

The EUMETSAT contribution to the ECV services of the Copernicus Climate Change Service



Climate Change

Joaquín Muñoz Sabater & the C3S team
European Centre for Medium-Range Weather Forecasts (ECMWF)

EUMETSAT Meteorological Satellite Conference – Brussels, Belgium – 19-23 Sept 2022

open, free, complete

Sentinels

A red circular icon containing a white thermometer and a cloud with a rain drop.

CLIMATE CHANGE

A blue circular icon containing a white padlock with an open keyhole.A blue circular icon containing a white fish.

MARINE MONITORING

A blue circular icon containing a white padlock with an open keyhole.A light blue circular icon containing a white globe with latitude and longitude lines.

ATMOSPHERE MONITORING

A blue circular icon containing a white padlock with an open keyhole.A green circular icon containing a white bar chart with a leaf.

LAND MONITORING

A blue circular icon containing a white padlock with an open keyhole.A teal circular icon containing a white shield.

SECURITY

A blue circular icon containing a white padlock with an open keyhole.An orange circular icon containing a white tent.

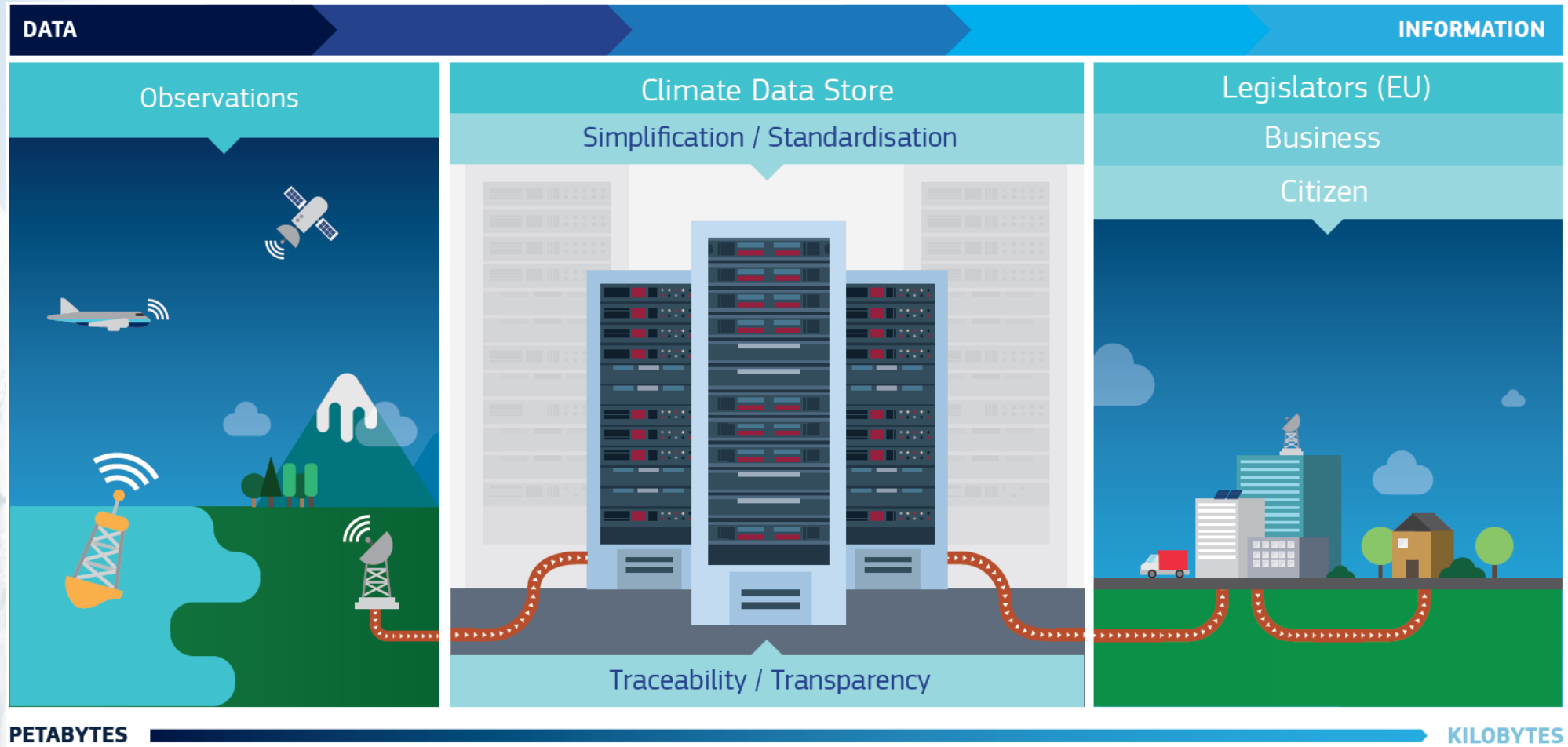
EMERGENCY MANAGEMENT

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Climate Change

The Copernicus Climate Change Service (C3S)



authoritative quality-controlled data and information based on Earth Observation about the past, present and future climate;

tools to inform climate change mitigation and adaptation strategies by policy makers and businesses;

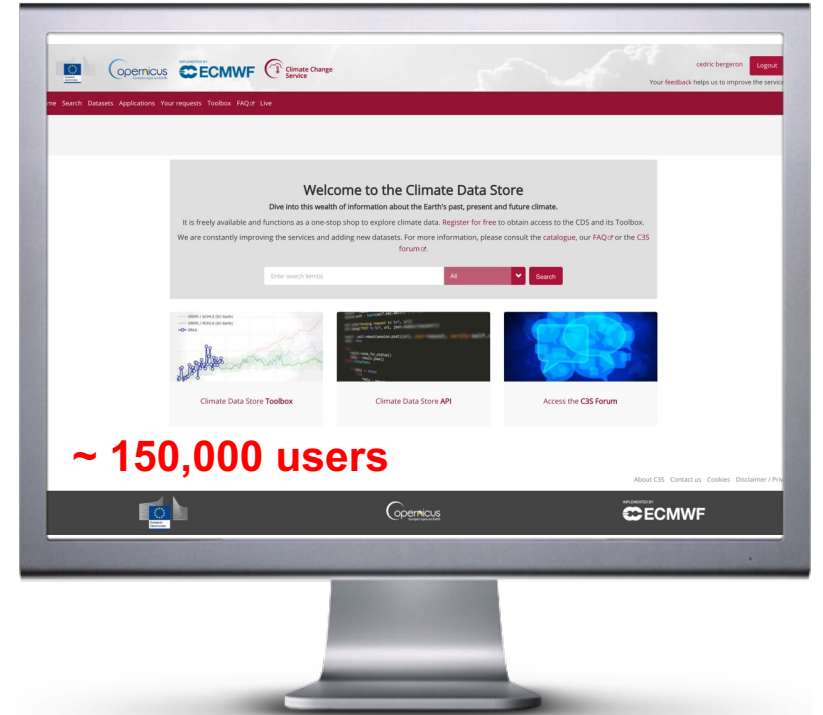
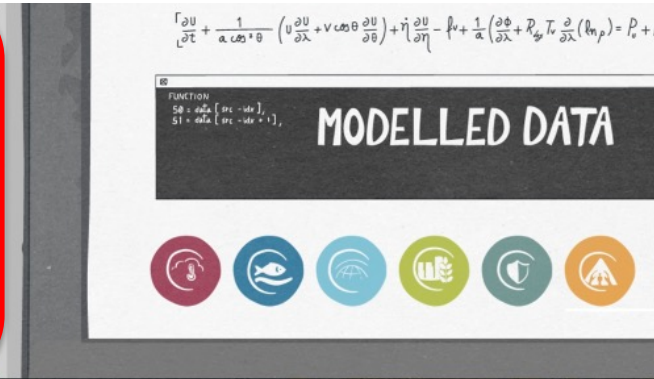
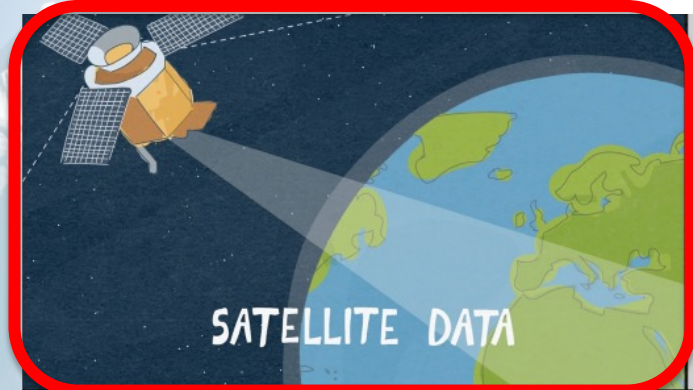
examples of best practice in the use of climate information.





