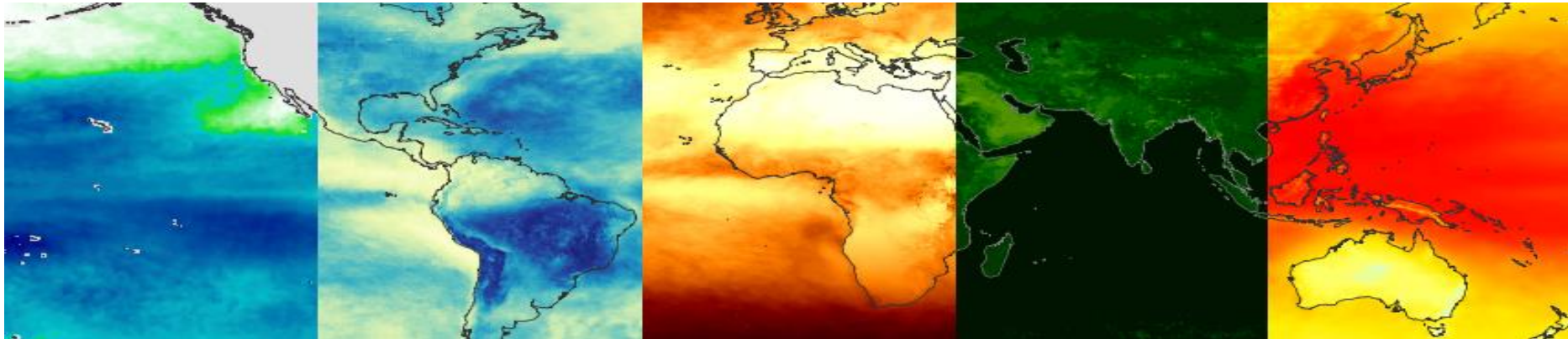


# CM SAF: Products and Services for Climate monitoring

R. Hollmann and the CM SAF team



# Overview

- **Introduction**
- **CM SAF Products**
- **A few application examples**
- **CM SAF Services**
- **Summary and conclusions**



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# CM SAF's role and mandate

Global Stakeholder in **Climate Monitoring**

UNFCCC, IPCC, GFCS, GCOS, IPCC, CGMS, CEOS, WMO, GEO, ...



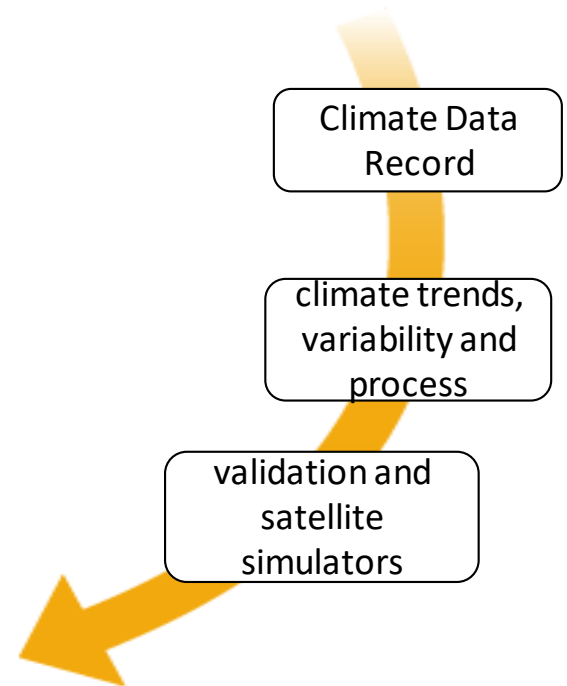
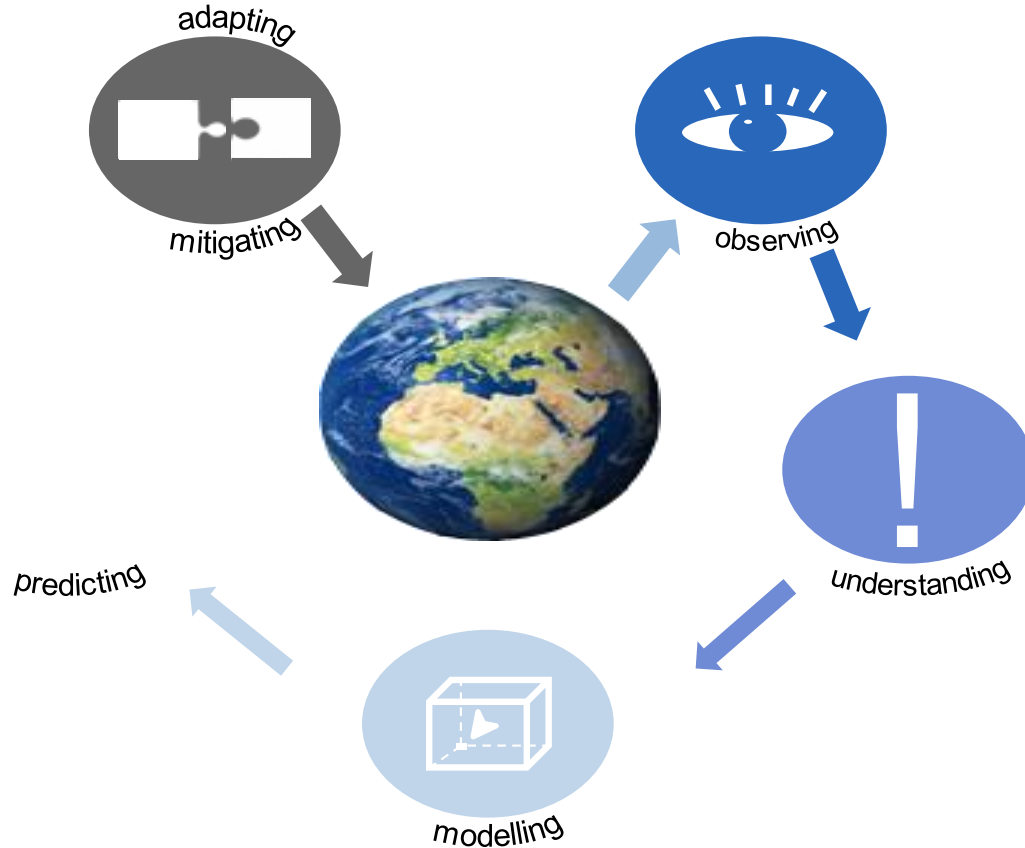
**EUMETSAT's  
Strategy 2025:**

