EUMETSAT CM SAF CLIMATE MONITORING

Deutscher Wetterdienst
Wetter und Klima aus einer Hand
DWD

Satellite Application Facility on Climate Monitoring- Climate Data Records and Services -

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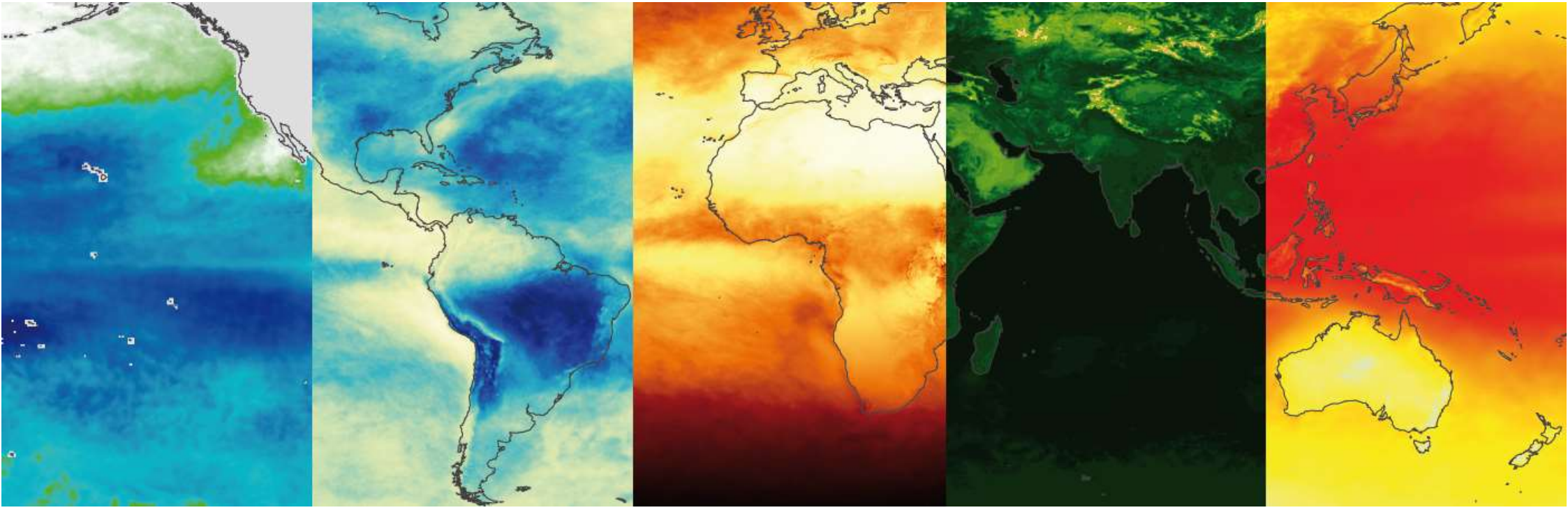
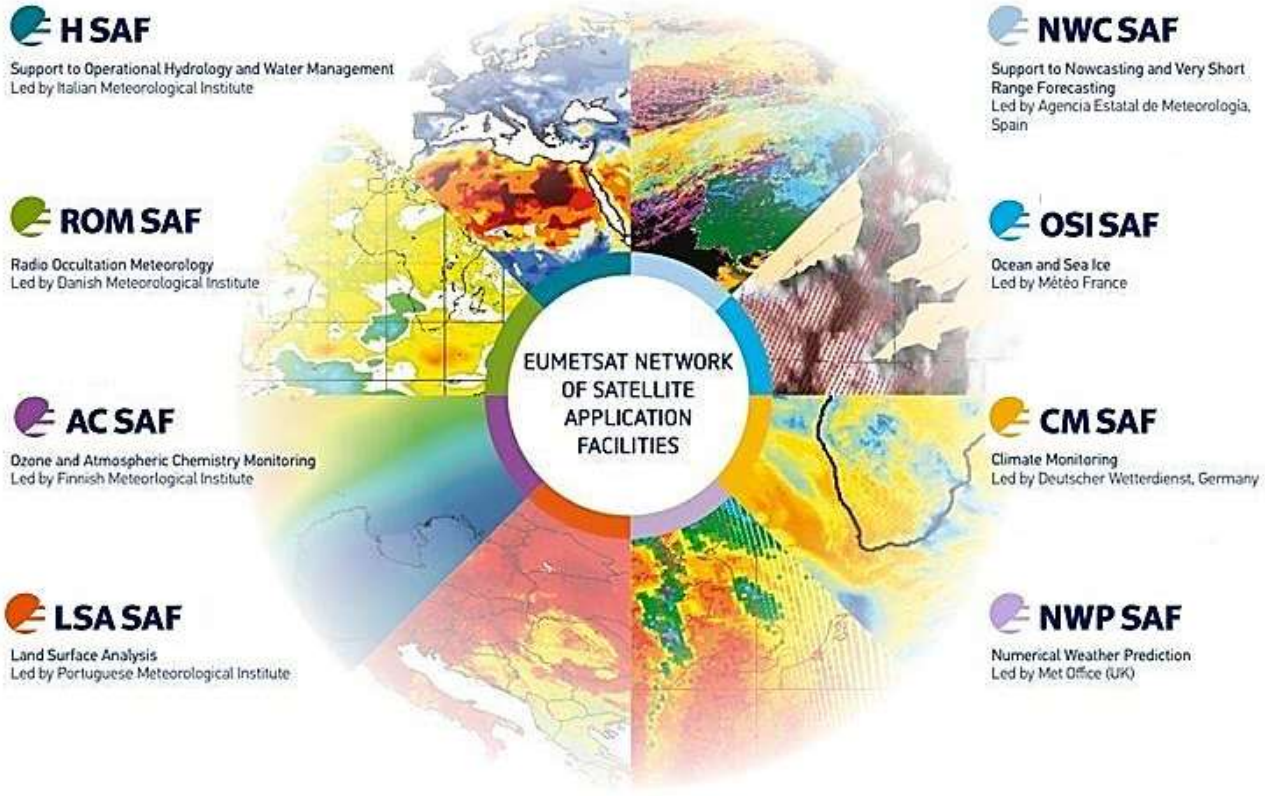
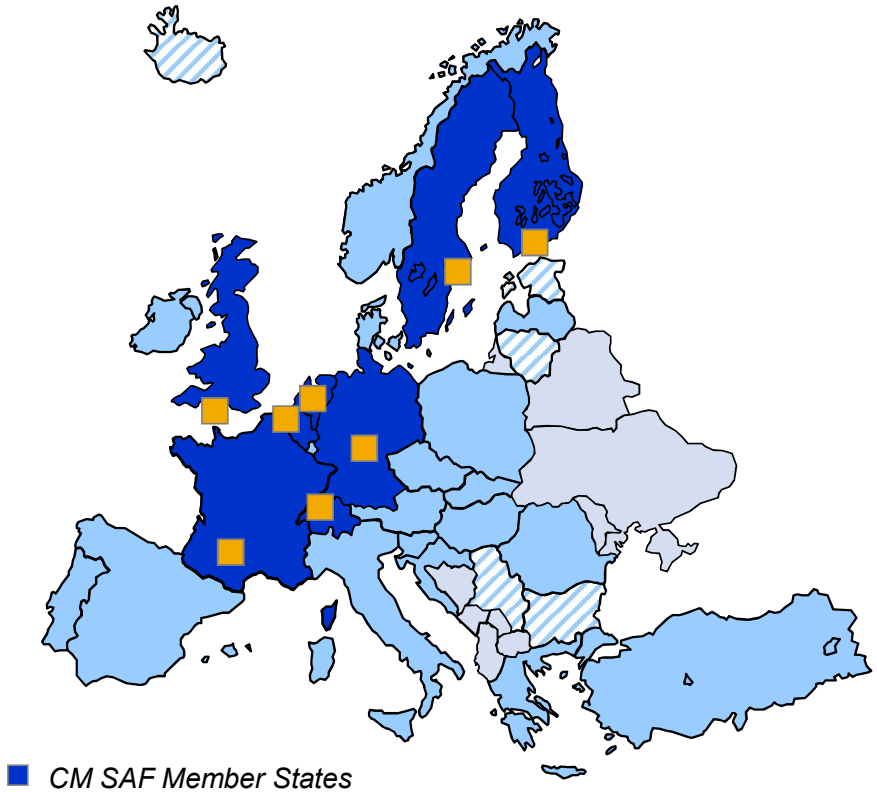


