



C3S Climate Data Store workshop

ECMWF, Reading, UK
3-6 March 2015

Existing Solutions:

EUMETSAT Satellite Application Facility on Climate Monitoring

Martin Werscheck
Deutscher Wetterdienst

CM SAF: Content

- **Mandate**
- **EUMETSAT Satellite Application Facility (SAF) network**
- **Products**
- **Users**
- **Downstream application (examples)**
- **CM SAF & Copernicus Climate Change Service**
- **Planning 2017 - 2022**

www.cmsaf.eu

CM SAF: Mission Statement

The EUMETSAT
Network of
Satellite Application
Facilities



The Satellite Application Facility on Climate Monitoring

develops
generates
archives
disseminates

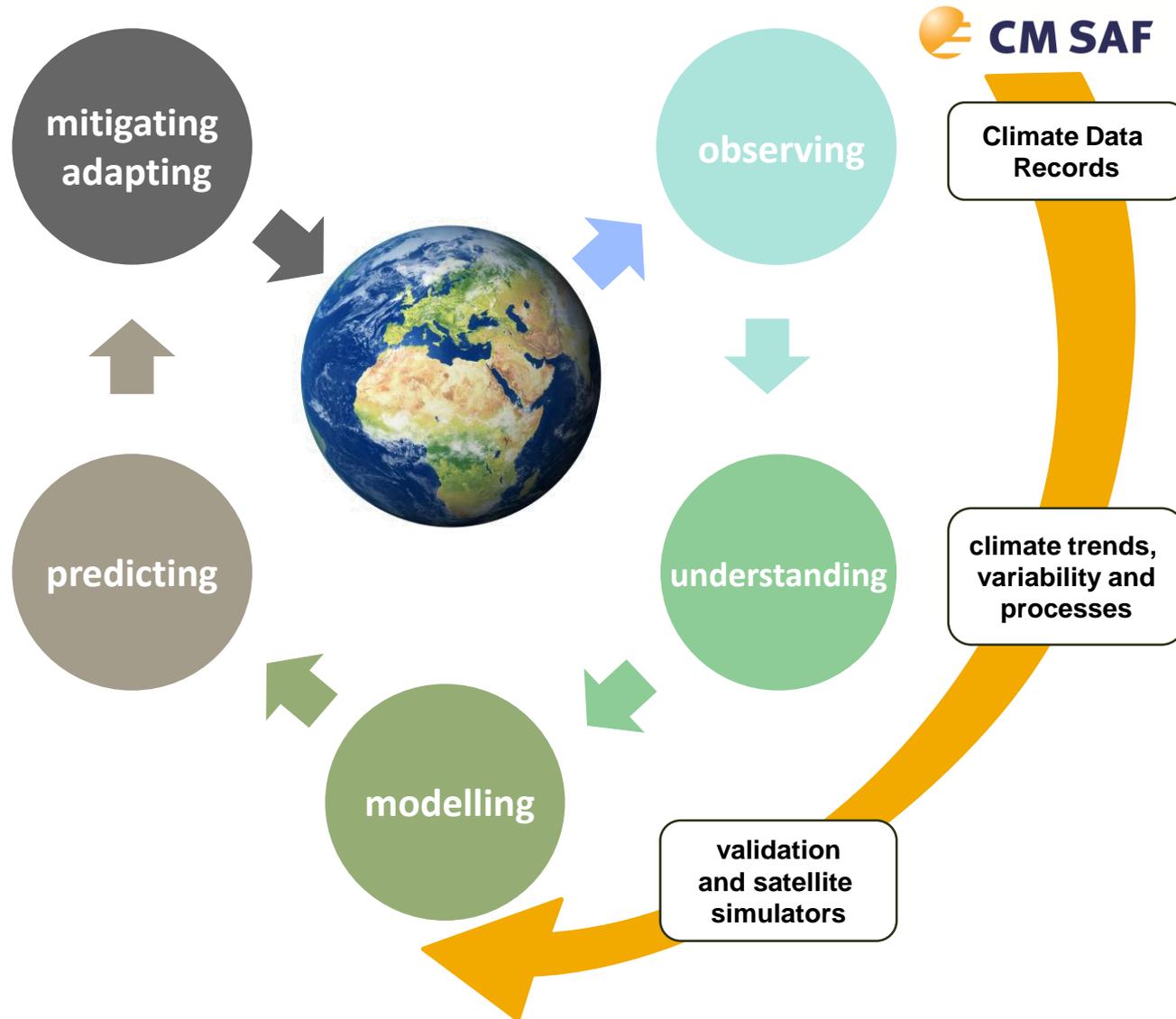
high quality satellite data derived products of the

