25 years of a sustained Generation of Satellite-Based Climate Data Records by CM SAF

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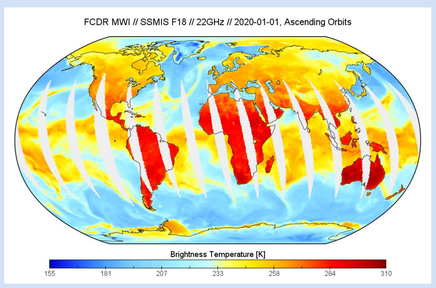
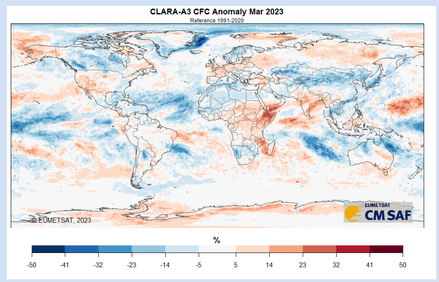
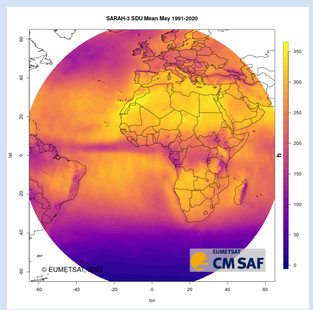
In recent decades, climate variability and change have caused impacts on natural and human systems on all continents. Observations are needed to understand and document these interactions and their causes. They are increasingly based on remote sensing from satellites offering global scale and continuous coverage. Only long term and consistent observations of the Earth system allow us to quantify impacts of climate variability and change on the natural and human dimension. The EUMETSAT Satellite Application Facility on Climate Monitoring (CM SAF) provides high-quality, global satellite-based climate data records for monitoring of the Earth's climate. CM SAF started in 1999 and has now been generating data in a sustained operational environment for more than 25 years.



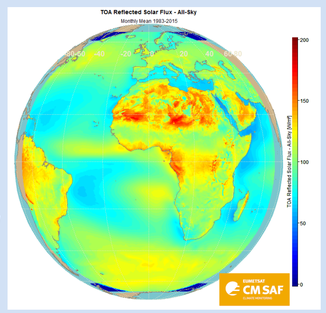
Microwave brightness temperatures at 22 GHz on 01/01/2020 (asc. orbits), DOI: 10.5676/EUM_SAF_CM/FCDR_MWI/V004



Example application: Cloud fraction anomaly in May 2023, ICDR difference to CDR average over the period 1991-2020, CLARA-A3, DOI: 10.5676/EUM_SAF_CM/CLARA_AVHRR/V003



Sunshine duration (1983-2020) from SARAH-3 CDR
DOI: 10.5676/EUM_SAF_CM/SARAH/V003



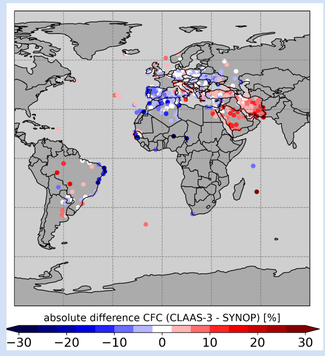
Top of the atmosphere Thermal Radiation (1983-2015)
DOI: 10.5676/EUM_SAF_CM/TOA_MET/V001

Climate Data Records (CDRs) of EUMETSAT's CM SAF

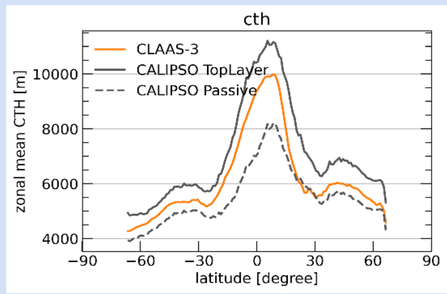
Since 2012, CM SAF has been operationally delivering high-quality satellite based CDRs for climate monitoring, analyses, services and model evaluation. CM SAF's CDRs are based on carefully (inter-)calibrated satellite data using the latest versions of the respective algorithms. All CM SAF data records undergo a rigorous technical and scientific external review process, while still being flexible enough to incorporate the latest developments. To support the emerging operational climate monitoring services, additionally Interim CDRs for selected CDRs are generated. These ICDRs are based on the respective algorithms of the CDR to allow the continuation of the time series with shorter time latency. It is now possible to cover the WMO reference period (1991-2020) with satellite-based CDRs from several sensors.
CM SAF is in the process of updating several already released CDRs and will provide CDRs of additional parameters after careful validation and review of the data records over the next few years, including work towards usage of the next generation satellites, EPS-SG and MTG.

Example results from validation

Prior to a CDR release, the CDR undergoes a series of external reviews. The focus is on validation and inter-comparison of the CDR. Example validation results are shown for CLAAS-3. Full details of results from validation are available via the validation reports and associated publications, available via https://www.cmsaf.eu/doi.