Climate Change

The Climate Data Store – ‘A one stop shop for climate data’



<https://cds.climate.copernicus.eu>



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implemented by ECMWF



Climate Change

The Essential Climate Variables (ECVs)

CRYOSPHERE



Snow



Ice Sheets and Ice Shelves



Glaciers



Permafrost

COP1

□ = satellite ECVs

□ = ECVs from reanalysis

SURFACE ATMOSPHERE



Surface Radiation Budget



Surface Pressure



Surface Temperature



Surface Water Vapour



Surface Wind Speed and Direction



Precipitation

UPPER-AIR ATMOSPHERE



Upper-air Temperature



Upper-air Water Vapour



Upper-air Wind Speed and Direction



Lightning



Earth Radiation Budget



Clouds

ATMOSPHERIC COMPOSITION



Precursors for Aerosols and Ozone



Aerosols



CO₂, CH₄, and other GHGs



Ozone

SURFACE OCEAN PHYSICS



Surface Currents



Surface Stress



Sea Surface Temperature



Sea Ice



Ocean Surface Heat Flux



Sea Level



Sea Surface Salinity



Sea State

SUBSURFACE OCEAN PHYSICS



Subsurface Temperature



Subsurface Currents



Subsurface Salinity

OCEAN BIOLOGY / ECOSYSTEMS



Plankton



Marine Habitats

OCEAN BIOGEOCHEMISTRY



Ocean Colour



Transient Tracers



Inorganic Carbon



Oxygen



Nitrous Oxide



Nutrients

BIOSPHERE



Soil Carbon



Albedo



Fire



FAPAR*



Leaf Area Index (LAI)