energy and water cycle

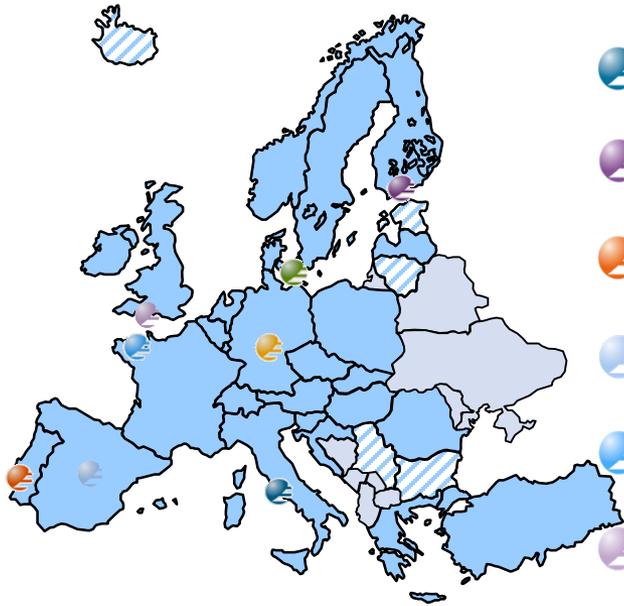
and related

sustained services

in support to understand our climate



CM SAF: The EUMETSAT SAF Network



 EUMETSAT Member States
 EUMETSAT Cooperating States

-  **CM SAF** Climate Monitoring

-  **H SAF** Support to Operational Hydrology and Water Management

-  **O3M SAF** Ozone and Atmospheric Chemistry Monitoring

-  **LSA SAF** Land Surface Analysis

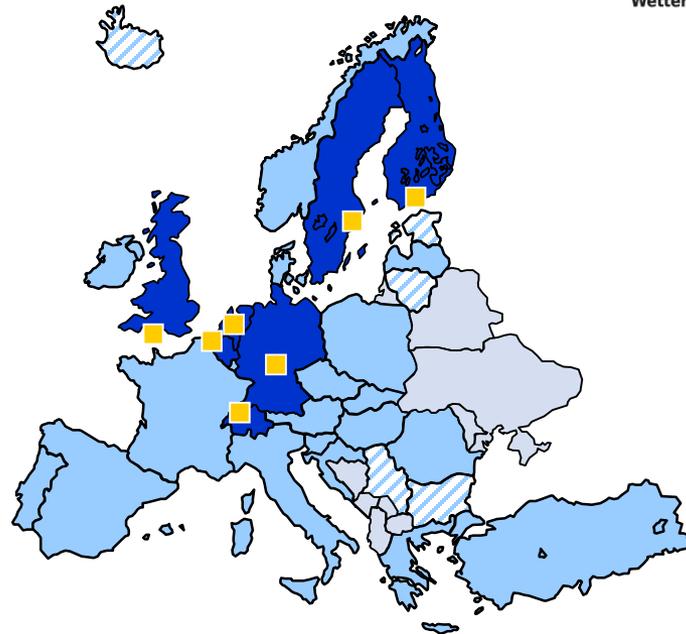
-  **NWC SAF** Support to Nowcasting and Very Short Range Forecasting

-  **OSI SAF** Ocean and Sea Ice

-  **NWP SAF** Numerical Weather Prediction

-  **ROM SAF** Radio Occultation Meteorology SAF


CM SAF: Partners



-  EUMETSAT Member States
-  EUMETSAT Cooperating States
-  CM SAF Member States
-  Location of Partner NMHSs

Deutscher Wetterdienst
Wetter und Klima aus einer Hand



Swedish Meteorological and Hydrological Institute



Koninklijk Nederlands
Meteorologisch Instituut
Ministerie van Infrastructuur en Milieu



