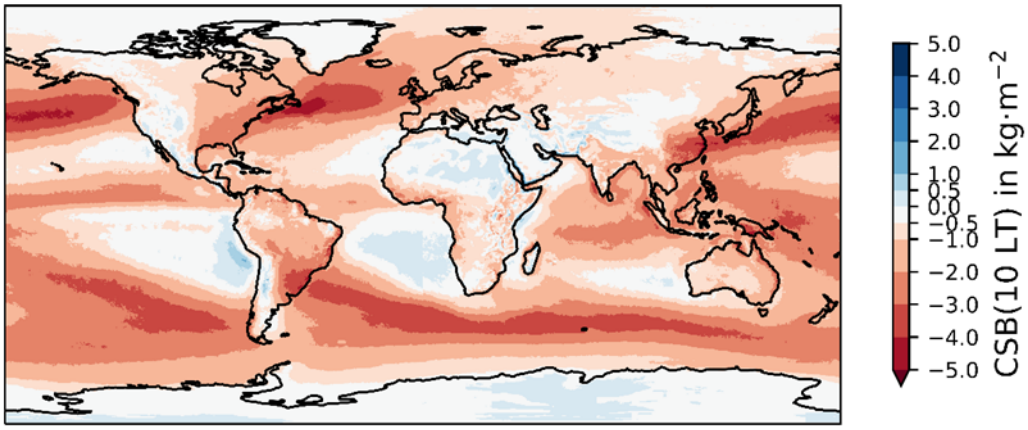

Figure 3-2: Climatology of the clear-sky bias for local time, LT=10. The analysis is based on hourly ERA5 data records for local overpass time of MERIS (considered time period 2002–2011) (from RD 4).

The sampling differs between observations over land (NIR) and ocean (microwave imagers): clear-sky vs almost all-sky, day vs day and night and one satellite per day vs up to six satellites per day, respectively. The sampling was not aligned between land and ocean observations. Among others, the microwave imagers allow observations under almost all-sky conditions and by this, are not affected by a dry clear-sky bias as this is the case for NIR observations.

4 Data format description

The CM SAF/WV_cci combined TCWV CDR is provided as NetCDF (Network Common Data Format) files version 4 (http://www.unidata.ucar.edu/software/netcdf/). The data files are conforming to the NetCDF Climate and Forecast (CF) Metadata Convention version 1.7 (http://cf-pcmdi.llnl.gov/) and NetCDF Attribute Convention for Dataset Discovery version 1.3.

4.1 Data file contents

A common NetCDF file consists of dimensions, variables, and attributes. These components can be used together to capture the meaning of data. The following variables are available in the CDR data files:

Each data file contains the following coordinate variables:

time
: start of averaging time period
[days counted from 1970-01-01]

time_bnds
: two-dimensional array defining the averaging time period
[days counted from 1970-01-01]

latitude
: geographical latitude of grid-box centre [degree_north]

lat_bnds
: two-dimensional array defining the northern and southern boundaries of the grid box
[days counted from 1970-01-01]

longitude
: geographical longitude of grid-box centre [degree_east]

lon_bnds
: two-dimensional array defining the eastern and western boundaries of the grid box
[days counted from 1970-01-01]

Each data file contains the following 3-dimensional variables with dimensions (lon, lat, time) and with the number of time elements being 1:

tcwv
: total column water vapour grid box mean value in units of kg/m^2

stdv
: standard deviation of *tcwv* within grid-box and averaging period in units of kg/m^2

tcwv_ran
: square-root of mean squared retrieval uncertainty, normalised by the number of valid observations, i.e., the propagated retrieval uncertainty, in units of kg/m^2

tcwv_err

average retrieval uncertainty in units of kg/m^2

num_obs

total number of valid observations counted during the averaging period

num_days_tcwv

total number of days with at least one observation counted during the average period (not available in daily files)

num_hours_tcwv

total number of hours with at least one observation counted during the average period (not available in monthly files and not available for NIR observations)

surface_type_flag

surface mask: 0: land, 1: ocean, 2: clouds_NIR, 3: heavy_precipitation_MW, 4: sea_ice, 5: coast, 6: partly_cloudy over land, 7: partly_sea_ice

tcwv_quality_flag

Quality flag of Total Column Water Vapour - 0: no known issues, 1: cost function above 1, 2: cost function above 2, 3: invalid (only available in daily files)

Each data file contains the following 1-dimensional variable:

record_status

record status per time step: 0: ok, 1: void, 2: bad quality

Each data file contains the following scalar variable:

crs

Coordinate reference system to define how the georeferenced spatial data relates to real locations on the Earth's surface.

Each file extracted from the CM SAF database has one record of the dimension (time, lat, lon) with the time dimension as the record dimension. This allows it to concatenate the individual records into an aggregated file.