Land Surface Temperature



Above-ground Biomass



Land Cover

*Fraction of Absorbed Photosynthetically Active Radiation

HYDROSPHERE



Soil Moisture



Lakes



Groundwater



River Discharge



Evaporation from Land

ANTHROPOSPHERE



Anthropogenic Water Use



Anthropogenic Greenhouse Gas Fluxes



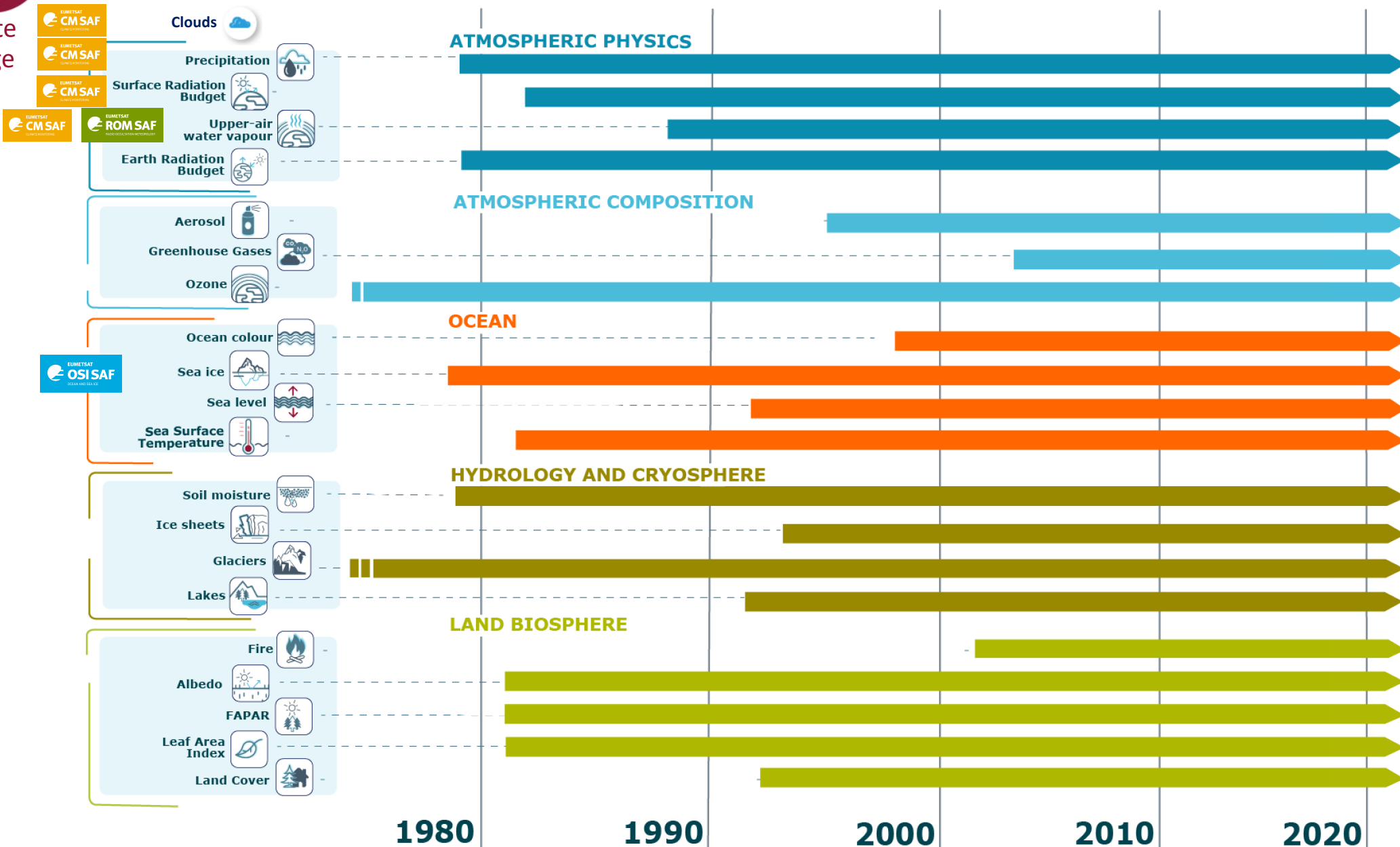
Climate Change Service

climate.copernicus.eu



Satellite ECV data records in C3S

Climate Change



IN COLLABORATION with more than **50** organisations.



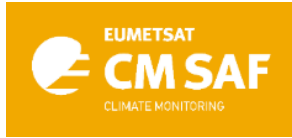
Mainly use Sentinel-3 data

Future use of other Sentinel data



Climate Change

EUMETSAT datasets in the CDS

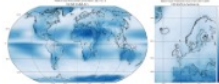


Cloud properties global gridded monthly and daily data from 1982 to present derived from satellite observations

Dataset Satellite observations Atmosphere (upper air) Global

, alongside CM SAF and CCI, the Copernicus Climate Change Service (C3S) is only associated with the CCI

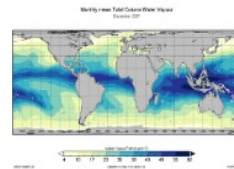
Updated 2022-08-22



Monthly and 6-hourly total column water vapour over ocean from 1988 to 2020 derived from satellite observations

Dataset Satellite observations Atmosphere (upper air)

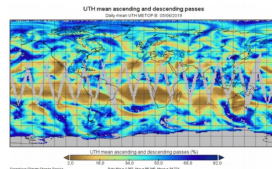
EUMETSAT Satellite Application Facility on Climate Monitoring (CM SAF) and the ICDR is produced within the