Royal Meteorological Institute of Belgium



Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

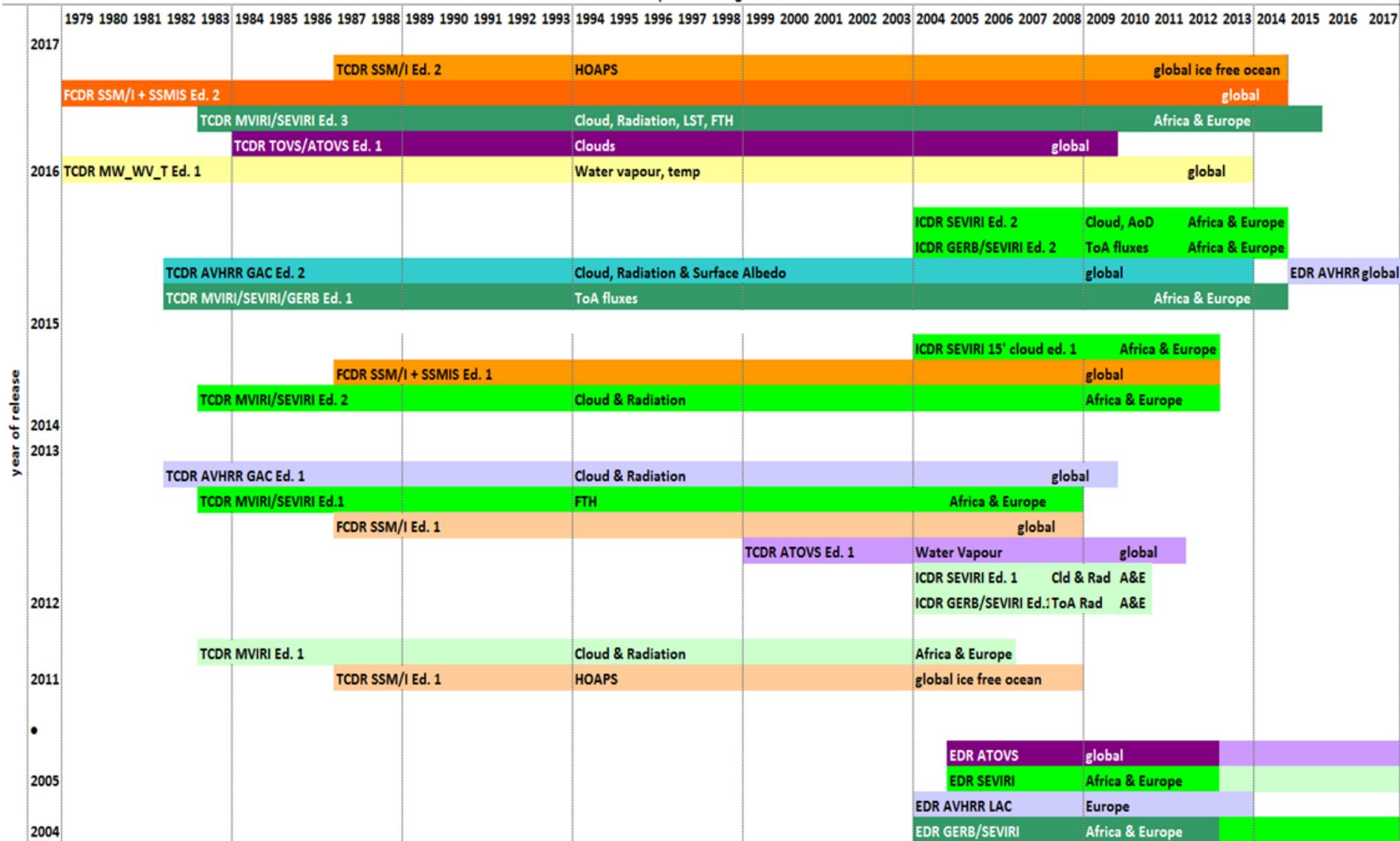


Finnish Meteorological Institute

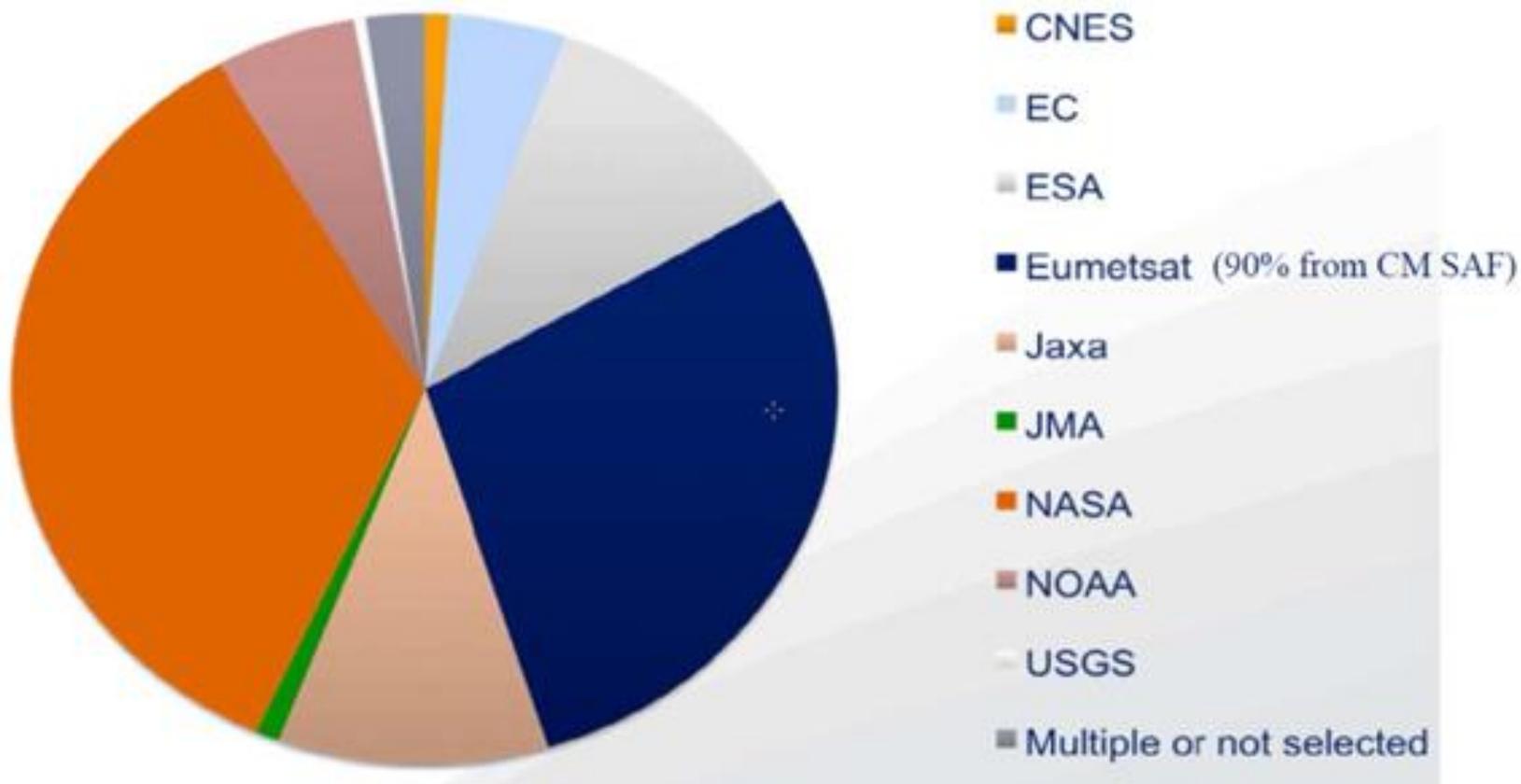


Met Office, United Kingdom

temporal coverage of CDR



CM SAF: TCDRs of ECVs



Courtesy: Alain Ratier, EUMETSAT

CM SAF: Radiative Product

Radiation	Acronym	Coverage			
		Europe & Africa		global	
		EDR	CDR	EDR	CDR
Surface Radiation Budget	SRB	◇	●	-	●
Surface Incoming Shortwave	SIS	●	●	○	●
Surface Net Shortwave	SNS	◇	●	-	●
Direct Irradiance at Surface	SID	●	●	-	-
Direct Normalized Irradiance at Surface	DNI	-	●	-	-
Spectrally Resolved Irradiance	SRI	-	●	-	-
Daylight	DAL	-	●	-	-
Surface Albedo	SAL	◇ ¹	●	○	● ¹
Cloud Albedo	CAL	-	●	-	-
Cloud Radiative Effect SW & LW	CFS/L	-	●	-	●
Surface Net Longwave	SNL	◇	●	-	●
Surface Downward Longwave	SDL	◇	●	-	●
Surface Outgoing Longwave	SOL	◇	●	-	●
Top of Atmosphere Reflected Solar Radiative Flux	TRS	●	●	-	-
Top of Atmosphere Emitted Thermal Radiative Flux	TET	●	●	-	-
Top of Atmosphere Incoming Solar Radiation	TIS	◇	-	-	-

- Available - not available ◇ data are only available until March 2012
- 1 including Arctic ○ planned

CM SAF: Cloud & Aerosol Products

Water Vapour + Temperature, radiances

	Acronym	Coverage			
		Europe & Africa		global	
		EDR	CDR	EDR	CDR
Cloud & Aerosol					
Cloud Fractional Cover	CFC	●1	●	○	●1
Cloud Optical Thickness	COT	●	●	-	●
Cloud Phase	CPH	●	●	○	●
Cloud Top Temperature/Height/Pressure	CTO	●1	●	○	●
Cloud Water Path (ice & liquid)	CWP	●	-	-	-
Liquid Water Path	LWP	●	●	○	●
Ice Water Path	IWP	-	●	○	●
High Cirrus Cloud Amount	CA	-	●	-	●
Joint Cloud property Histograms	JCH	-	●	-	●
Cloud Type	CTY	◇	-	-	-
Cloud Mask	CFC	-	●	-	-
Water Vapour + Temperature, radiances					
Vertically Integrated Water Vapour	HTW	-	-	●	●
Layered Water Vapour and Temperature	HLW	-	-	●	●
Specific Humidity and Temperature at pressure levels	HSH	-	-	●	●
Free Tropospheric Humidity	FTH	-	●	-	-
Land Surface Temperature	LST	-	○	-	-
Microwave Radiances	FCDR-SSM/I	-	-	-	●