The EUMETSAT SAF Network



CM SAF Partners



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 Verkeer en Waterstaat

Royal Meteorological Institute of Belgium

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra
Federal Office of Meteorology and Climatology
MeteoSwiss

Finnish Meteorological Institute

Met Office, United Kingdom

Centre National de la recherche scientifique

Satellite Application Facility on Climate Monitoring

EUMETSAT CM SAF CLIMATE MONITORING

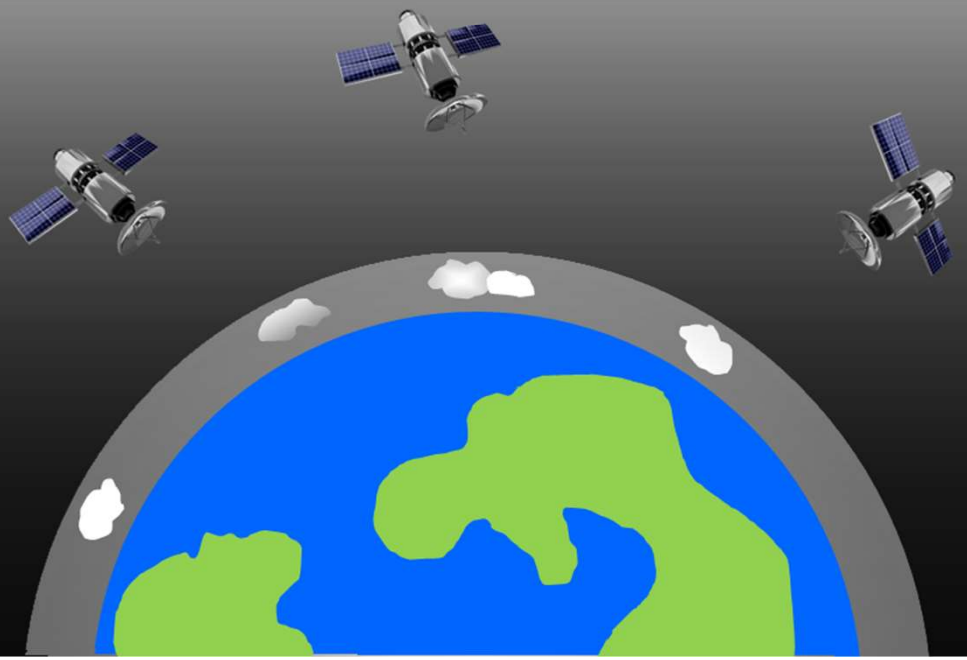
What we do → **Satellite-derived Products of Energy & Water Cycle** → **Why we do it**