Upper tropospheric humidity gridded data from 1999 to present derived from satellite observations

Dataset Global Atmosphere (upper air) Satellite observations

Upper Tropospheric Humidity (UTH) is of key importance to the Earth's greenhouse effect and understanding of climate change. It is considered an essential climate variable because it controls key atmospheric processes, including water vapour and cloud feedbacks that can amplify the climate system's response to increases in other greenhouse gases. The UTH Thematic Climate Data Record (TCDR) and Int...

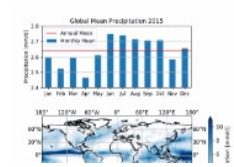


Precipitation monthly and daily gridded data from 2000 to 2017 derived from satellite microwave observations

Dataset Satellite observations Global Land (hydrology) Atmosphere (surface)

(HOAPS) in the Satellite Application Facility on Climate Monitoring (CM SAF). ii) Cross-track scanning MW

Updated 2022-08-19

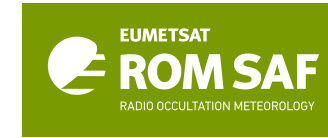
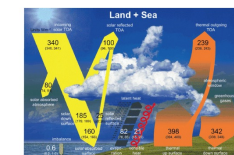


Surface radiation budget from 1982 to present derived from satellite observations

Dataset Satellite observations Atmosphere (surface) Global

This dataset provides the Surface Radiation Budget (SRB) Essential Climate Variable (ECV). SRB represents the balance between the heating of the surface through incoming solar radiation and cooling through emission of infra-red radiation which is a fundamental component of the surface energy budget. Small changes in the surface radiation budget can lead to large climatological responses, which ma...

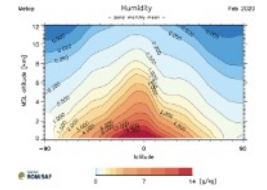
Updated 2022-08-20



Tropospheric humidity profiles averaged monthly and zonally from 2006 to present derived from satellite observations

Dataset Global Atmosphere (upper air) Satellite observations

Application Facility (ROM SAF) and comprises the Climate Data Record (CDR, December 2006 to December 2016, ROM

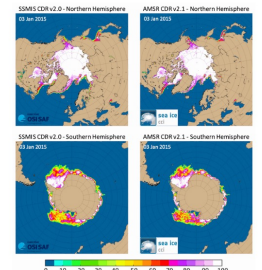


Sea ice concentration daily gridded data from 1979 to present derived from satellite observations

Dataset Satellite observations Ocean (physics) Global

This dataset provides daily gridded data of sea ice concentration for both hemispheres derived from satellite passive microwave brightness temperatures. Sea ice is an important component of our climate system and a sensitive indicator of climate change. Its presence or its retreat has a strong impact on air-sea interactions, the Earth's energy budget as well as marine ecosystems. It is recognised ...

Updated 2022-09-17

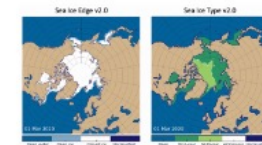


Sea ice edge and type daily gridded data from 1978 to present derived from satellite observations

Dataset Satellite observations Ocean (physics) Global

Satellite Application Facility (OSI SAF). Variables in the dataset/application are: Sea ice edge, Sea ice

Updated 2022-09-07



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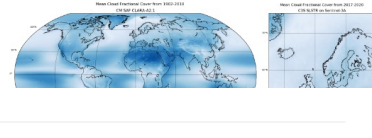
Presentation in the Climate Data Store

Cloud properties global gridded monthly and daily data from 1982 to present derived from satellite observations

CDS Service disruption starting 8 September 2022 for 5-6 weeks. You can find more information here.