Possible variable attributes are given in Table 4-1.

Table 4-1: Attributes assigned to non-scalar variables. For some variables only a subset of attributes is assigned.

Name	Description
long_name	long descriptive name
standard_name	standard name that references a description of a variable's content in the CF standard name table
coordinates	dimension names except unlimited dimension name
unit	physical unit [udunits standards]
ancillary_variables	variable name of ancillary data that is part of the same file

comment	text describing the content of a field
valid_range	maximum expected smallest and largest valid value of a variable
actual_range	smallest and largest valid value of a variable within a file
_FillValue	This number represent missing or undefined data. Missing values are to be filtered before scaling.
flag_values	list of bit fields expressing Boolean or enumerated flags
flag_meanings	descriptive words for each flag value

Global attributes are summarized in Table 4-2.

Table 4-2: Global NetCDF attributes.

Name	Description
title	data record title
institution	EUMETSAT/CM SAF
publisher_name	name of publishing institution
publisher_email	email contact
publisher_url	homepage of publisher
source	original data source
history	provides an audit trail for modifications to the original data
references	references that describe the data or methods used to produce it
tracking_id	
Conventions	conventions followed, "CF-1.7" for all files
product_version	data record version: major.minor
format_version	applied format and metadata standards, beyond CM SAF (here: CCI Data Standards v2.0)
summary	short description of data record
keywords	comma-separated keywords and phrases
id	digital object identifier (DOI)
naming_authority	EUMETSAT/CM SAF
esa_filename	original filename assigned within ESA WV_cci
keywords_vocabulary	GCMD Science Keywords, Version 8.1
cdm_data_type	data type, “grid” for gridded products
comment	background information on the origin of the data
date_created	date on which the data was created [ISO8601 date]
creator_name	DWD
creator_url	URL contact information for the creator of the data
creator_email	email contact information for the creator of the data
project	CM SAF
acknowledgement	acknowledgement

geospatial_lat_min	latitude bounding box minimum
geospatial_lat_max	latitude bounding box maximum
geospatial_lon_min	longitude bounding box minimum
geospatial_lon_max	longitude bounding box maximum
geospatial_vertical_min	lowest vertical level, here: 0.0
geospatial_vertical_max	highest vertical level, here: 0.0
time_coverage_start	temporal coverage start of the data [ISO8601 date]
time_coverage_end	temporal coverage end of the data [ISO8601 date]
time_coverage_duration	temporal coverage duration of the data [ISO8601 duration]
time_resolution	Temporal resolution of the data [ISO8601 resolution]
standard_name_vocabulary	Standard Name Table (v28, 07 January 2015)
license	applicable license
platform	comma separated list from GCMD Platform List
sensor	comma separated list from GCMD Sensor List
spatial_resolution	spatial resolution in km at the Equator
geospatial_lat_units	latitude untis
geospatial_lat_resolution	latitude resolution
geospatial_lon_units	longitude units
geospatial_lon_resolution	longitude resolution
key_variable	key variable name as used within the data file
platform_vocabulary	GCMD Platforms
instrument	comma separated list from GCMD Instrument List
instrument_vocabulary	GCMD Instruments
variable_id	variable ID within data file

5 Acknowledgment

The combined MW and NIR product was initiated and funded by the ESA Water_Vapour_cci project. The NIR retrieval was developed by Spectral Earth. The MW retrieval was originally developed at the University of Hamburg and the Max-Planck-Institute for Meteorology. Based on retrieval updates by CM SAF MW was processed by EUMETSAT CM SAF. The NIR data was processed and combined with the MW data by Brockmann Consult. NIR data is owned by Brockmann Consult and Spectral Earth.

This PUM is partly based on the Product User Guide from ESA WV_cci.

6 Data ordering via the Web User Interface (WUI)

The internet address https://wui.cmsaf.eu/ allows direct access to the CM SAF data ordering interface. On this webpage a detailed description how to use the interface for product search and ordering is given. We refer the user to this description since it is the central and most up to date documentation. However, some of the key features and services are briefly described in the following sections.

Further user service including information and documentation about CM SAF and the CM SAF products are available from the CM SAF home page (https://www.cmsaf.eu/).

6.1 Product ordering process

You need to be registered and logged in to order products. A login is provided upon registration, all products are delivered free of charge (Please note the copyright disclaimer given in section 8). After the selection of the product, the desired way of data transfer can be chosen. This is either via a temporary https account (the default setting), or email. Each order will be confirmed via email, and the user will get another email once the data have been prepared. If the https data transfer was selected, this second email will provide the information on how to access the https server.

6.2 Contact User Help Desk staff

In case of questions the contact information of the User Help Desk (e-mail address contact.cmsaf@dwd.de) are available via the CM SAF home webpage (https://www.cmsaf.eu/) or the home page of the Web User Interface (https://wui.cmsaf.eu/).