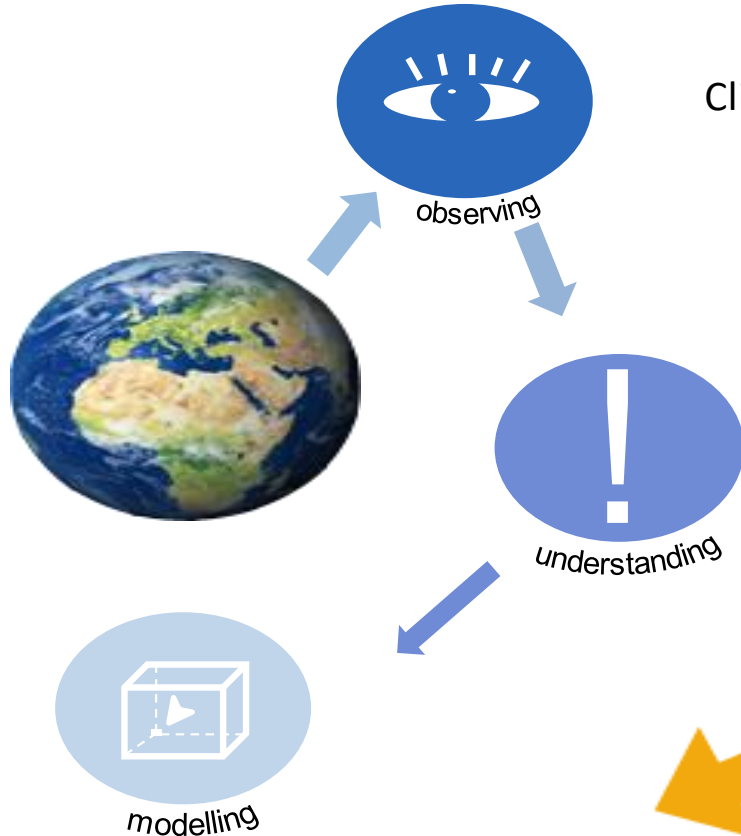
*support to climate services will be embedded [...] at its premises and across its network of SAFs, with the Climate Monitoring SAF (CM SAF) playing a leading role*

**FACTS** 

Images:

<https://pixabay.com/>





## Climate Monitoring based on Satellites

Climate Data Record

climate trends, variability and process

validation and satellite simulators

### We provide

- Essential Climate Variables
  - Thematic Climate Data Records
  - Interim Climate Data Records
- Fundamental Climate Data Records

### We provide

- Training & capacity building
- toolbox
- Application examples

### We support

- Process analysis
- Statistical analysis
- Climate assessments

### We provide

- Validation data (Obs4MIPs compatible)
- Satellite simulators

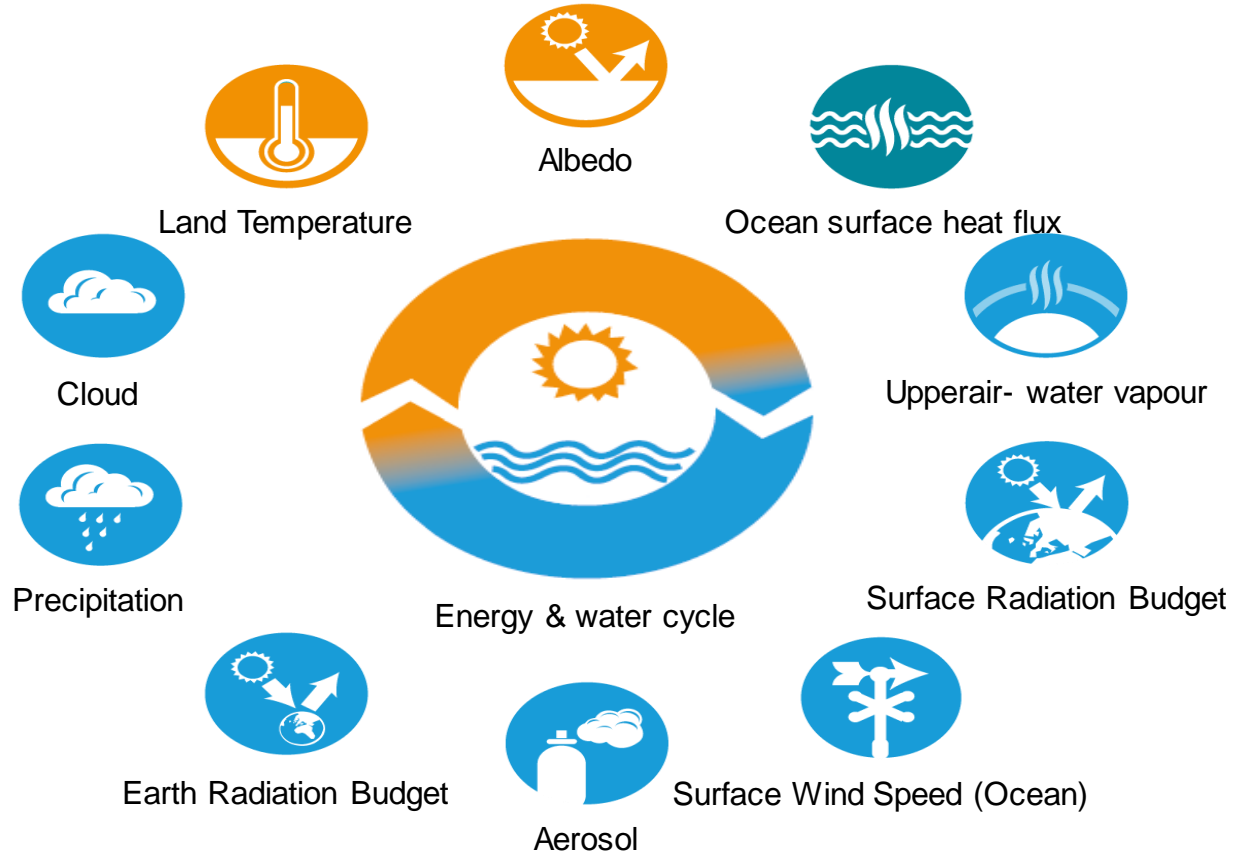
# Overview

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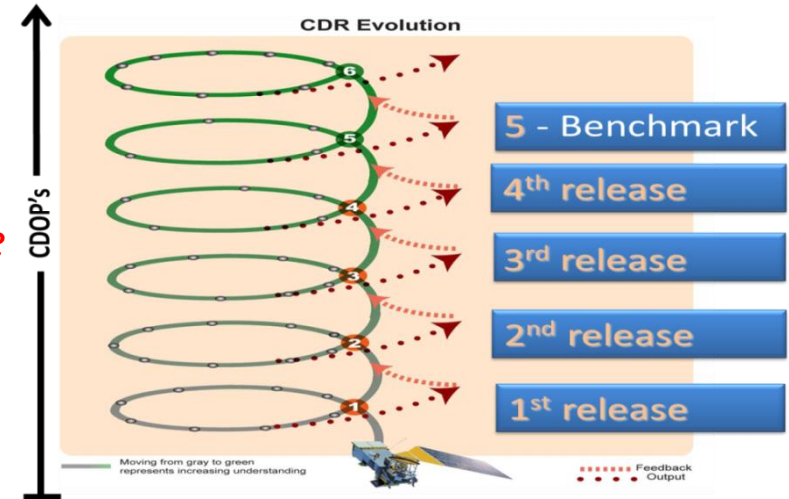


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- Global Clouds and Radiation (CLARA-A3), *extended in time, new: ERB*
- Regional Clouds (CLAAS-3), *extended in time*
- Global Ocean Fluxes (HOAPS), *extended in time*
- Global UTH, *extended in time*
- **FCDR** Microwave Imager, *extended in time*
- Regional Radiation (SARAH-3), *extended in time*
- Regional Land Surface Temperature, *extended in time*
- Regional Land Fluxes (e.g. budget, LST), *new*
- Global High Clouds from HIRS, *new*
- Global Precipitation, *new*



See Poster outside &  
 ask questions for details!