- Overview
- Download data
- Documentation

This dataset provides the Essential Climate Variable (ECV) Cloud Properties. Cloud properties describe the state of the Earth's upper-air atmosphere. Clouds have an effect on weather and climate through their contribution to the Earth's water cycle and impact on the Earth's energy budget. They influence the motion of the atmosphere on many scales and modify the atmospheric composition. By accumulating and carrying the evaporated and transpired water in the atmosphere, clouds redistribute water over the globe, which often involves precipitation. Further, the variable cloud properties determines energy budget and re-emits climate change responses to the ECV. Clouds produce different orographic effects. The "CLARA product family data overview"



The "CLARA product family" refers to EUMETSAT's CM SAF CLARA-A2.1 data record (CM SAF Cloud, Albedo and surface Radiation dataset from AVHRR data - Edition 2.1). It merges the AVHRR-sensor data from a variety of satellites into a combined TCDR several decades long. It includes the daily and monthly means of cloud fractional cover, cloud top level (consisting of cloud top temperature, pressure and height), and cloud physical properties (consisting of cloud optical thickness, effective radius, and water path) for both the liquid water and the ice phase. Several satellite data records now span over decades, offering the opportunity to compile long-term, comprehensive thematic climate data records (TCDRs). The provided cloud properties product is such a TCDR, produced by EUMETSAT's Satellite Application Facility on Climate Monitoring (CM SAF). A quarterly interim climate data record (ICDR) provision allows short-delay access to the most recent data. The data record has been validated in peer-reviewed publications in which the uncertainties, limitations and potential applications have been detailed. The data record has sufficient length, consistency, and continuity to detect climate variability and change.

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DATA DESCRIPTION	
Data type	Gridded
Projection	Regular latitude-longitude grid
Horizontal coverage	Global
Horizontal resolution	0.25° x 0.25°
Vertical coverage	Depends on the variable. Possible values are: surface, top of the atmosphere and total atmospheric column.
Vertical resolution	Single level
Temporal coverage	From January 1982 to December 2018 for the TCDR and from January 2019 to present for the ICDR
Temporal resolution	Monthly and daily
Temporal gaps	No gaps
Versions	TCDR: 2.0 ICDR: 2.1
File format	NetCDF 4
Conventions	Climate and Forecast (CF) Metadata Convention v1.6, Attribute Convention for Dataset Discovery (ACDD) 1.3
Update frequency	Every quarter appends an extra three month worth of data to the end of the datasets

MAIN VARIABLES		
Name	Units	Description
Cloud fraction	%	Fraction of a grid cell which is covered by clouds in relation to the whole grid cell. Files contain the variables: cloud fraction, cloud fraction low-level clouds, cloud fraction mid-level clouds, cloud fraction high-level clouds, cloud fraction day, cloud fraction night. "Cloud fraction" takes into account the entire atmospheric column over the grid cell during the time aggregation period. The other variables are focused on different atmospheric layers and periods of the day.
Cloud top level	Depends on the variable	Files contain temperature, pressure and height data at the cloud-top under the names: cloud top temperature, cloud top pressure, cloud top height. The cloud-top is defined as the top of the highest cloud in the grid cell. Height is measured from the ground topography in meter. Temperature is given in K and Pressure in hPa.

CLARA

CCIP

Contact

[ECMWF Support Portal](#)

Licence

[EUMETSAT CM SAF products licence](#)

[Licence to use Copernicus Products](#)

[ESA CCI products licence](#)

Publication date

2022-06-01

Resource updated

2022-08-22

References

[DOI](#)

[Citation](#)

[Acknowledgement](#)

DOI: 10.24381/cds.68653055

Established agreement on the operational interface for data presentation



Climate
Change

Data access

Overview

Download data

Documentation

Clear all

Product family ?

At least one selection must be made

- CLARA (CLOUD, Albedo and Radiation)
- CCI (Climate Change Initiative)

Origin ?

At least one selection must be made

- C3S (Copernicus Climate Change Service)
- EUMETSAT (European Organisation for the Exploitation of Meteorological Satellites)
- ESA (European Space Agency)

Variable ?