- Available
- not available
- ◇ data are only available until March 2012
- 1 including Arctic
- planned

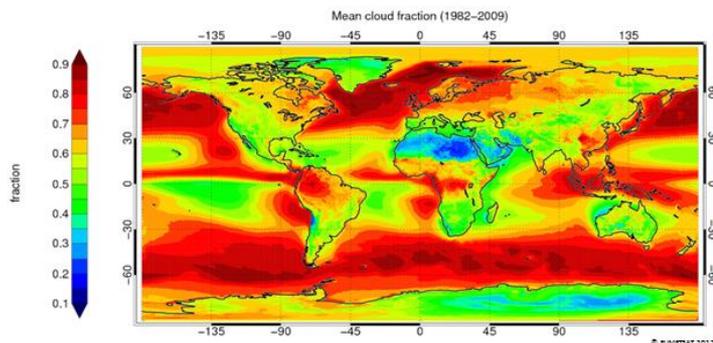
CM SAF: HOAPS Product

	Acronym	Coverage			
		Europe & Africa		global	
		EDR	CDR	EDR	CDR
HOAPS					
Latent Heat Flux	LHF	-	-	-	●
Precipitation	PRE	-	-	-	●
Evaporation	EVA	-	-	-	●
Freshwater Flux	EMP	-	-	-	●
Near Surface Specific Humidity	NSH	-	-	-	●
Vertically Integrated Water Vapour	HTW	-	-	-	●

- Available
- not available
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CM SAF cCloud, Albedo & Radiation dataset, AVHRR-based, Edition 1



Climatological mean field of CLARA-A1 cloud fractional coverage for the years 1982 – 2009.

Overview

The CLARA-A1 dataset is a global dataset of cloud, surface albedo and surface radiation products derived from measurements of the Advanced Very High Resolution Radiometer (AVHRR) onboard the polar orbiting NOAA and Metop satellites. Monthly and daily mean products have been compiled over a time period of 28 years starting in 1982 and ending in 2009. Results are available for individual satellites as well as aggregated for all satellites. The data are provided on two types of grids: one global regular latitude-longitude grid with 0.25 degrees resolution and two equal-area grids covering the polar regions with 25 km resolution (products on the polar grids are restricted to cloud amount and surface albedo). Further extensions, e.g. single- and multi-parameter histograms, and subsets, e.g. daytime-only and night-time only results, are also available.

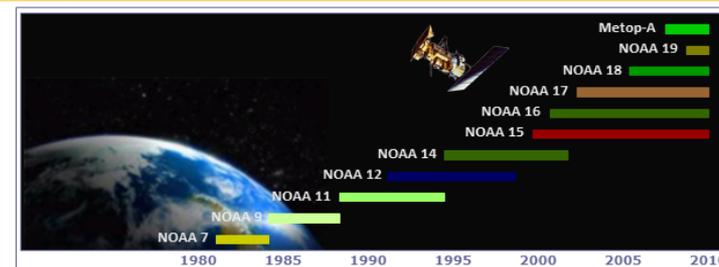
Available documentation

- Product User Manual
- Algorithm Theoretical Basis Document
- Validation Report

Karsson, K.-G., Riihelä, A., Müller, R., Meirink, J. F., Sedlar, J., Stengel, M., Lockhoff, M., Trentmann, J., Kaspar, F., Hollmann, R., and Wolters, E.: CLARA-A1: the CM SAF cloud, albedo and radiation dataset from 28 yr of global AVHRR data, Atmos. Chem. Phys. Discuss., 13, 935-982, doi:10.5194/acpd-13-935-2013, 2013.



Satellite Input Data



Temporal coverage of used AVHRR instruments aboard NOAA and Metop satellites.

Products

Fractional Cloud Cover	CFC	Surface Albedo	SAL
Joint Cloud property Histogramm	JCH	Surface Net Shortwave Radiation	SNS
Cloud Top Height, Temperature, Pressure	CTO	Surface Outgoing Longwave Rad.	SOL
Cloud Optical Thickness	COT	Downward Longwave Rad.	SDL
Cloud Phase	CPH	Surface Net Longwave Rad.	SNL
Liquid Water Path	LWP	Radiation Budget	SRB
Ice Water Path	IWP	Cloud Radiative Effect short wave	CFS
Surface Incoming Shortwave Radiation	SIS	Cloud Radiative Effect long wave	CFL

Technical Specifications

Time period:	1982 – 2009 (Clouds & Surface Albedo); 1989 – 2009 (Radiation)
Temporal resolution:	daily mean, pentad mean, monthly mean, monthly histograms (depending on product)
Spatial coverage:	global on a regular latitude/longitude grid (polar areas: equal area)
Spatial resolution:	0,25° x 0,25° (JCH: 1°x1°; polar areas: 25x25km²)
Data Format:	NetCDF 3, Climate and Forecast (CF) Metadata Convention v1.5 Note: On request, data are also available reformatted using the CMOR (http://www2-pcmdi.llnl.gov/cmor) library compliant with Obs4MIPs (https://www.earthsystemcog.org/projects/obs4mips/) file format standard.