Develop

Generate

Archive

Distribute



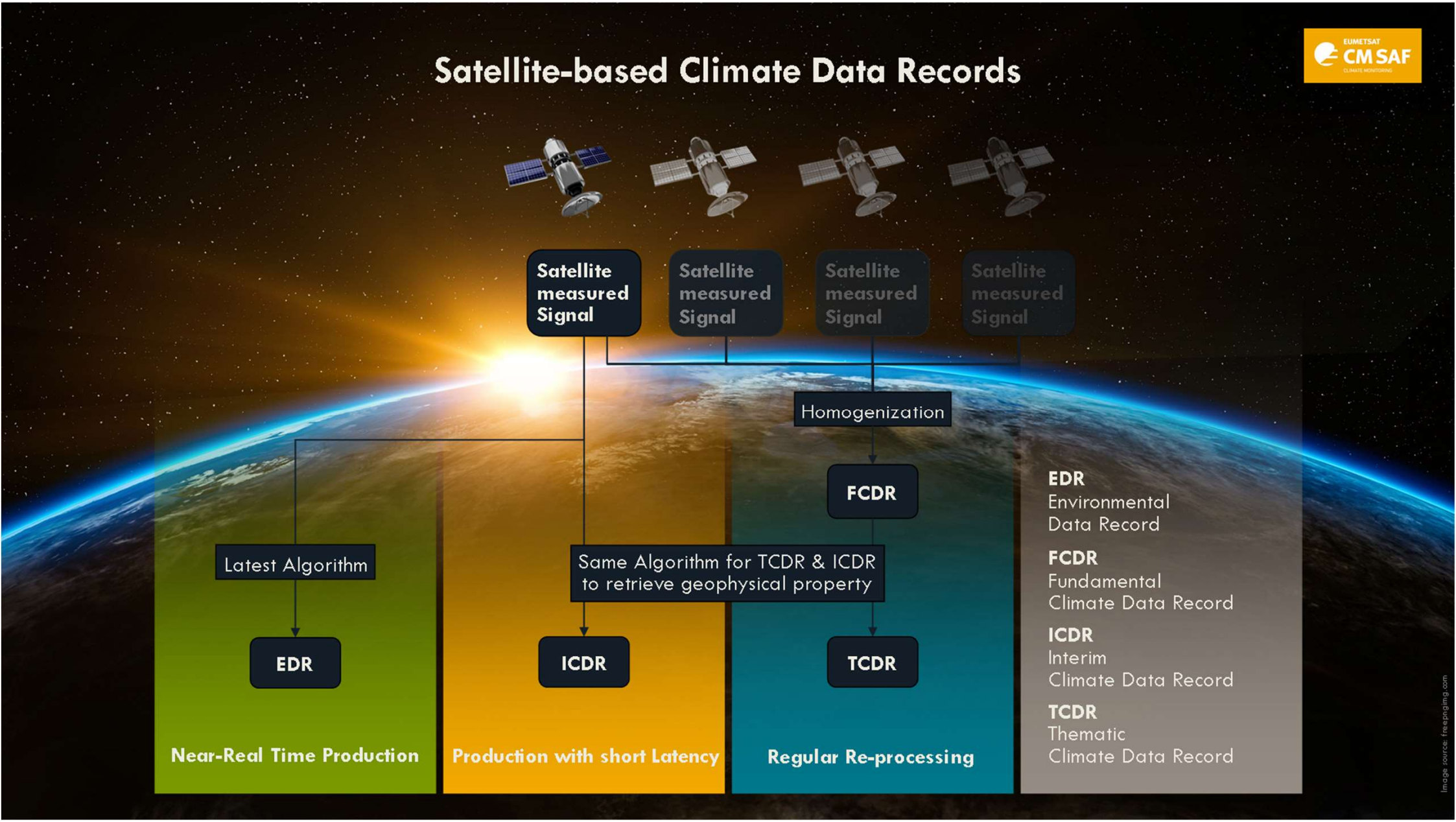
Monitor

Understand

Adapt

Climate Variability
&
Climate Change

Image source: freepngimg.com

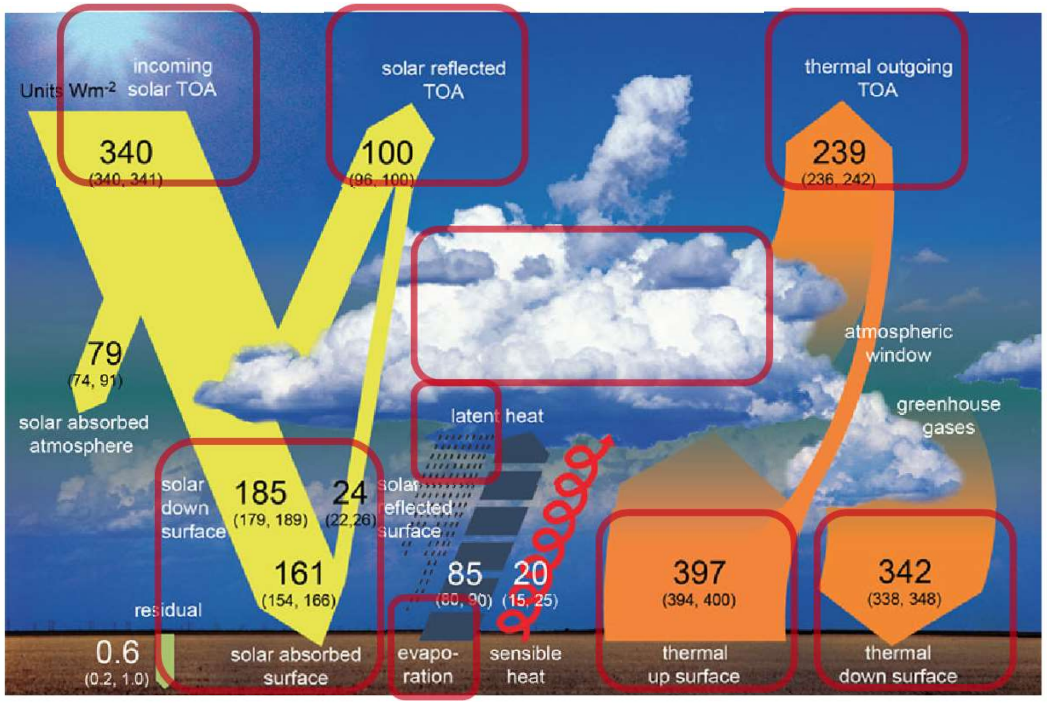

Satellite-based Climate Data Records
EUMETSAT
CM SAF
CLIMATE MONITORING
Satellite measured Signal
Satellite measured Signal
Satellite measured Signal
Satellite measured Signal
Homogenization
FCDR
Latest Algorithm
Same Algorithm for TCDR & ICDR to retrieve geophysical property
EDR
ICDR
TCDR
Near-Real Time Production
Production with short Latency
Regular Re-processing
EDR
Environmental Data Record
FCDR
Fundamental Climate Data Record
ICDR
Interim Climate Data Record
TCDR
Thematic Climate Data Record
Image source: freepngimg.com

CM SAF Climate Data Records

- **Fundamental Climate Data Records (FCDR)** are Re-calibrated and inter- calibrated long-term data records of satellite radiance information. The need for recalibration results from the changes in the sensitivity of a satellite sensor during its operational orbit time. The need for inter-calibration results from technological advancements made in satellites and remote sensing sensitivity**.**
- **Thematic Climate Data Records (TCDR)** are geophysical variables derived from the FCDRs. An algorithm is applied to the FCDR to estimate the geophysical variable from the satellite observation. The production of a TCDR requires a lot of time and computational resources, and it is usually updated every few years.
- **Interim Climate Data Records (ICDR)** are regularly updated TCDRs available in short-time latency with an algorithm and processing system as consistent as possible to the generation of the corresponding TCDR.

CM SAF Portfolio

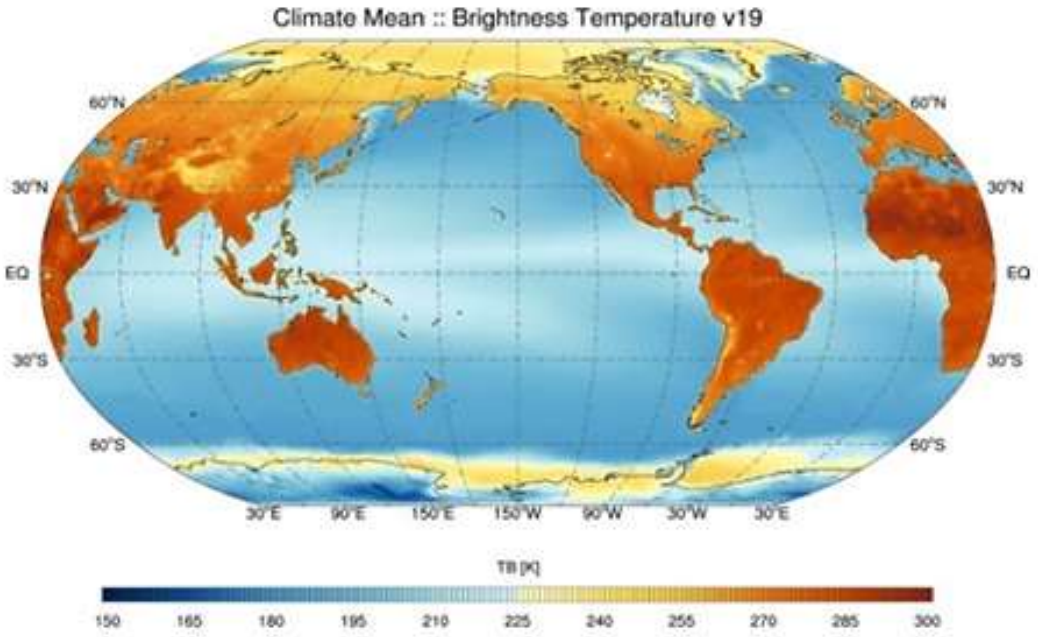
➔ Parameters describing the Global Energy and Water Cycle



Source:
Wild et al., 2013, Clim Dyn

FCDR SSMIS, SSM/I and SMMR

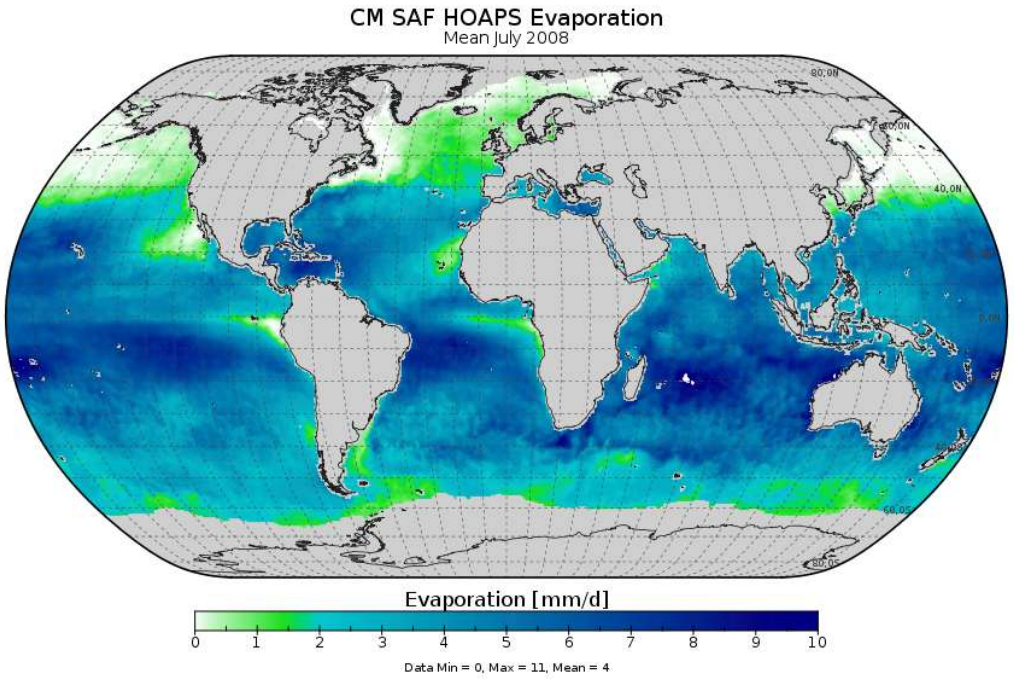
- **Variables**
  - Brightness temperature
- **Resolution**
  - Spatial: native SSM/I
  - Temporal: native SSM/I
- **Coverage**
  - Spatial: global
  - Temporal: 1978 to 2013
- **Satellites**
  - DMSP SSM/I and SSMIS
  - Nimbus-7 SMMR