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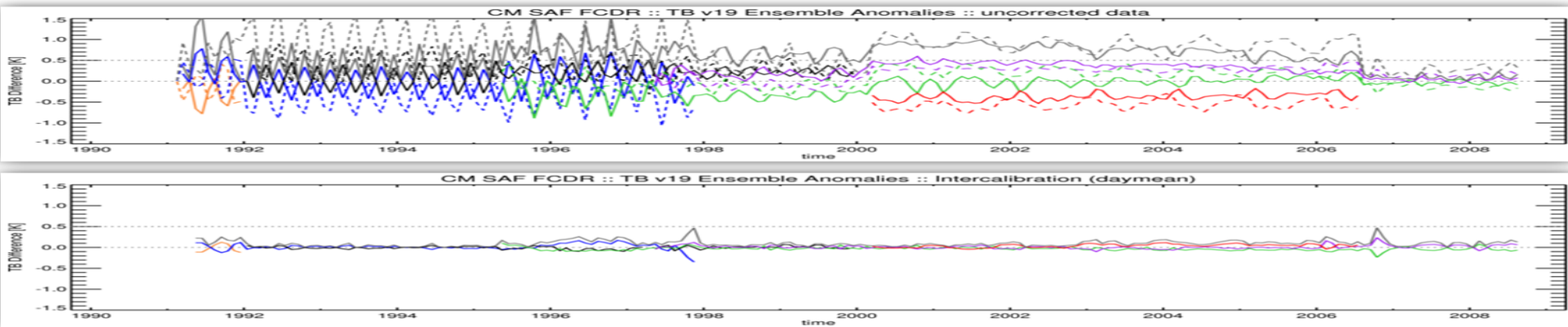
# Targeted Application areas CM SAF CDRs and ICDRs

- FCDR as input for Reanalyses, TCDR's
  
- Climate Science
  
- Evaluation of (Climate) Models
  
- Climate Services / NMHSs operational climate monitoring
  - TCDR + ICDR as important component is needed

## Publications CLARA-A1 (49) and A2 (23) vs application areas

- Arctic and Antarctic surface albedo and flux studies (15)
- Global (and regional) climate model evaluation (13)
- Global and regional climate monitoring (12)
- Evaluation of surface radiation climatologies and networks (12)
- Climate trend studies including inter-comparison of satellite data with other observations (6)
- Studies of physical processes (e.g., fluxes and evapotranspiration) (6)
- New validation methods and development of algorithms (6)
- Boreal snow studies (3)
- Biological studies (1)

**Fundamental Climate Data Record (FCDR, SMMR+SSM/I+SSMIS FCDR from CM SAF, latest version: 10.5676/EUM\_SAF\_CM/FCDR\_MWI/V003)**



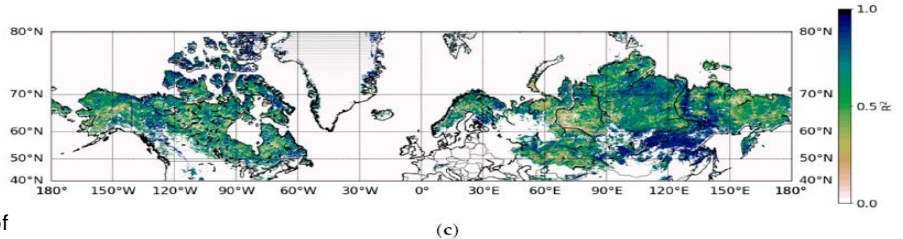
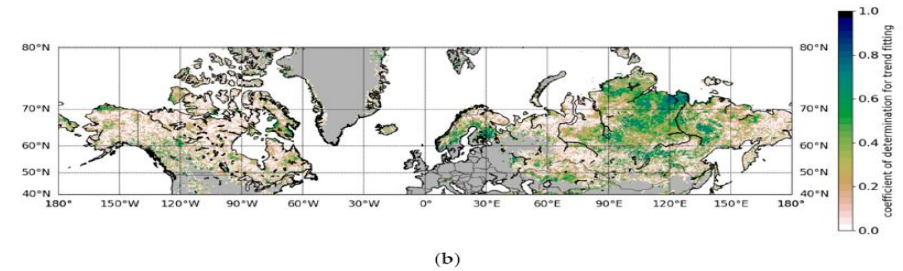
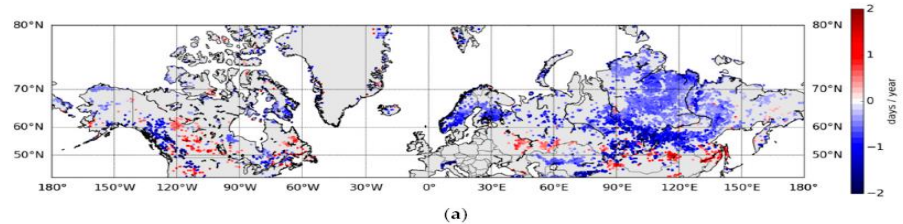
**Key input to HOAPS product suite, in-house expertise and processing of Level 1 data and ECVs key advantages for the quality of the products.**

Various users, among them **ECMWF/C3S (ERA5)**, **OSI SAF** and **ESA CCI\_Sea\_Ice**