Free Data Access & Contact

www.cmsaf.eu/wui
User help desk: contact.cmsaf@dwd.de

CM SAF: Quality Control and product life cycle

The definition, generation and the release of a CM SAF **Climate Data Record** undergoes a three-step, rigorous peer review process:

Requirement Review (RR)

- Assess the adequateness and feasibility of the product requirements

Product Consolidation Review (PCR)

- Assess the maturity of the algorithm selected / developed for product generation
- Assess the infrastructure capability to generate the data set

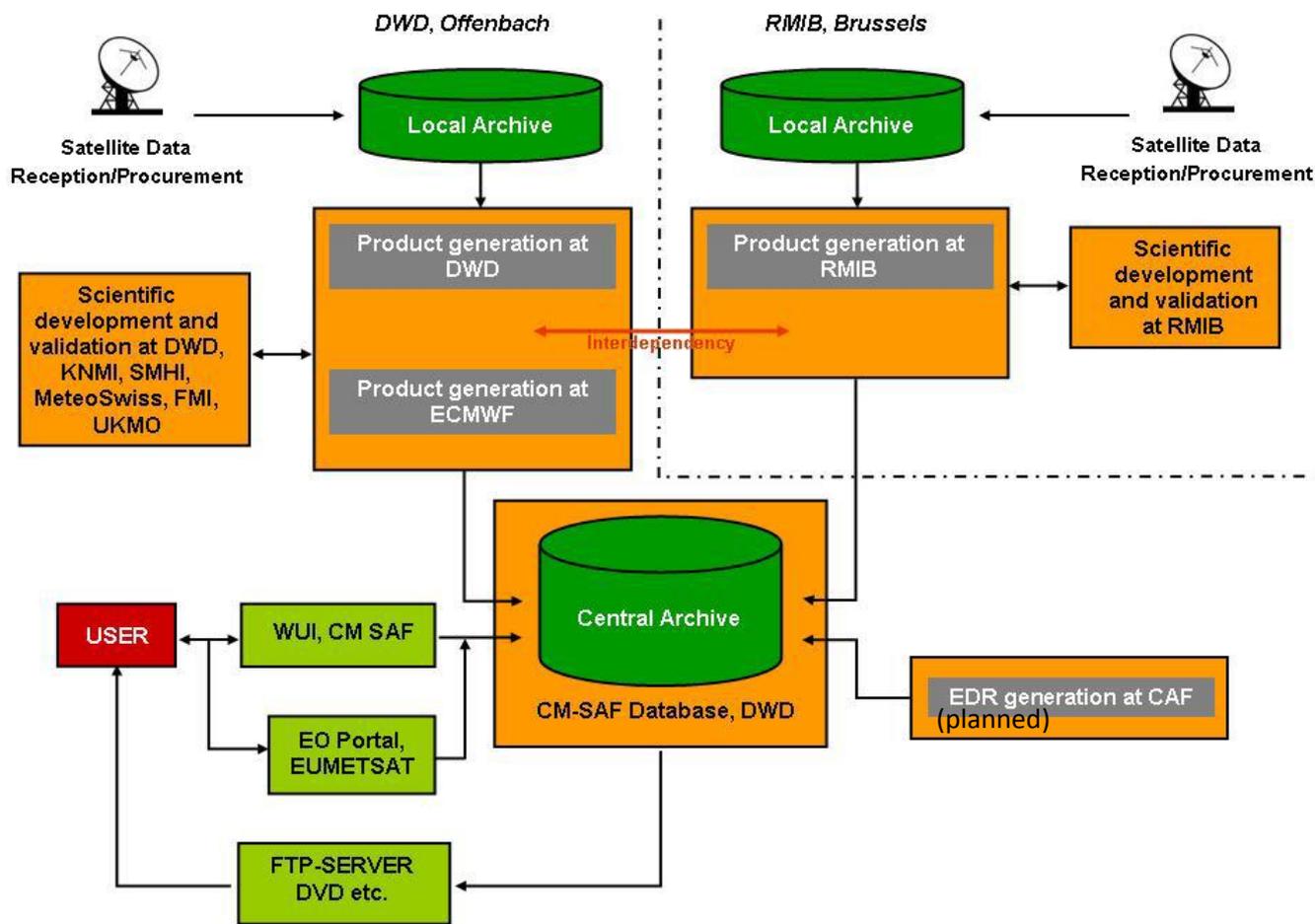
Delivery Readiness Review (DRR)

- Assess the validation results against the defined product requirements
- Assess the readiness to deliver the data record

Operations Review (OR) (annual review)

- Assess the level of compliance of the delivered products & services against the Service Specifications

CM SAF: Processing Centres



CM SAF: Data Access

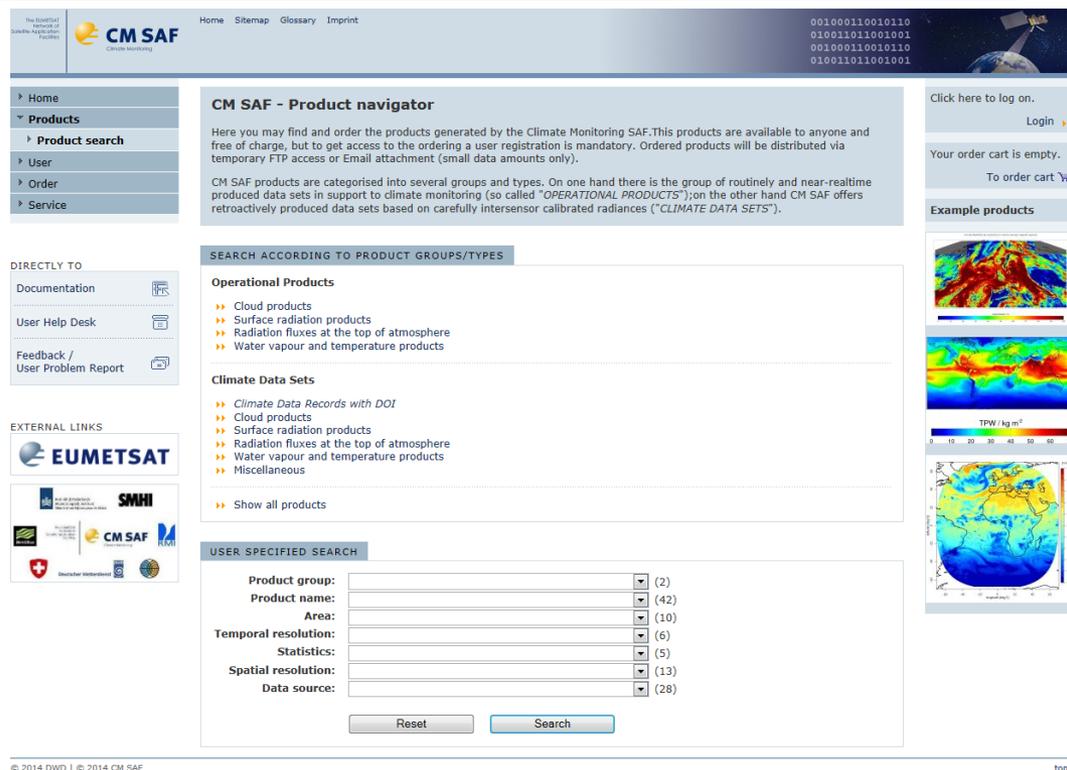
Free and easy access via

<https://wui.cmsaf.eu/>



WUI allows:

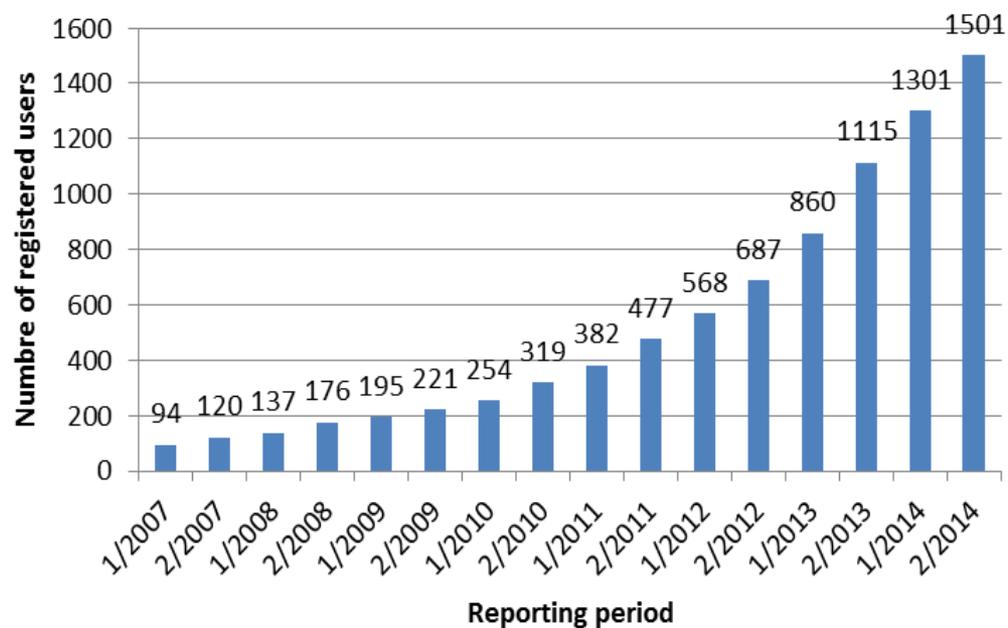
- Easy selection and online ordering of Data Records
- Standing orders
- Postprocessing, i.a.
 - Reformating of data
 - Area selection (also CORDEX areas)
 - On request some data are available compliant with Ops4MIPs



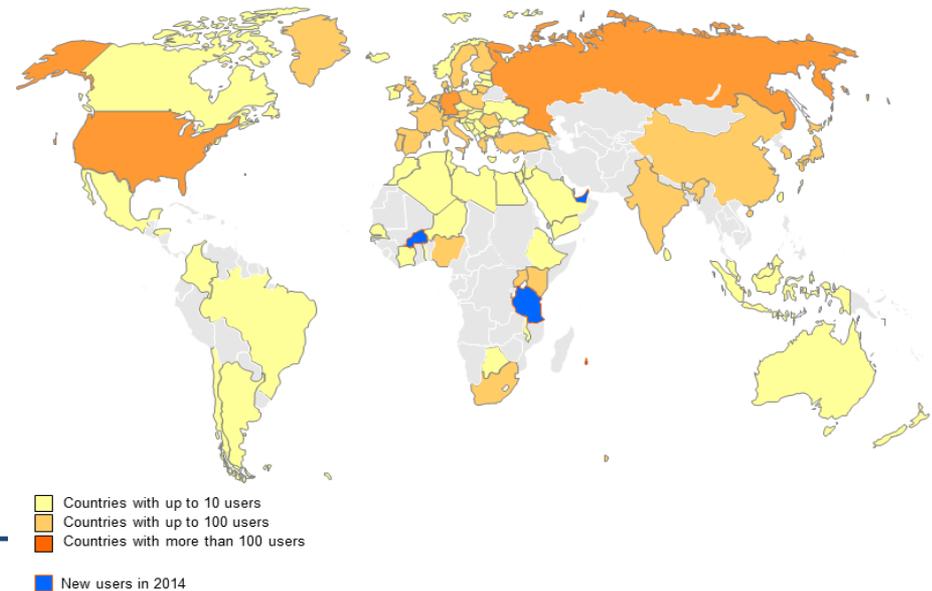
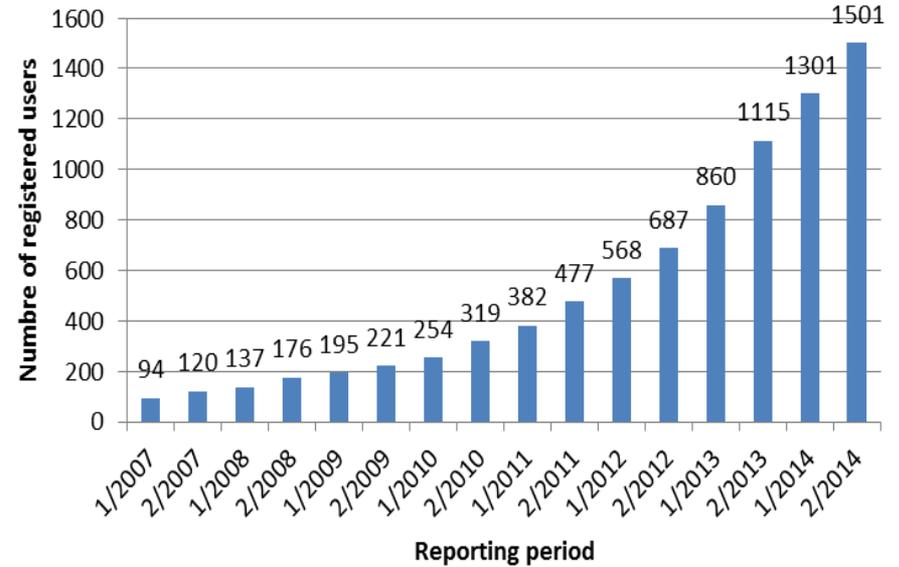
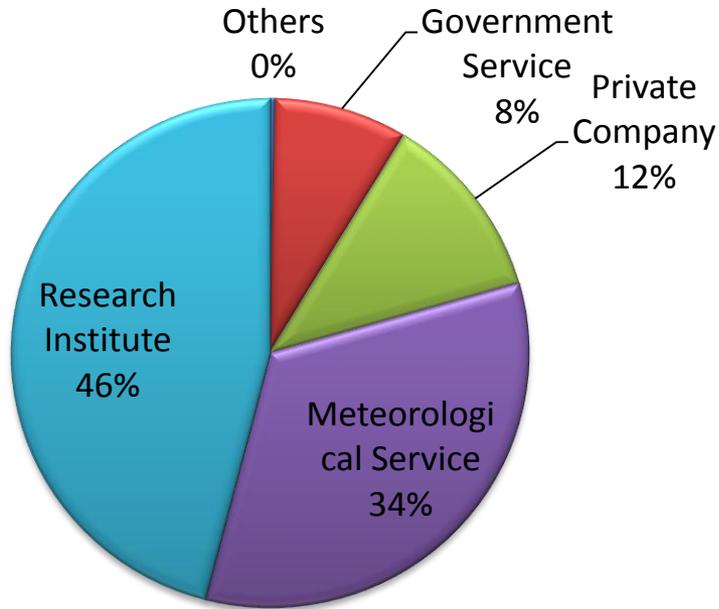
Offline tools:

- Graphical User Interface (cloud & radiation products)
- Climate Data Operators (CDO)
- R tools

CM SAF: Users



CM SAF: Users



CM SAF: User support

- [User \(requirements\) workshops](#)
- [User training workshops](#)
- CM SAF community site (<http://training.eumetsat.int/enrol/index.php?id=147>)
- User help desk
- User information & documentation, including i.a.
 - Newsletter
 - Service Messages
 - Change logs
 - FAQs
 - Product User Manuals (PUM)
 - Algorithm Theoretical Baseline Documents (ATBD)
 - Validation Reports (ValReps & Annual Quality Assessment; AQA)
 - Operations Reports

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Upcoming

- Commentary Metadata 
- Maturity Matrix (System & Application)

CM SAF: Downstream Application; Example 1 PVGIS @ JRC



Photovoltaic Geographical Information System - Interactive Maps


[EUROPA](#) > [EC](#) > [JRC](#) > [IE](#) > [RE](#) > [SOLAREC](#) > [PVGIS](#) > [Interactive maps](#) > [africa](#)

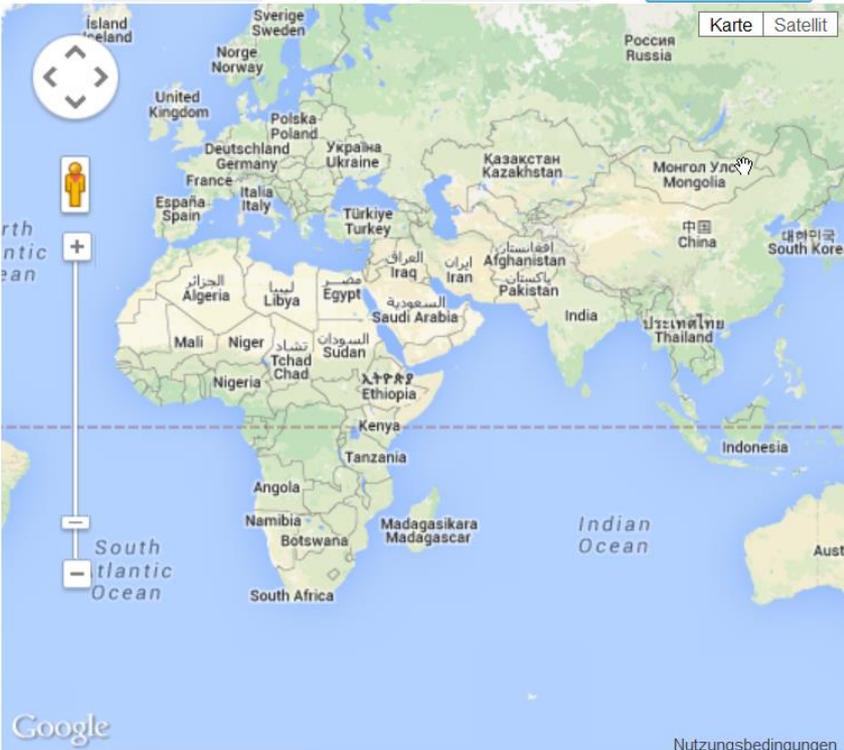
[Contact](#)
[Important legal notice](#)

New: PVGIS expanded to cover Asia. Click [here](#) to read about it.


 e.g., "Ispra, Italy" or "45.256N, 16.9589E"

cursor position: 47.754, 113.555
 selected position:

Latitude: Longitude:



PV Estimation	Monthly radiation	Daily radiation	Stand-alone PV
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Performance of Grid-connected PV

Radiation database: [\[What is this?\]](#)
 PV technology:

Installed peak PV power kWp
 Estimated system losses [0;100] %

Fixed mounting options:
 Mounting position:

Slope [0;90] ° Optimize slope
 Azimuth [-180;180] ° Also optimize azimuth
(Azimuth angle from -180 to 180. East=-90, South=0)

Tracking options:
 Vertical axis Slope [0;90] ° Optimize
 Inclined axis Slope [0;90] ° Optimize
 2-axis tracking