*Mean difference between CLAAS-3 and SYNOP cloud cover at SYNOP sites for the period 2004-2020 (**left**) and averaged zonal mean CTH bias from CLAAS-3 and CALIPSO-GEWEX top layer and passive flavour for the period 2006-2016 (**bottom**).*



Sensor	Parameter	CDR period	Area	ICDR start year
Fundamental Climate Data Records (FCDR)				
SMMR, SSM/I SSMI(S)	Microwave Radiances (SMMR, SSMI, SSMIS)	1979-2022	global	
	Microwave Radiances (SMMR, SSMI, SSMIS)	1979-2024		
Climate Data Records and Interim Climate Data Records (CDR & ICDR)				
SSMI(S), AMSR-E, TMI, GMI, AMSR-2	Total column water vapour, evaporation, latent heat flux, freshwater flux, near surface wind speed and humidity (HOAPS-4)	1987-2014	global ice-free ocean	
	Similar to HOAPS-4 + liquid water path (HOAPS-5)	1987-2024		
Microwave Imager + Sounder, Geo-ring	Global precipitation (GIRAFE)	2002-2020	global	2021
		1998-2024[1]		
Microwave Sounder	Upper tropospheric humidity	1994-2018	global	
		1994-2024		
Microwave + Near Infrared Imager	Total column water vapour	2002-2017	global	
		2002-2022		
ATOVS	Total column water vapour, layer integrated water vapour and temperature, specific humidity and temperature at 6 levels	1999-2012	global	
AVHRR GAC	Cloud properties, surface and top of atmosphere radiation, surface albedo (CLARA-A3)	1979-2020	global	2021
AVHRR GAC/ VIIRS	Similar to CLARA- A3 (CLARA-A3.5)	1979-2024	global	2025
SEVIRI	Aerosol Optical Depth (AOD)	2004-2012	Europe & Africa	
	Cloud parameters (CLAAS-3)	2004-2020		2021
SEVIRI/FCI	Cloud and TOA radiation parameters (CLAAS-4)	2004-2024	Europe & Africa	2025
GERB/ SEVIRI	Top of atmosphere radiative fluxes (Edition 2)	2004-2015	Europe & Africa	
MVIRI/SEVIRI	Cloud fraction (COMET ed 2.), land surface temperature (SUMET ed. 2) and + latent and Sensible Heat fluxes (land, LandFlux ed. 1)	1983-2020	Europe & Africa	
	Free tropospheric humidity	1983-2009		
	Top of atmosphere radiative fluxes	1983-2015		
	Latent and Sensible Heat fluxes, land surface temperature, surface radiation budget	demonstration data[2]	Geo-ring	
	Solar surface radiation parameters (SARAH-3)	1983-2020	Europe & Africa	2021
Geo-ring	Solar surface radiation parameters (SARAH-4) [3]	1983-2025	Geo-ring	2026[4]
Geo-ring	International Cloud Climatology Project - Next Generation (ISCCP-NG, clouds + TOA radiation) from CM SAF	Demonstration data in 2025	Geo-ring	

[1] release foreseen in 2027/2028, [2] selected parameters only, [3] record length depending on location in Geo-ring: 1983-2025 (Meteosat 0° service, SARAH-4), 2005-2025 (Himawari), 2000-2025 (GOES-E), 2000-2025 (GOES-W), [4]ICDR generation for Meteosat 0° coverage only

Table 1: Details for latest version of released (black) and upcoming (blue) CM SAF CDRs. Further information can be found via the corresponding Digital Object Identifiers (DOI) available at www.cmsaf.eu/doi.

User Help Desk and services

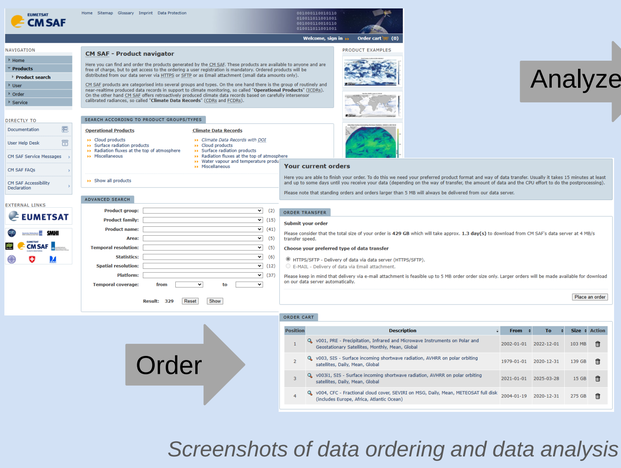
Data can be ordered through the CM SAF webpage wui.cmsaf.eu and is provided free of charge to any interested user (user registration required). A selection of sub-regions and re-projection of data is possible during the ordering process. Add-on products and ancillary data (e.g., lat/lon, land/sea mask) as well as example files are available on the webpage.

A subset of parameters is also available via the EUMETSAT EUMETCast service. Additionally, CM SAF is currently adding several already released data records to the EUMETSAT Data Store (EDS). It is envisaged to make all new releases available via the EDS, where users can, e.g., download data via an API. Support of CM SAF products in the EUMETSAT Data Tailor is envisaged in the future.

To support the processing and visualisation of the products an R-toolbox with ready-to-use functions for processing and visualisation of the CM SAF data records is provided, too.
The toolbox can be downloaded from https://www.cmsaf.eu/tools.

Additionally, service messages, information on changes in processing, known product disruptions as well as newsletters and documentation on the products are being provided on the CM SAF webpage.

Also the latest images of a selection of our global and regional Interim Climate Data Records with links to direct ordering of the products are provided.



Screenshots of data ordering and data analysis

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