DOI:10.5676/EUM_SAF_CM/FCDR_MWI/V003

TCDR HOAPS

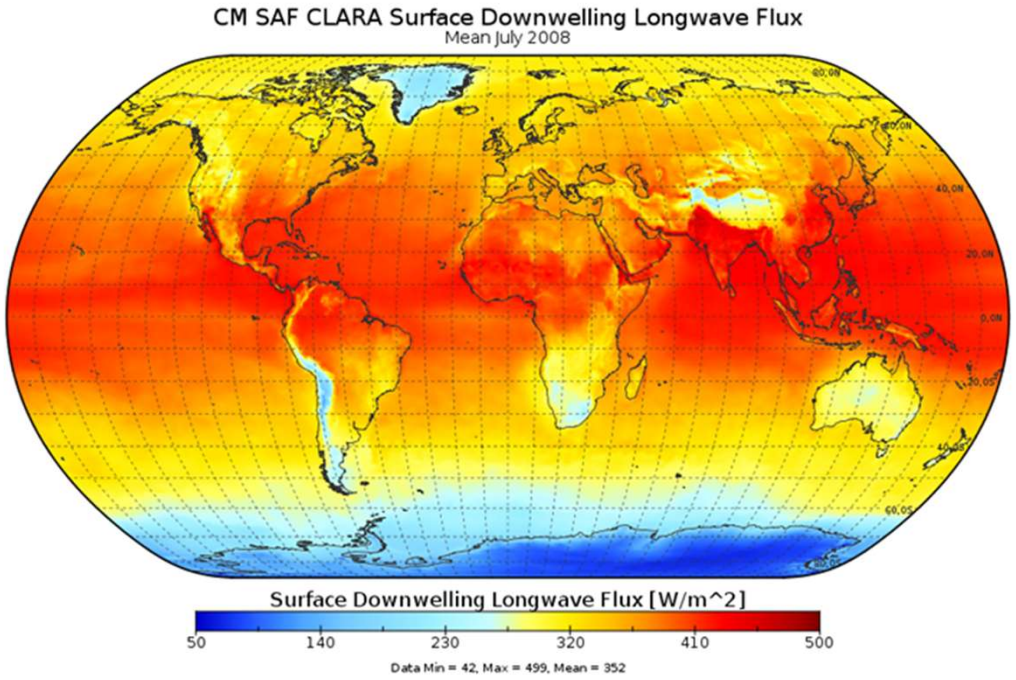
- **Variables**
  - Total column water vapour
  - Wind, humidity (close to surface)
  - Precipitation, evaporation
  - Latent heat flux, fresh water flux
- **Resolution**
  - Spatial: 0.5° × 0.5°
  - Temporal: 6-hourly composites, monthly means
- **Coverage**
  - Spatial: global ice-free ocean
  - Temporal: 1987 to 2014
- **Satellites**
  - DMSP SSM/I and SSMIS, Nimbus-7 SMMR from CM SAF FCDR



DOI:10.5676/EUM_SAF_CM/HOAPS/V002

TCDR CLARA-A2

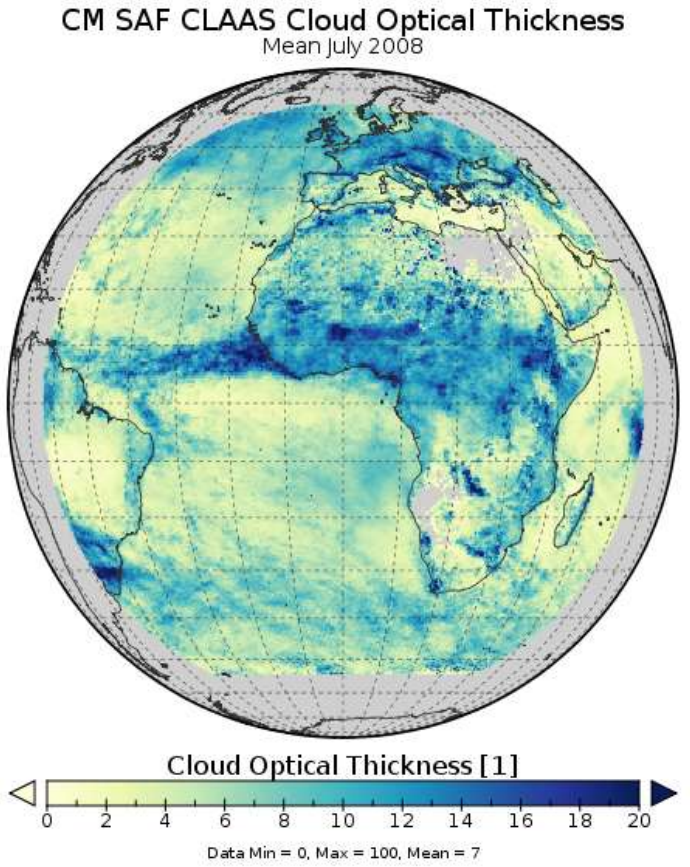
- **Variables**
  - Cloud properties
  - Surface albedo
  - Radiation
- **Resolution**
  - Spatial: 0.25°×0.25°
  - Temporal: daily-, pentad-, monthly mean
- **Coverage**
  - Spatial: global
  - Temporal: 1982 to 2015
- **Satellites**
  - NOAA, Metop (AVHRR)



DOI:10.5676/EUM_SAF_CM/CLARA_AVHRR/V002

TCDR CLAAS-2

- **Variables**
  - Cloud properties
  - Liquid and ice water path
- **Resolution**
  - Spatial: native, 0.05°×0.05° (0.25°×0.25°)
  - Temporal: 15 min, hourly-, daily-, monthly means, mean monthly diurnal cycle
- **Coverage**
  - Spatial: Meteosat disk
  - Temporal: 2004 to 2015
- **Satellites**
  - Meteosat Second Generation (SEVIRI)