Horizon file

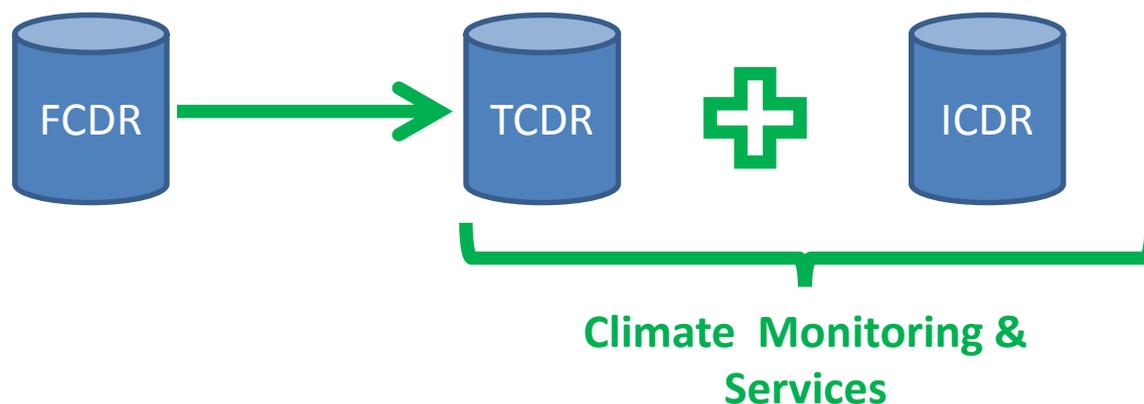
Output options
 Show graphs Show horizon
 Web page Text file PDF

[\[help\]](#)

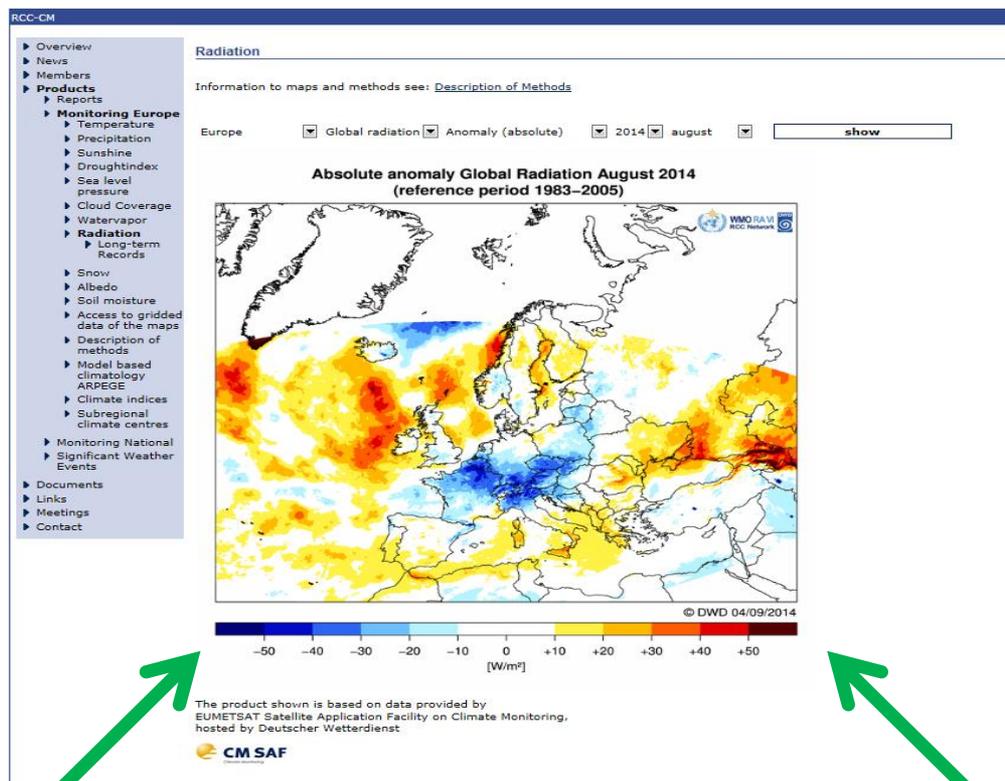
<http://re.jrc.ec.europa.eu/pvgis/apps4/pvest.php?map=africa&lang=en>

CM SAF: FCDR -> TCDR -> ICDR

	FCDR	TCDR	ICDR
CDR type	Fundamental Climate Data Record	Thematic Climate Data Record	Intermediate Climate Data Record
CDR description	Calibrated / Intercalibrated Sensor data	Long time series of Essential Climate Variables	Regular & consistent updates of TCDRs
Provider	Satellite operators	e.g. CM SAF	GCFS?, RCC?, C3S?



CM SAF: Downstream Application; Example 2 WMO Regional Climate Centre RA VI



**Thematic
Climate Data
Record**

**Long time series of
Essential Climate Variables**



**Intermediate
Climate Data Record**

**Regular & consistent
updates of TCDRs**

CM SAF: FCDR -> TCDR -> ICDR

CM SAF



- Peer-reviewed dataset and method
- Continuous development and scientific updates of algorithms
- Clear traceability of user requirements
- High quality
- Well documented
- User support & training

??



- Consistent with TCDR datasets
- Based on TCDR expertise & team
- Regular updates
- Esp. for climate monitoring and services
- Capitalize on TCDR production & service environment

CM SAF: From data to information

CDS



CIS



O&D

**Climatological
Background
Information:**
Thematic Climate
Data Records
TCDR



**Climatological
Up-to-date
Information:**
Intermediate Climate
Data Records
ICDR



- Maps & films
- Statistics
- Indices &
- Indicators
-
- Interactive
- User-taylored
- Post-processing
- Web-Mapping services
- others

CM SAF: Next Phase (2017 – 2022)

Currently drafting the proposal for 2017 – 2022:

- Continue with successful product & service portfolio
- Extend to
 - („Real“) Global („All“) Precipitation Climate Data Record
 - Include Global Evapotranspiration Climate Data Record
- Focus on Thematic Climate Data Records (long time series of ECVs)
(at the cost of other activities, e.g. ICDRs?)

CM SAF: Summary

Products & services related to the global energy & water cycle

Thorough quality assurance & control mechanisms

Comprehensive user interaction and support

Ready to contribute to C3S

**Ready to consider adjustments / tailoring / adding to C3S on request
(remember proposal writing now!)**

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