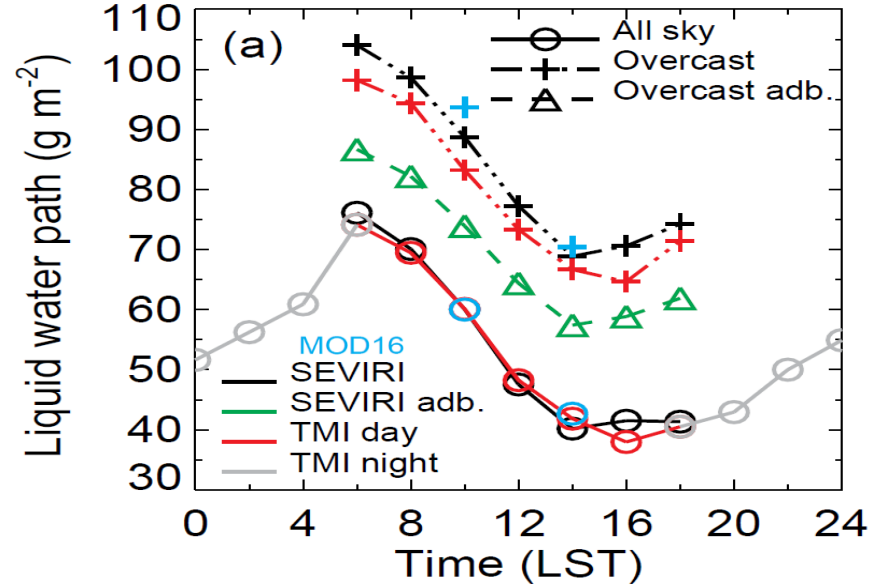
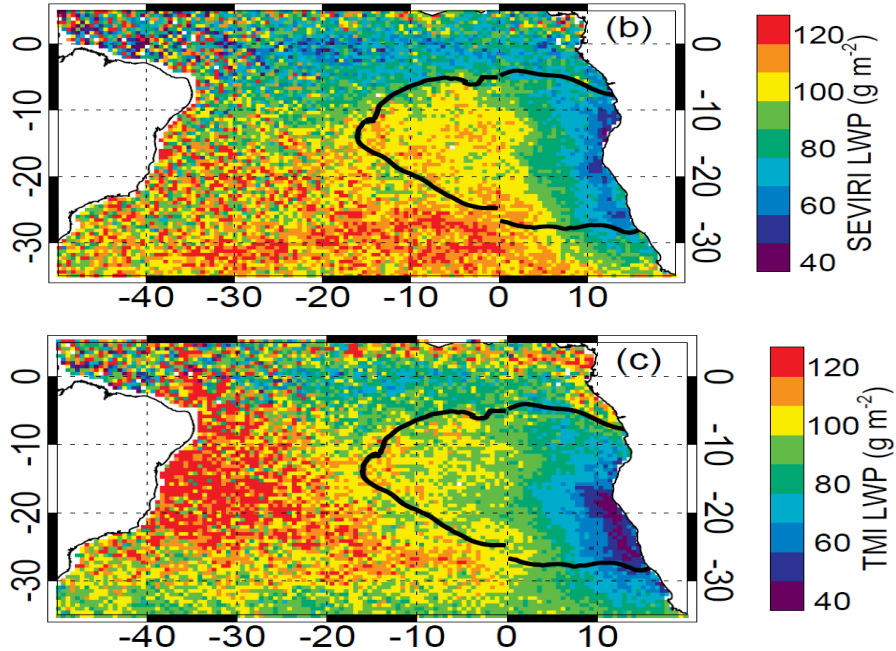
Anttila et al. (2018) examined seasonal snow melt timing and the pre-melt albedo from CLARA-A2 Surface Albedo, finding

- trends towards earlier melt onset
- longer melting seasons
- pre-melt albedo decreases induced by vegetation growth

Anttila, K., Manninen, T., Jääskeläinen, E., Riihelä, A., & Lahtinen, P. (2018). The Role of Climate and Land Use in the Changes in Surface Albedo Prior to Snow Melt and the Timing of Melt Season of Seasonal Snow in Northern Land Areas of 40°N–80°N during 1982–2015. *Remote Sensing*, 10(10), 1619.



## Diurnal cycle of South-Atlantic stratocumulus clouds



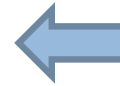
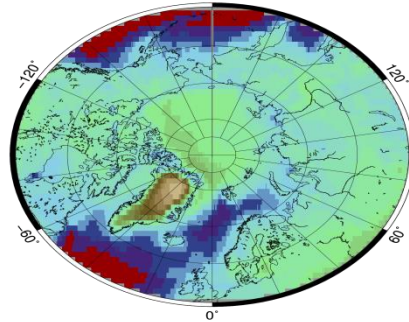
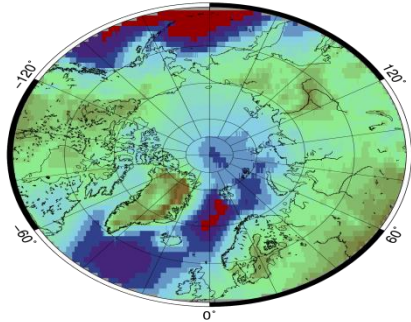
Seethala et al., ACP, 2018



Cloud Fraction JJA

CLARA-A2 (a)

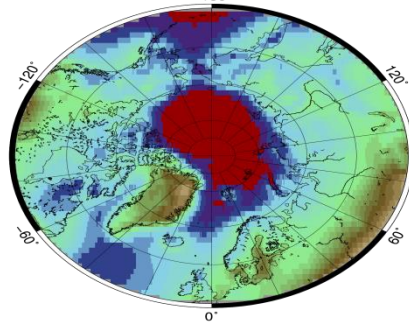
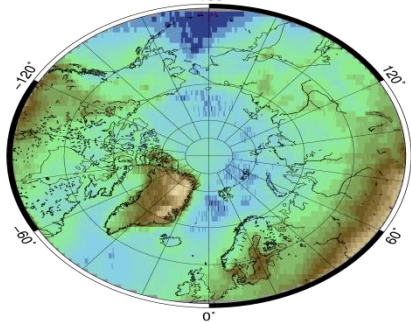
ISCCP (b)



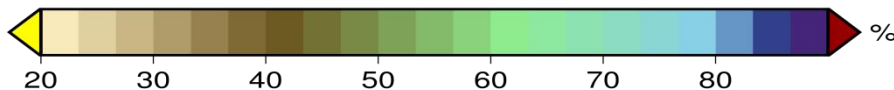
**Mean Arctic  
cloudiness 1982-  
2014 for CLARA-  
A2 and ISCCP-H**

EC Earth CLARA-A2 (c)

EC Earth ISCCP (d)



**Results after applying  
CLARA-A2 simulator (left)  
and ISCCP-simulator  
(right) to mean cloudiness  
from EC Earth**



Karlsson, Sedlar, 2019

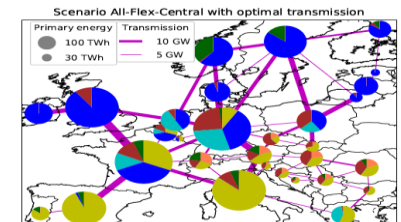
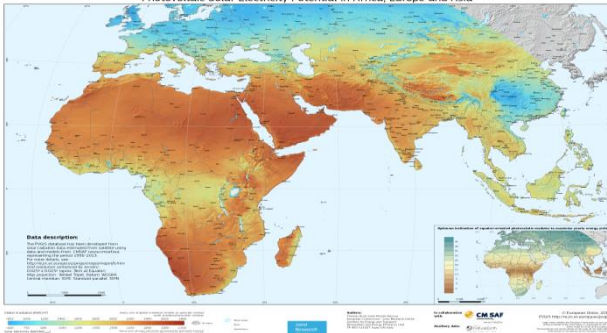
## CM SAF Solar Radiation data used in studies / services of solar energy resources, incl. EU