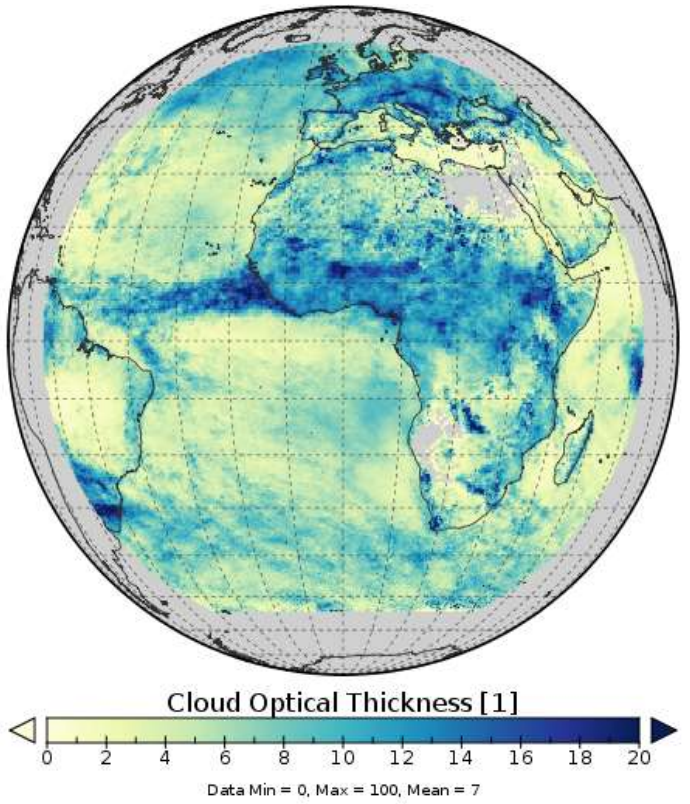


DOI:10.5676/EUM_SAF_CM/CLAAS/V002

ICDR SEVIRI Clouds

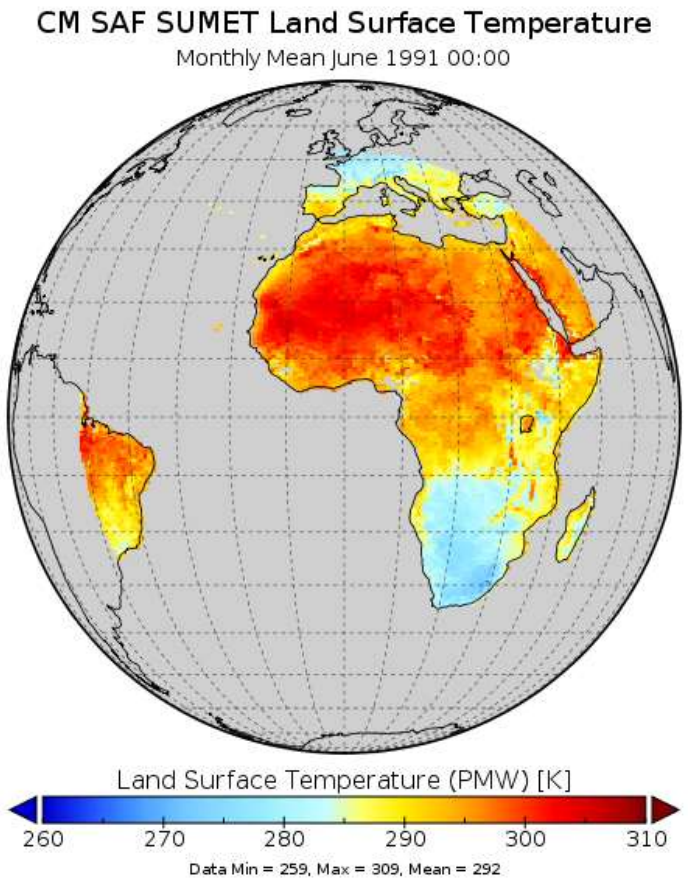
based on CLAAS-2 methods

- **Variables**
  - Cloud fraction
  - Cloud top parameters
- **Resolution**
  - Spatial: native, 0.05°×0.05° (0.25°×0.25°)
  - Temporal: daily-, monthly means
- **Coverage**
  - Spatial: Meteosat disk
  - Temporal: since January 2018
- **Satellites**
  - Meteosat Second Generation (SEVIRI)



TCDR SUMET

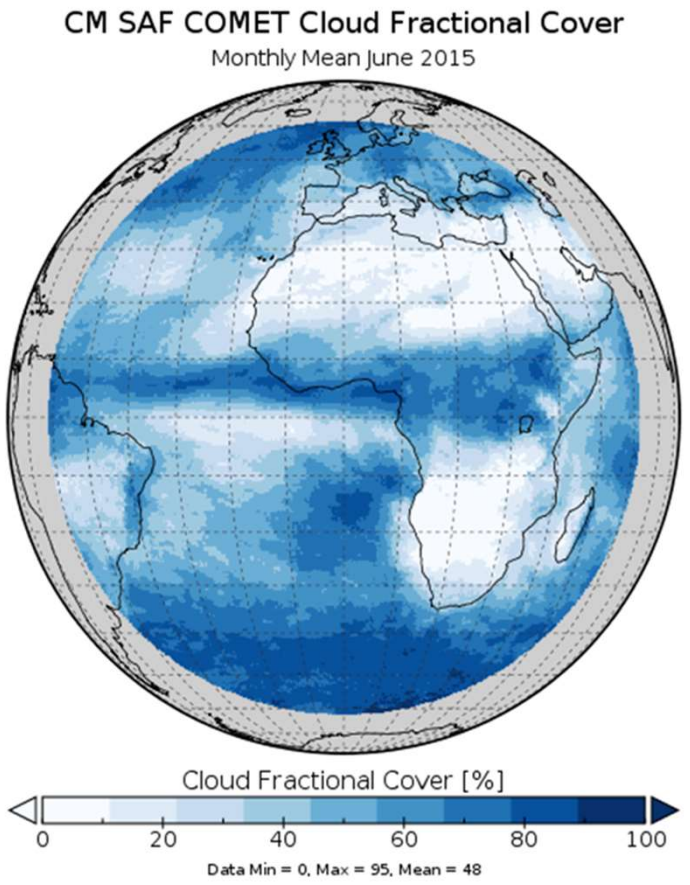
- **Variables**
  - Land surface temperature basing on physical model (LTP)
  - Land surface temperature basing on statistical model (LTS)
- **Resolution**
  - Spatial: 0.05° × 0.05°
  - Temporal: hourly instantaneous, monthly mean diurnal cycle
- **Coverage**
  - Spatial: Meteosat disk
  - Temporal: 1991 to 2015
- **Satellites**
  - Meteosat (MVIRI / SEVIRI)



DOI:10.5676/EUM_SAF_CM/LST_METEOSAT/V001

TCDR COMET

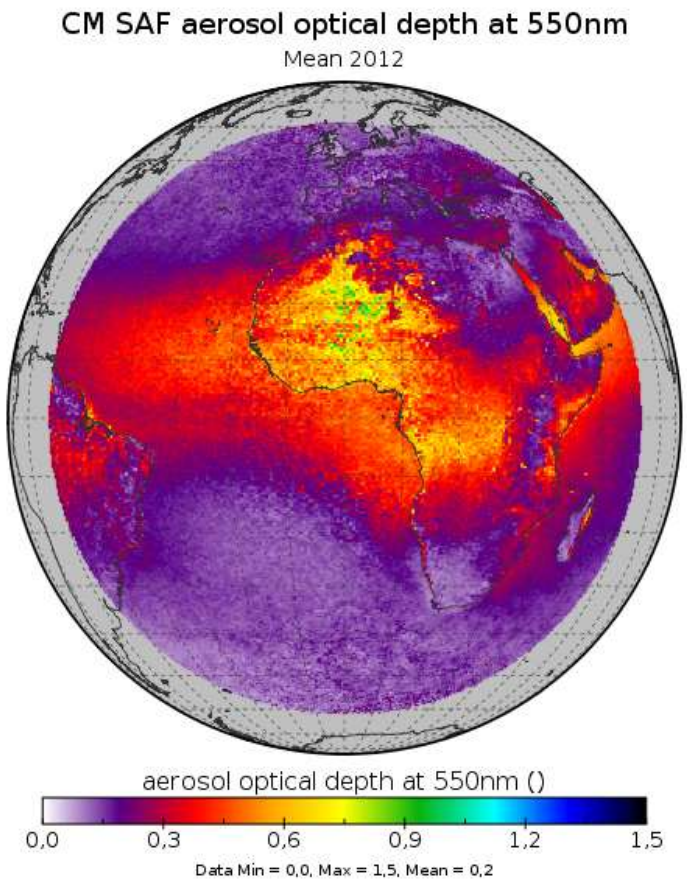
- **Variables**
  - Fractional cloud cover (CFC)
- **Resolution**
  - Spatial: 0.05° × 0.05°
  - Temporal: hourly instantaneous, daily and monthly means, monthly mean diurnal cycle
- **Coverage**
  - Spatial: Meteosat disk
  - Temporal: 1991 to 2015
- **Satellites**
  - Meteosat (MVIRI / SEVIRI)