6.3 User Problem Report

Users of CM SAF products and services are encouraged to provide feedback on the CM SAF products and services to the CM SAF team. Users can either contact the User Help Desk (see section 6.2) or use the “User Problem Report” page.

6.4 Service Messages / log of changes

Service messages and a log of changes are also accessible from the CM SAF homepage (https://www.cmsaf.eu/) and provide useful information on product status, versioning and known deficiencies.

7 Feedback

7.1 User feedback

Users of CM SAF products and services are encouraged to provide feedback on the CM SAF product and services to the CM SAF team. We are keen to learn of what use the CM SAF data are. So please feedback your experiences as well as your application area of the CM SAF data.

EUMETSAT CM SAF is an user driven service and is committed to consider the needs and requirements of its users in the planning for product improvements and additions. Please provide your feedback e.g. to our User Help Desk (e-mail address contact.cmsaf@dwd.de).

7.2 Specific requirements for future products

Beside your general feedback you are cordially invited to provide your specific requirements on future products for your applications. Please provide your requirements e.g. to our staff or via our User Help Desk (e-mail address contact.cmsaf@dwd.de).

7.3 User Workshops

CM SAF is organizing training workshops on a regular basis in order to facilitate the use of our data. Furthermore, through our regular (approximately every four years) user's workshop we revisit our product baseline. Your participation in any of these workshops is highly appreciated. Please have a look at on the CM SAF home web page (https://www.cmsaf.eu/) to get the latest news on upcoming events.

8 Copyright and Disclaimer

The user of CM SAF data agrees to respect the following regulations:

8.1 Copyright

All intellectual property rights of the CM SAF products belong to EUMETSAT. The use of these products is granted to every interested user, free of charge. If you wish to use these products in publications, presentations, web pages etc., ***EUMETSAT's copyright credit must be shown by displaying the words "copyright (year) EUMETSAT" on each of the products used.***

8.2 Acknowledgement and Identification

When exploiting EUMETSAT/CM SAF data you are kindly requested to acknowledge this contribution accordingly and make reference to the CM SAF, e.g. by stating "The work performed was done (i.a.) by using data from EUMETSAT's Satellite Application Facility on Climate Monitoring (CM SAF)". It is highly recommended to clearly identify the product version used. An effective way to do this is the citation of CM SAF data records via the digital object identifier (DOI). All information can be retrieved through (https://www.cmsaf.eu/DOI/). The DOI for this data set is provided on the title page of this document.

8.3 Re-distribution of CM SAF data

Please do not re-distribute CM SAF data to 3rd parties. The use of the CM SAF products is granted free of charge to every interested user, but we have an essential interest to know how many and what users the CM SAF has. This helps to ensure of the CM SAF operational services as well as its evolution according to users needs and requirements. Each new user shall register at CM SAF in order to retrieve the data.

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10 Glossary

ATBD	Algorithm Theoretical Baseline Document
AMSR-E	Advanced Microwave Scanning Radiometer for EOS
CCI	Climate Change Initiative
CF	Climate and Forecast
CM SAF	Satellite Application Facility on Climate Monitoring
CDOP	Continuous Development and Operations Phase
DMSP	Defense Meteorological Satellite Program
DWD	Deutscher Wetterdienst (German MetService)
ECV	Essential Climate Variable
EIA	Earth Incidence Angle
EPS	European Polar System
ESA	European Space Agency
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
FCDR	Fundamental Climate Data Record
FMI	Finnish Meteorological Institute
FOV	Field of view
GCOS	Global Climate Observing System
GLOBE	The Global Land One-kilometer Base Elevation
HOAPS	The Hamburg Ocean Atmosphere Fluxes and Parameters from Satellite data
KNMI	Koninklijk Nederlands Meteorologisch Institut
MERIS	Medium Resolution Imaging Spectrometer
MODIS	Moderate Resolution Imaging Spectroradiometer
NASA	National Aeronautics and Space Administration
NESDIS	National Environmental Satellite, Data, and Information System
NetCDF	Network Common Data Form
NIR	Near Infrared
NOAA	National Oceanic & Atmospheric Administration

OLCI	Ocean and Land Colour Instrument
PRD	Product Requirement Document
PUM	Product User Manual
QC	Quality Control
RMIB	Royal Meteorological Institute of Belgium
SAF	Satellite Application Facility
SMHI	Swedish Meteorological and Hydrological Institute
SMMR	Scanning Multichannel Microwave Radiometer
SSM/I	Special Sensor Microwave Imager
SSMIS	Special Sensor Microwave Imager Sounder
TB	Brightness Temperature
TCWV	Total Column of Water Vapour
TMI	Tropical Rainfall Measuring Mission’s (TRMM) Microwave Imager (TMI)