→ CM SAF data helps EU and national activities to guide renewable energy expansion

→ CM SAF data help scientists to develop the future European electricity grid with enhanced share of renewables



Photovoltaic Solar Electricity Potential in Africa, Europe and Asia



Schweizerische Eidgenossenschaft  
 Confédération suisse  
 Confederazione Svizzera  
 Confederaziun svizra  
 Eidgenössisches Departement des Innern EDI  
 Bundesamt für Meteorologie und Klimatologie MeteoSchweiz



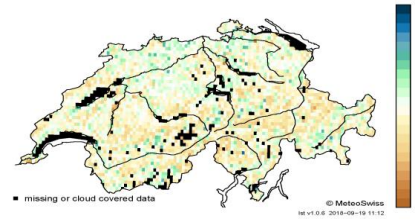
Fachbericht MeteoSchweiz Nr. 272

## Hitze und Trockenheit im Sommerhalbjahr 2018 – eine klimatologische Übersicht

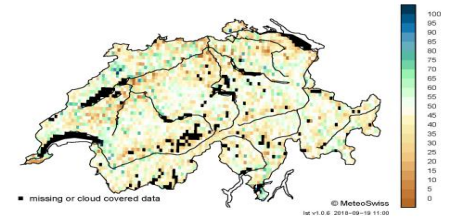
MeteoSchweiz



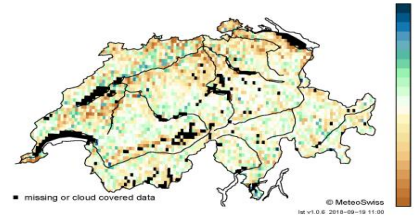
9.-15. April 2018



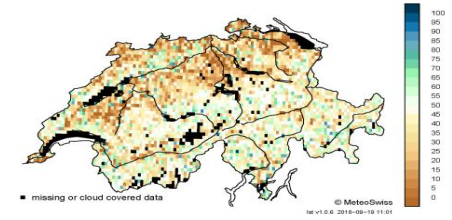
21.-27. Mai 2018



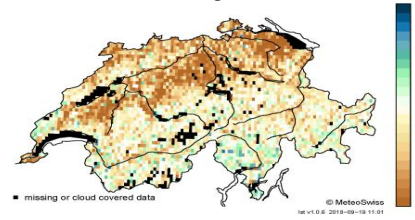
25. Juni - 1. Juli 2018



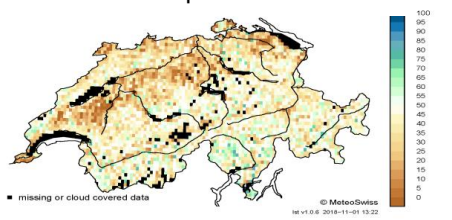
23. Juli - 29. Juli 2018



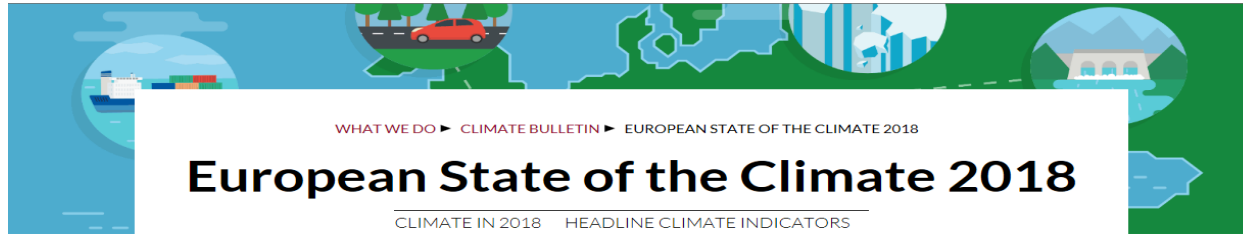
20. - 26. August 2018



17.-23. September 2018

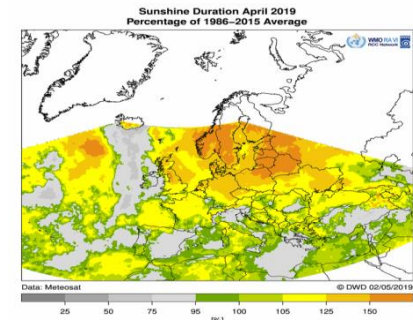
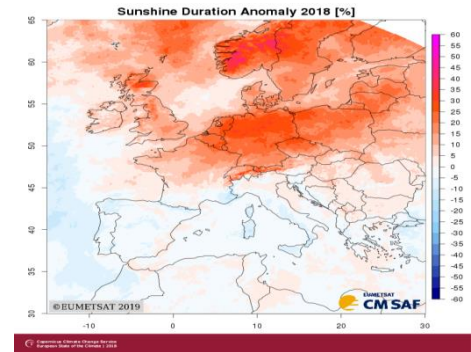






## CM SAF Sunshine Duration included in European State of the Climate 2018

- ➔ CM SAF data contributes to EU / Copernicus
- ➔ Other operational applications of CM SAF data include WMO RCC RA VI (e.g., SIS, CFC, SDU)
- ➔ TCDR + ICDR concept well suited for climate monitoring
- ➔ adding Sunshine Duration to the CM SAF portfolio enhanced visibility / usage of CM SAF data



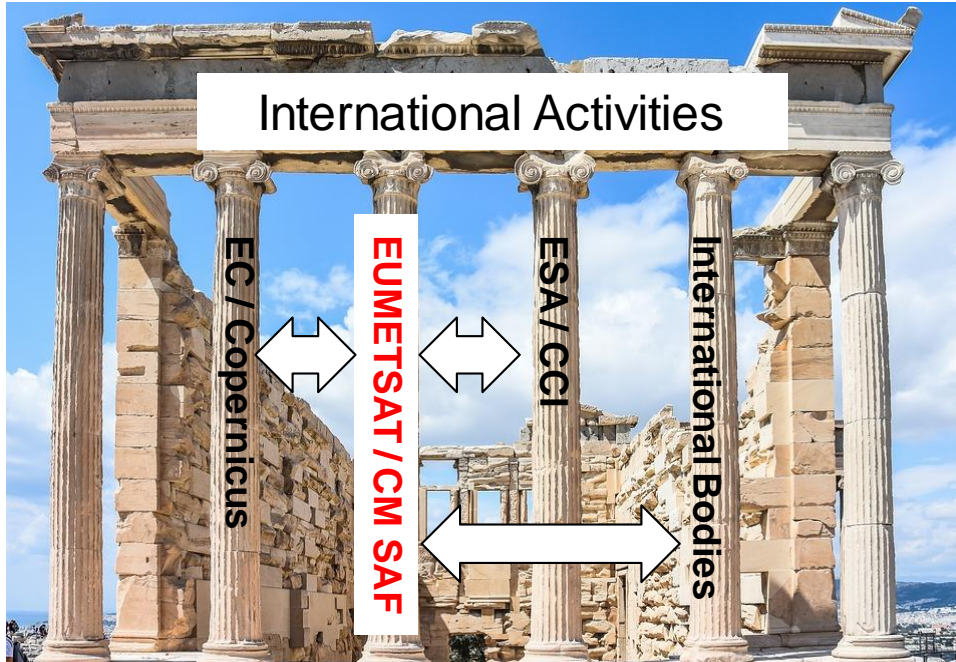
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# International activities