DOI:10.5676/EUM_SAF_CM/CFC_METEOSAT/V001

TCDR AOD

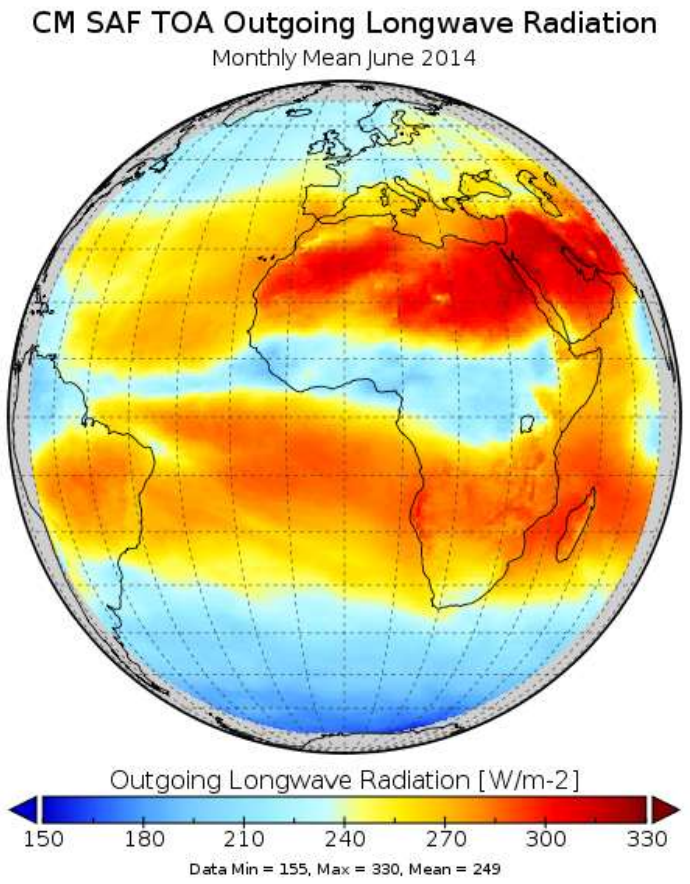
- **Variables**
  - Aerosol Optical Depth (AOD)
- **Resolution**
  - Spatial: native
  - Temporal: daily and monthly means
- **Coverage**
  - Spatial: Meteosat disk
  - Temporal: 02/2004 to 12/2012
- **Satellites**
  - Meteosat Second Generation (SEVIRI)



DOI:10.5676/EUM_SAF_CM/MSG_AOD/V001

TCDR TOA Radiation

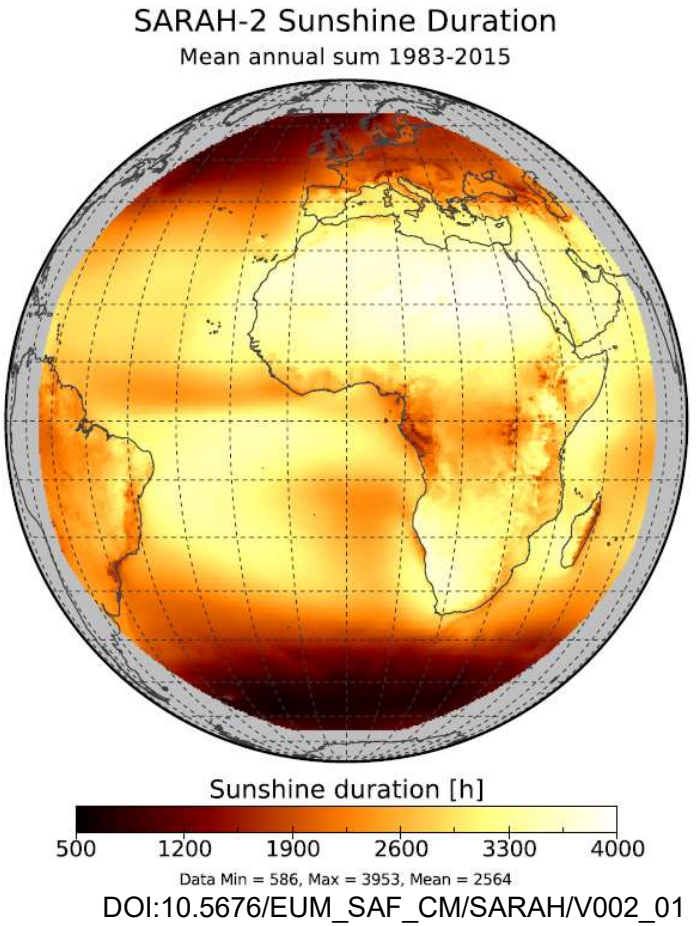
- **Variables**
  - TOA reflected solar (TRS)
  - TOA emitted thermal (TET)
- **Resolution**
  - Spatial: 0.05° × 0.05°
  - Temporal: daily and monthly means, monthly means of hourly means
- **Coverage**
  - Spatial: Meteosat disk
  - Temporal: 2004 to 2015
- **Satellites**
  - Meteosat Second Generation (GERB / SEVIRI)



DOI:10.5676/EUM_SAF_CM/CFC_METEOSAT/V001

TCDR SARAH-2.1

- **Variables**
  - Surface Incoming Shortwave Radiation (SIS)
  - Surface Incoming Direct Radiation (SID)
  - Direct Normalized Irradiance (DNI)
  - Effective Cloud Albedo (CAL)
  - Spectral resolved irradiance (SRI)
  - Sunshine duration (SDU)
- **Resolution**
  - Spatial: 0.05° × 0.05°
  - Temporal: 30 min, daily-, monthly means
- **Coverage**
  - Spatial: Meteosat disk
  - Temporal: 1983 to 2017
- **Satellites**
  - Meteosat 2 to 10 (MVIRI / SEVIRI)

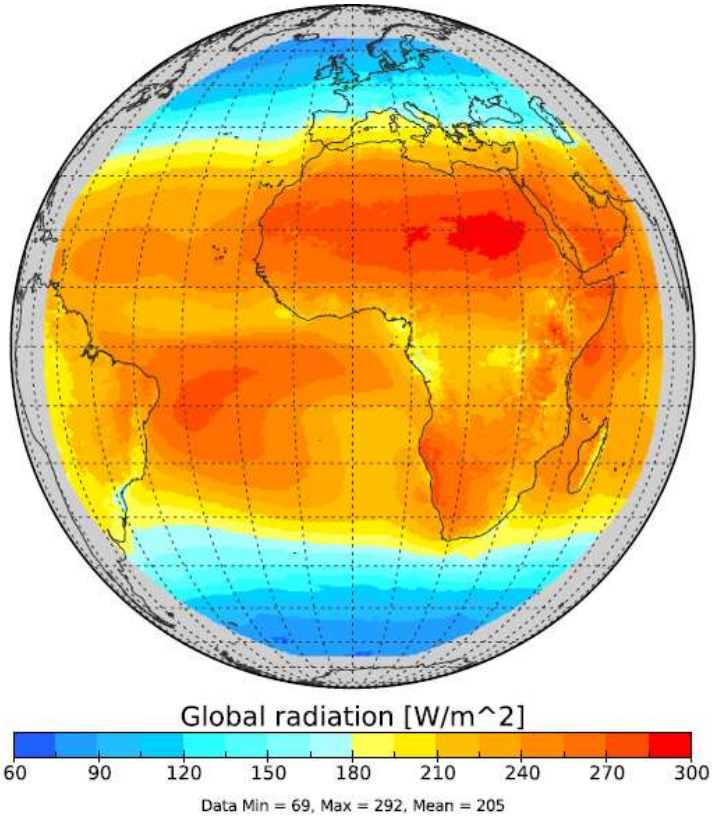


DOI:10.5676/EUM_SAF_CM/SARAH/V002_01

ICDR SEVIRI Radiation

based on SARAH-2 methods

- **Variables**
  - Surface Incoming Shortwave Radiation (SIS)
  - Surface Incoming Direct Radiation (SID)
  - Direct Normalized Irradiance (DNI)
  - Sunshine Duration (SDU)
- **Resolution**
  - Spatial: 0.05° × 0.05°
  - Temporal: 30 min, daily-, monthly means
- **Coverage**
  - Spatial: Meteosat disk
  - Temporal: since January 2018
- **Satellites**
  - Meteosat (SEVIRI)