- ESA CCI: Clouds, WV, ...
- EC C3S Copernicus

FACTS

Images:

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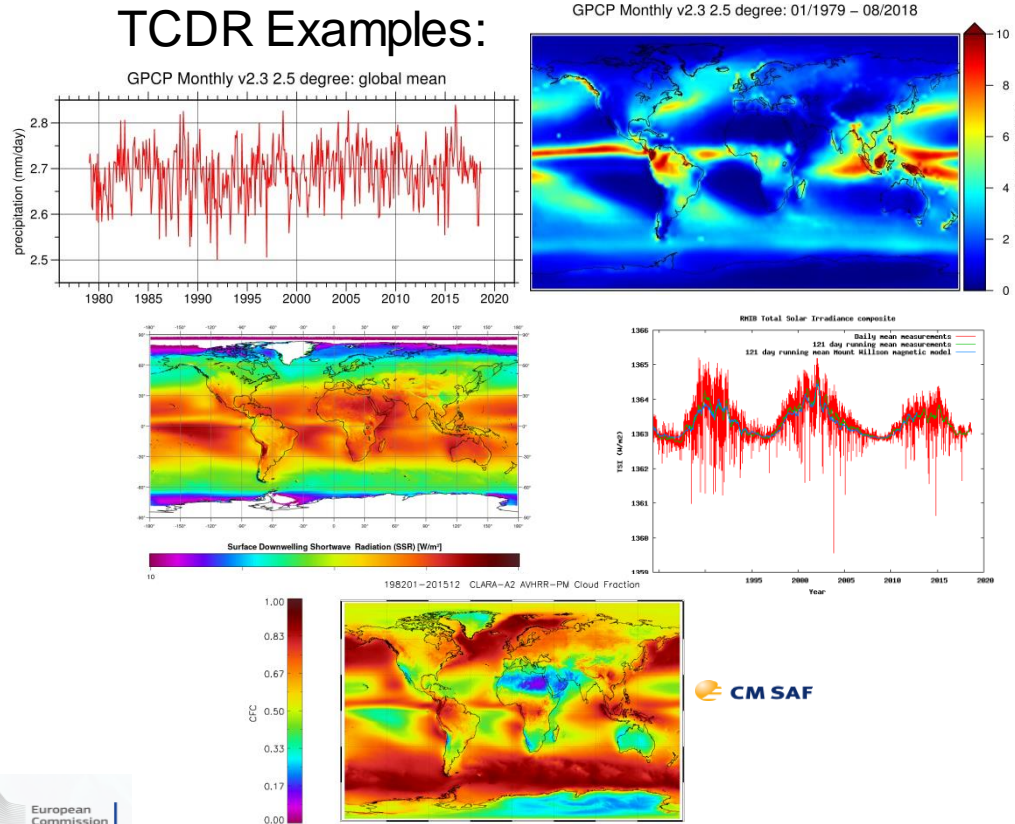
Climate Change

# CM SAF C3S Contributions

## Main Contributions

- ➔ Clouds
- ➔ Radiation (surface)
- ➔ Water Vapor
- ➔ Generation of complementary ICDR's and TCDR's

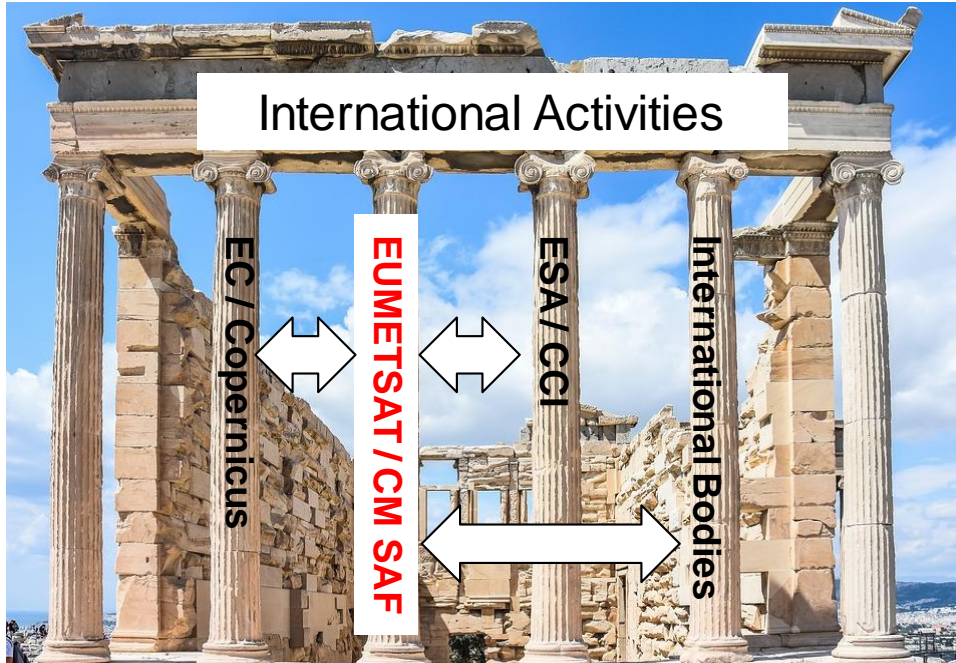
## TCDR Examples:



CM SAF



# International activities



- ESA CCI: Clouds, WV, ...
- EC C3S Copernicus
- GVAP, ICWG, ITWG,

FACTS

Images:

<https://pixabay.com/>

## CM SAF Support to GEWEX Water Vapour Assessment (G-VAP)

- ➔ G-VAP: Quantify the state of the art in satellite water vapour products being constructed for climate applications (not only Satellite CDR's!)
- ➔ Overview of available water vapour data records at <http://gewex-vap.org/>.
- ➔ GEWEX data archive: Doi: 10.5676/EUM\_SAF\_CM/GVAP/V001
- ➔ Co-Lead from CM SAF: Marc Schröder

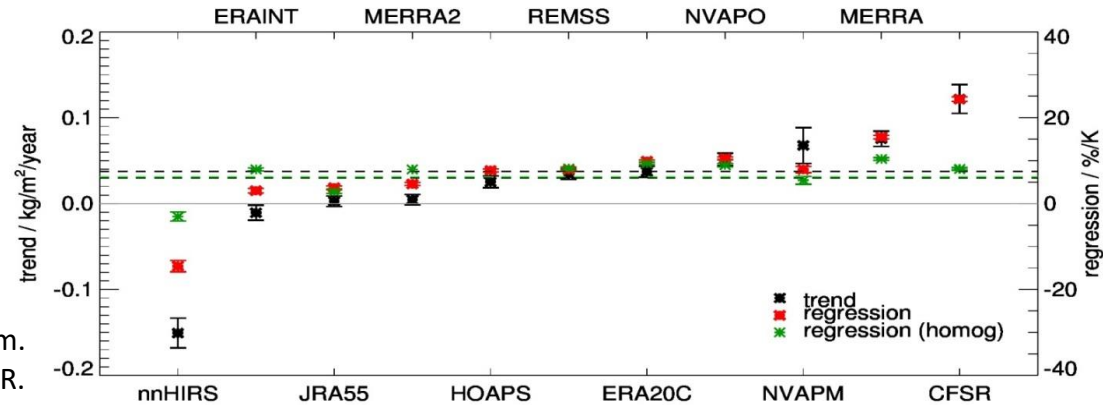
### Key Publications:

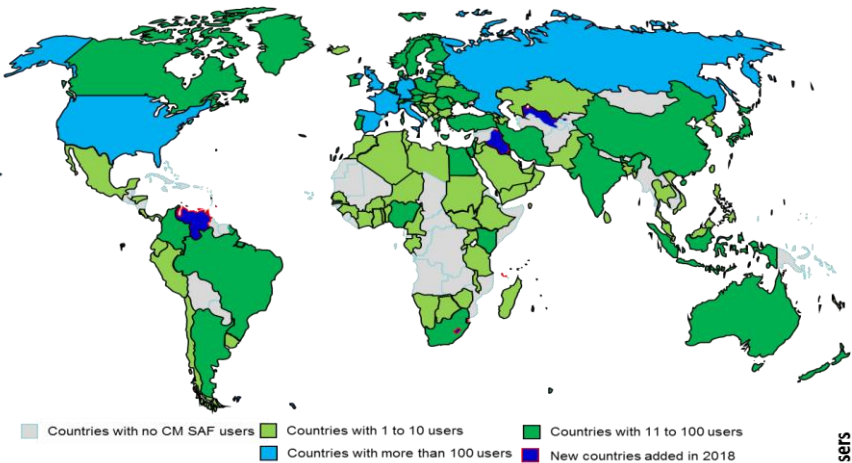
Schröder et al. (2018) in ESSD, 10.5194/essd-10-1093-2018

WCRP report on G-VAP available at <https://www.wcrp-climate.org/>

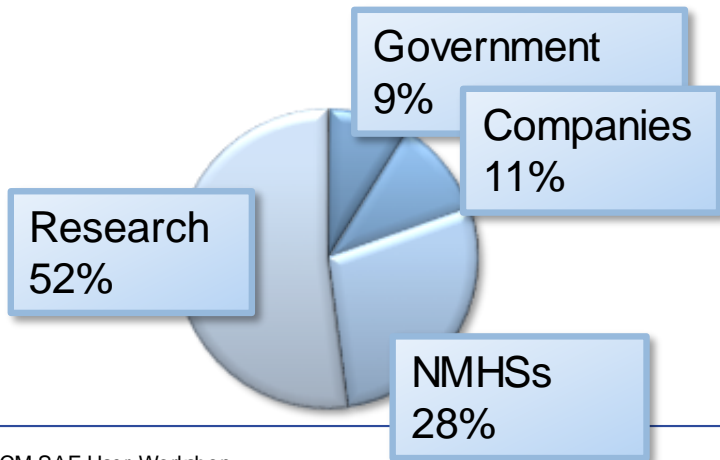
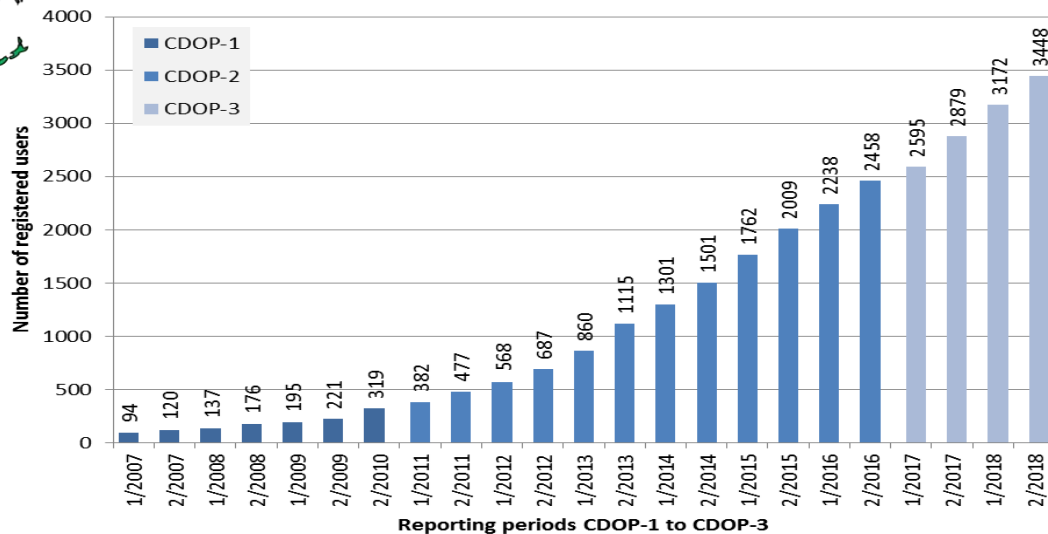
Schröder et al. (2016) in JAMC, Schröder et al. (2019) in Rem. Sens., Shi et al. (2018) in Rem Sens, Trent et al. (2019) in JGR.