Available CM SAF CDRs

Sensor, Satellite resp.	Parameter	CDR Period	Coverage
Fundamental **C**limate **D**ata **R**ecord (FCDR)			
SMMR, SSM/I, SSMIS	**Microwave Radiances**	1978 – 2015	global
Climate **D**ata **R**ecord (CDR)			
SEVIRI	**Cloud parameters (frac., height, opt. dep., phase, eff. rad., LWP, IWP), AOD**	2004 – 2015	Regional
GERB/SEVIRI	**Top of atmosphere radiative fluxes**	2004 – 2015	
MVIRI/SEVIRI	**TOA, surface radiation & Cloud frac.** **Land Surface Temperature** **Free tropospheric humidity**	1983 – 2015 1991 – 2015 1983 – 2009	
AVHRR GAC	**Cloud parameters, surface radiation parameters, incl. albedo**	1982 – 2015	Global
SSM/I, SSMIS, SMMR	**HOAPS 4 (precip, evap, hum., wind, ...)** **(ice-free ocean)**	1987 – 2014	
ATOVS	**Water vapour and temperature profiles**	1999 – 2012	
MSU, AMSU, SSM/T2, MHS	**Upper troposphere humidity**	1992 – 2015	

Committed CM SAF CDRs until 2022

Sensor, Satellite resp.	Parameter	CDR Period	Coverage
Fundamental **C**limate **D**ata **R**ecord (FCDR)			
SMMR, SSM/I, SSMIS	**Microwave Radiances**	1978 – 2020	global
Climate **D**ata **R**ecord (CDR)			
SEVIRI	**Cloud parameters (frac., height, opt. dep., phase, eff. Rad., LWP, IWP)**	2004 – 2020	Regional
MVIRI/SEVIRI	**TOA, surface radiation & Cloud frac. land surface temp, evapo. Free tropospheric humidity**	1983 – 2020	
Microwave imagers+sounders, georing	**Global precipitation**	2002 – 2019	
AVHRR GAC	**Cloud parameters, surface radiation parameters, incl. albedo**	1978 – 2020	Global
SSM/I, SSMIS, TMI, GMI, AMSR-2	**HOAPS 5 (precip, evap, hum., wind, ..) Ice-free ocean**	1987 – 2020	
HIRS	**Cirrus cloud fraction, cloud top pressure**	1980 – 2016	
MSU, AMSU, SSM/T2, MHS	**Upper troposphere humidity**	1993 – 2020	

Quality assurance

- Rigorous review cycle is applied before publishing CDRs
- DOI is assigned
- CDR comes with comprehensive documentation and publications
- CDR with uncertainty estimates
- Participation in international assessments and retrieval evaluations

Participation in international assessments

- GEWEX Water Vapor Assessment (G-VAP)

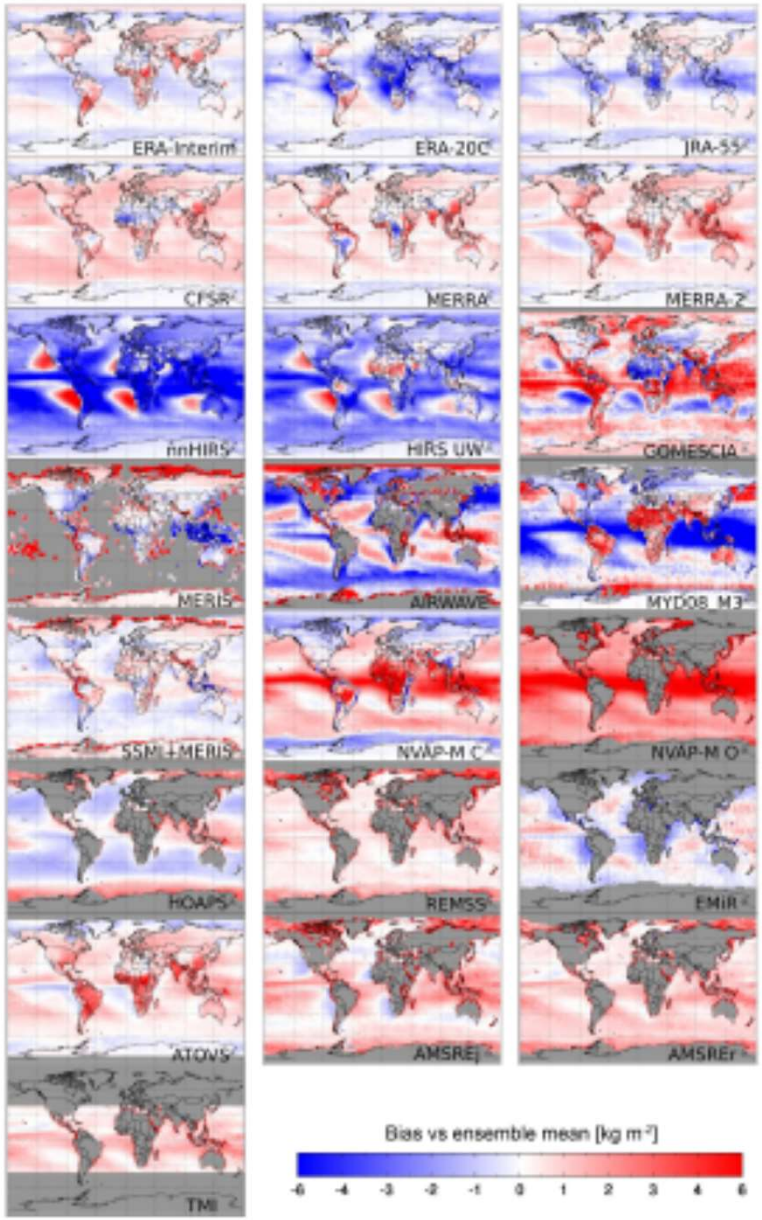
  Information, also data, at:
  http://gewex-vap.org/

- International Precipitation Working Group (IPWG)

  Information, also on data, at:
  http://www.isac.cnr.it/~ipwg/

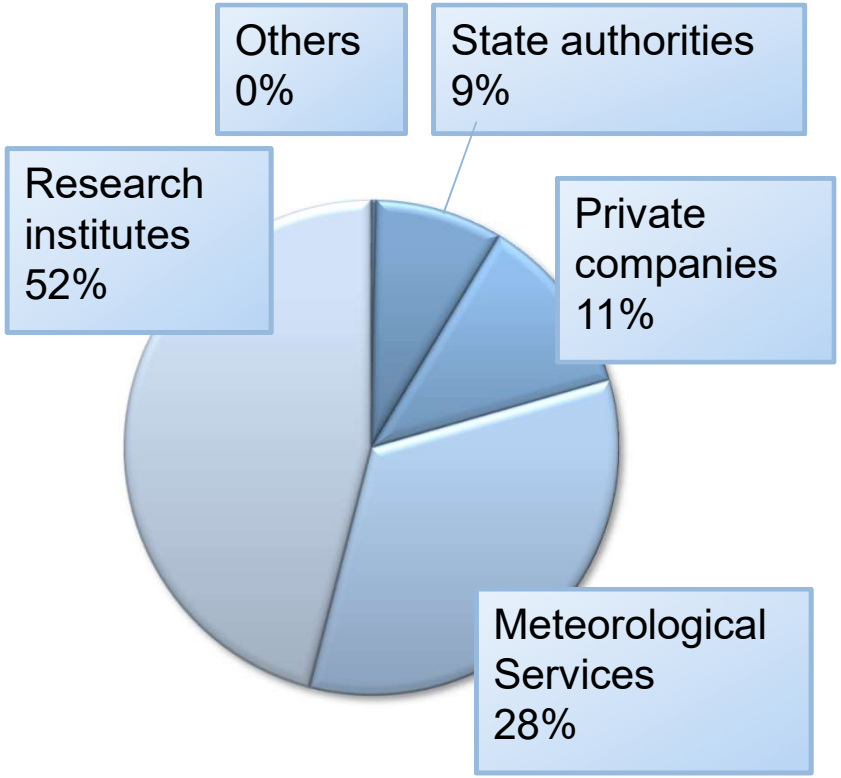
- International Clouds Working Group (ICWG)