*Schröder et al. (2019)*





- users from more than 130 countries in all continents
- number ever rising

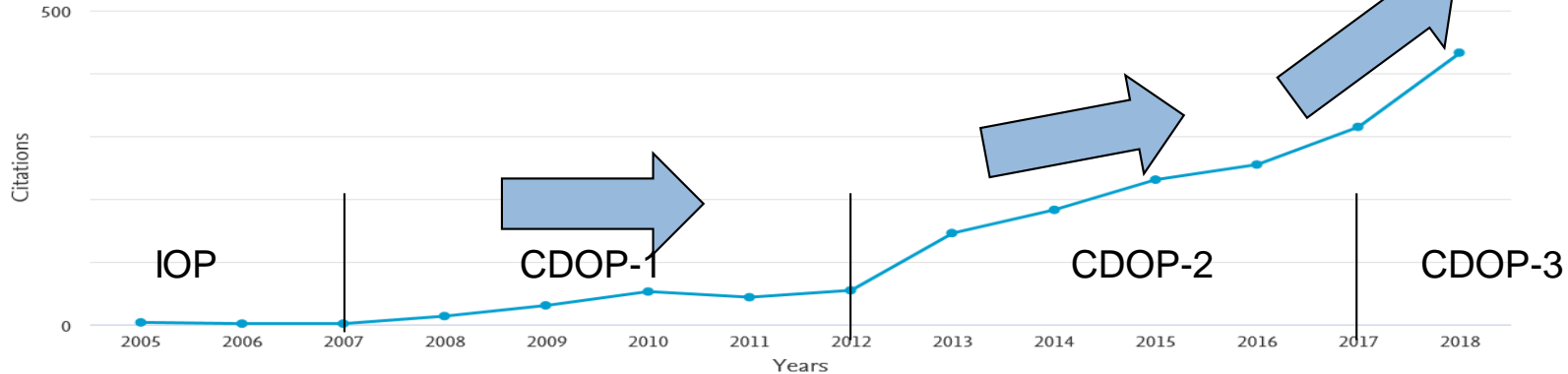
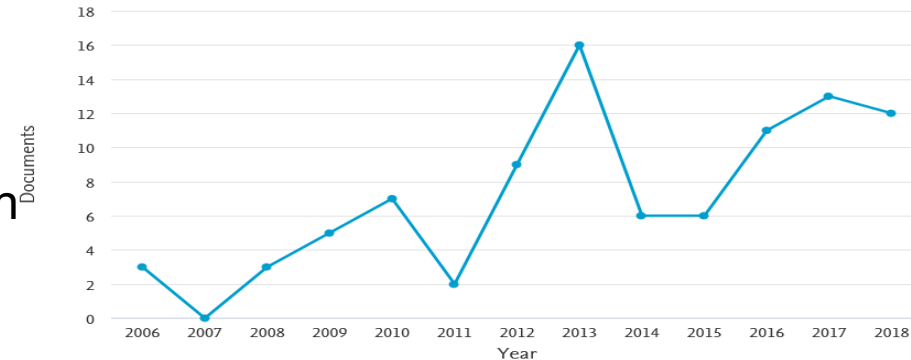


■ Scopus search in title, abstract, keywords

- „CM SAF“ or „CM-SAF“ or
- „climate monitoring SAF“ or
- „climate monitoring satellite application facility“

■ only peer-reviewed articles

Documents by year



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# Summary



PP (Project Phase), IOP (Initial Operations Phase)

## → Main topics addressed from 1999 - 2007

- Concept development
- Setup of system
- Focus on regional components of  
Energy budget and water cycle
- First EDRs generated



FACTS

Images:

<https://pixabay.com/>

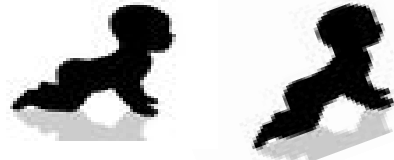
# Summary



PP (Project Phase), IOP (Initial Operations Phase), CDOP (Continuous Development and Operations Phases)

## → Main topics addressed from 2007 - 2012

- Paradigm change with focus on TCDR's
- 1<sup>st</sup> TCDR generation cycle
- regional and global components of Energy budget and water cycle



FACTS

Images:

<https://pixabay.com/>

# Summary



PP (Project Phase), IOP (Initial Operations Phase), CDOP (Continuous Development and Operations Phases)

## → Main topics addressed from 2012 - 2017

- 2<sup>nd</sup> TCDR generation cycle
- Global and regional components of Energy budget and water cycle
- Concept TCDR / ICDR developed
- International assessments & SCOPE-CM



FACTS

Images:

<https://pixabay.com/>

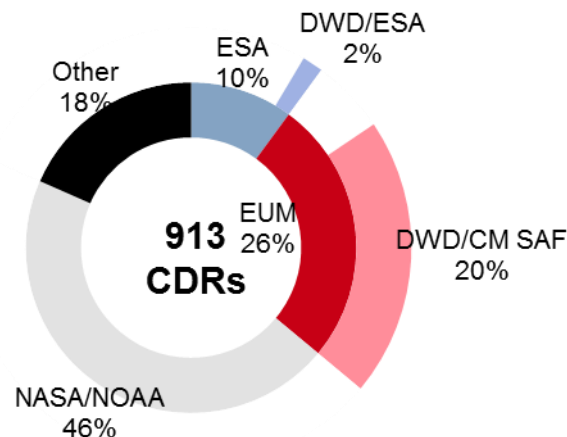
# Summary



PP (Project Phase), IOP (Initial Operations Phase), CDOP (Continuous Development and Operations Phases)

## → Main topics addressed from 2017 – 2022

- 3<sup>rd</sup> TCDR generation cycle, uncertainty
- + Extension of Product portfolio
- + First ICDRs provided
- + Support to International assessments
- + Important European CDR provider



**FACTS**

Images:

<https://pixabay.com/>

# Summary



PP (Project Phase), IOP (Initial Operations Phase), CDOP (Continuous Development and Operations Phases)

## → Main topics addressed beyond 2022?

- 4<sup>th</sup> / 5<sup>th</sup> TCDR generation cycle
- + New components of global and regional components of Energy budget and water cycle?
- + Bridging to GeoRing, new sensors with enhanced capabilities?
- + More ICDRs to be provided?

**2019  
User  
Workshop**



**FACTS**

Images:

<https://pixabay.com/>

# Conclusion

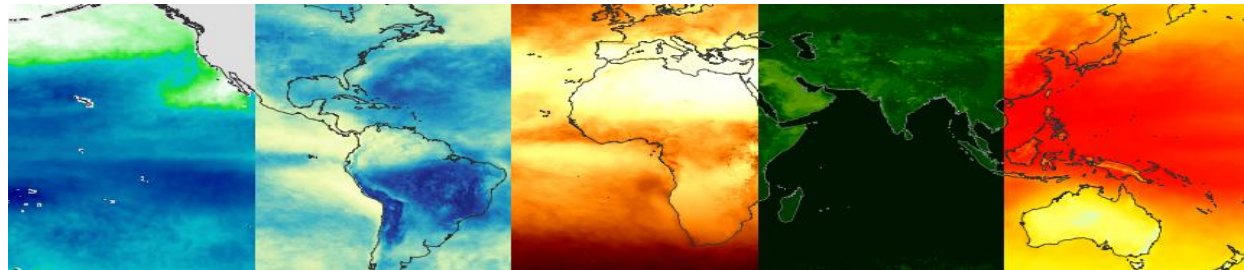
- Since 20 years CM SAF is contributing / pioneering to climate monitoring with satellites
- CM SAF performs sustained CDR generation in an operational environment
- CM SAF is taking benefit from research using relevant opportunities
- CM SAF provides extensive services, training, support to User
- CM SAF data are freely available
- CM SAF provides an easy direct data access



Contact data:

[www.cmsaf.eu](http://www.cmsaf.eu)

Contact.cmsaf@dwd.de





# Splinter Groups

- Two Splinter Groups
- Tuesday Morning:
  - Thematic Areas
- Tuesday Afternoon
  - Application Areas
  
- 2 sticker to select Splinter Group
- Voting until **20:00 TODAY!**