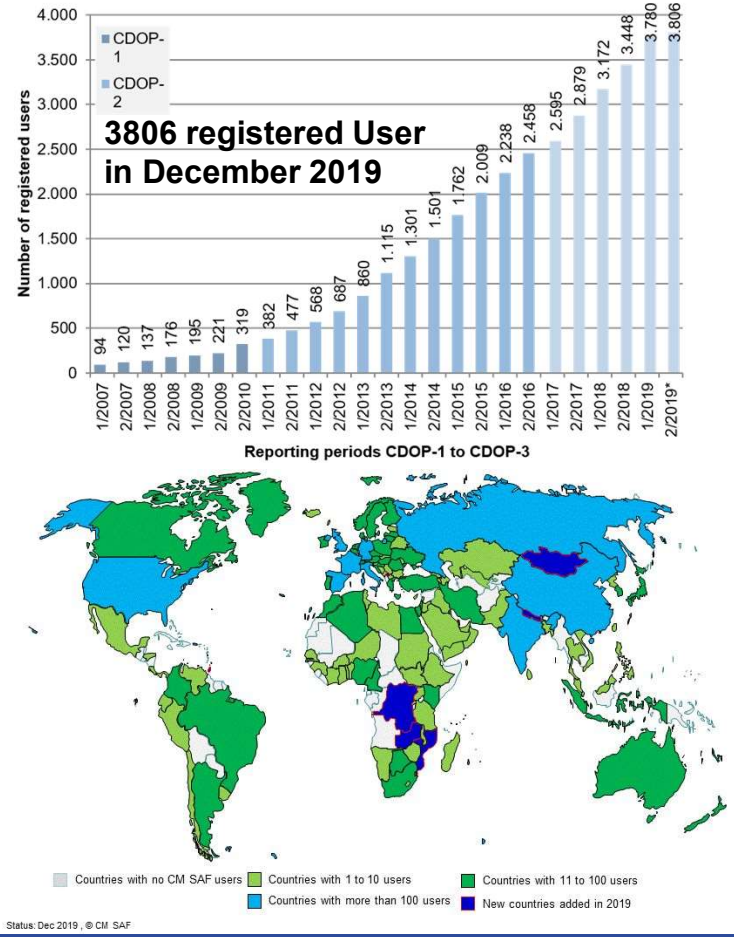
  More information at:
  http://www.icare.univ-lille1.fr/crew/index.php/Welcome



TCWV, difference to ensemble mean of G-VAP data archive
Source: Schröder et al. (2018), ESSD

CM SAF Users


Others
0%
State authorities
9%
Research
institutes
52%
Private
companies
11%
Meteorological
Services
28%


CDOP-1
CDOP-2
3806 registered User
in December 2019
Number of registered users
4.000
3.500
3.000
2.500
2.000
1.500
1.000
500
0
94
120
137
176
195
221
319
382
477
568
687
860
1.115
1.301
1.501
1.762
2.009
2.238
2.458
2.595
2.879
3.172
3.448
3.780
3.806
1/2007
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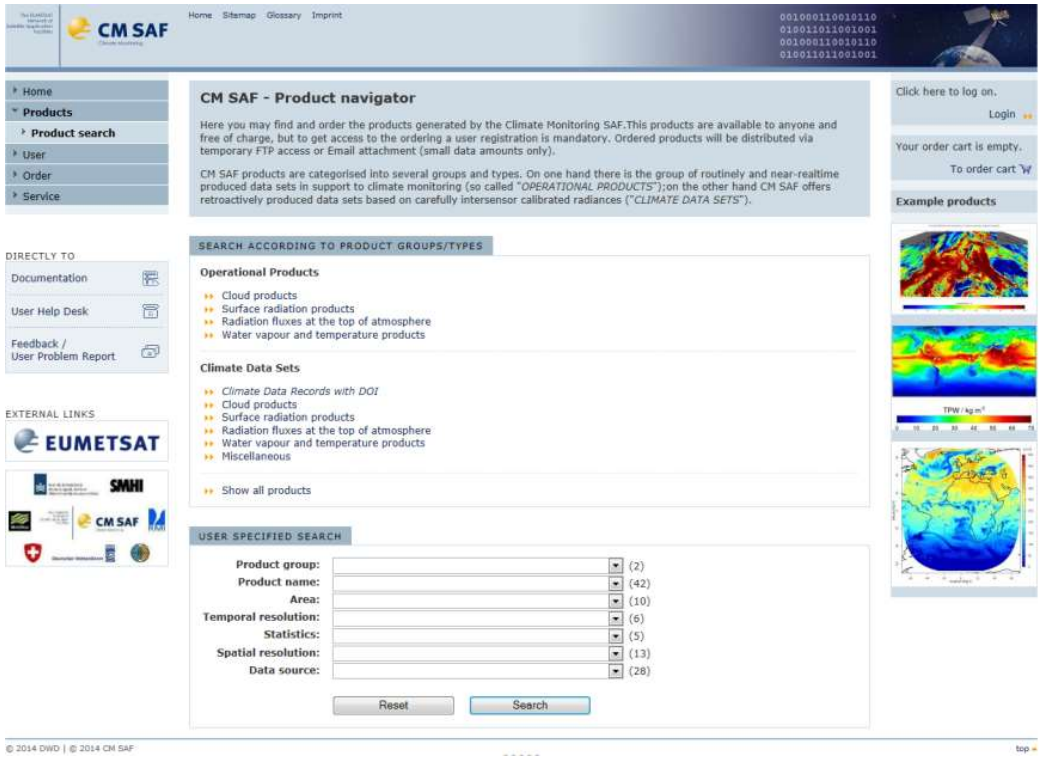
1/2019
2/2019*
Reporting periods CDOP-1 to CDOP-3
Countries with no CM SAF users
Countries with 1 to 10 users
Countries with 11 to 100 users
Countries with more than 100 users
New countries added in 2019
Status: Dec 2019 , © CM SAF

Data Access

- **Web User Interface**
  - Easy selection and online ordering
  - Possibility of regular data delivery
  - Postprocessing
    - Spatial, temporal selection
  - Data format (NetCDF)
  - Download via https or sftp
  - All data free of charge
- **User Help Desk**



https://wui.cmsaf.eu

Data Access

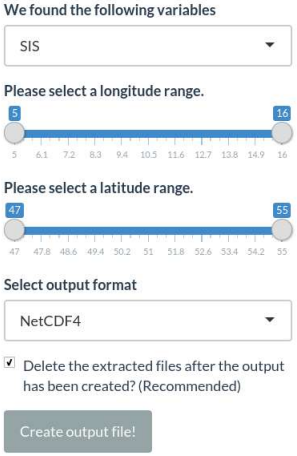
- **EUMETCast**
- The following CM SAF products are disseminated via EUMETCast:
  - Monthly mean fractional cloud cover
  - Daily and monthly mean surface incoming shortwave radiation
  - Daily and monthly sum sunshine duration
- Product format is NetCDF
- EUMETCast Africa:
  - Channel: E1B-SAF-4

https://eoportal.eumetsat.int

CM SAF R Toolbox

- CM SAF provides CM SAF R Toolbox for free
- No R or scripting experiences needed

the CM SAF R TOOLBOX



www.cmsaf.eu/R_toolbox

Training

- Training workshops in cooperation with EUMETSAT
- Practical exercises with CM SAF data
- To learn more about EUMETSAT training workshops see:

https://training.eumetsat.int

Summary

- Products and services in connection with global energy and water cycle
- Thoroughly quality assurance and control mechanisms
- Extensive exchange and support with / of users
- Free and uncomplicated data access
- Peer-reviewed publications using CM SAF data are available here:
  - https://www.cmsaf.eu/SiteGlobals/Forms/Suche/EN/JournalSearch_Form.html?nn=1885934

Contact data:

www.cmsaf.eu

Contact.cmsaf@dwd.de