At least one selection must be made

- Cloud fraction
- Cloud physical properties of the ice phase
- Cloud physical properties of the liquid phase
- Cloud top level
- All variables (CCI product family)

Select all

Climate data record type ?

At least one selection must be made

- Interim Climate Data Record (ICDR)
- Thematic Climate Data Record (TCDR)

Established agreement on
the operational interface
for data exchange



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Documentation

CLARA product family, TCDR and ICDR documentation

- [Algorithm Theoretical Basis Document](#)
This document provides information on the processing algorithm implemented for the retrieval of the dataset.
- [Product User Manual](#)
This document provides information on the features, quality and usage of the dataset.
- [Validation Report](#)
This document provides information on the validation and intercomparison of the dataset.

- ▶ CCI product family, ESA TCDR documentation
- ▶ CCI product family, C3S ICDR documentation
- ▶ Common documentation
- ▶ Tutorial
- ▶ Example workflows for the CDS Toolbox
- ▶ Known issues



Pages / ... / CM SAF cLOUD, Albedo and surface Radiation (CLARA)

CM SAF cLOUD, Albedo and surface Radiation (CLARA): Product user guide (PUG)

This page provides the Product user guides (PUGs) for the [Cloud properties global gridded monthly and daily data from 1982 to present derived from satellite observations](#). The documents have been produced in the scope and by CM SAF.

[Product User Manual CM SAF Cloud, Albedo, Radiation data record, AVHRR-based, Edition 2.1 \(CLARA-A2.1\) Cloud Products](#)
[Product User Manual ICDR AVHRR – based on CLARA-A2 methods Cloud properties](#)

[ecv](#) [clara](#) [cloud_properties](#)

[Web: C3S Help and Support](#) - [CAMS Help and Support](#)

EUMETSAT Satellite Application Facility on Climate Monitoring



Product User Manual CM SAF Cloud, Albedo, Radiation data record, AVHRR-based, Edition 2.1 (CLARA-A2.1) Cloud Products

DOI: 10.5676/EUM_SAF_CM/CLARA_AVHRR/V002_01

Fractional Cloud Cover	CM-11015
Joint Cloud property Histogram	CM-11025
Cloud Top level	CM-11035
Cloud Phase	CM-11045
Liquid Water Path	CM-11055
Ice Water Path	CM-11065

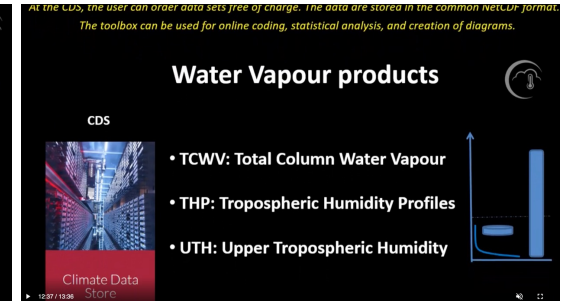
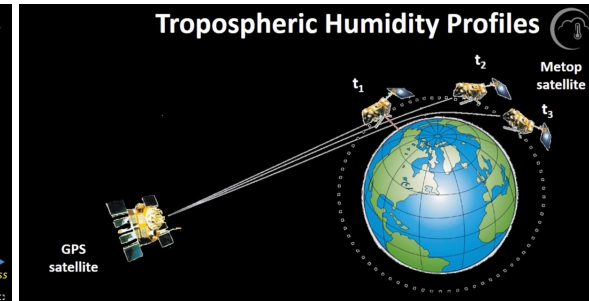
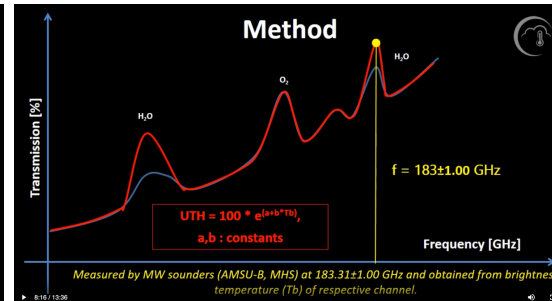
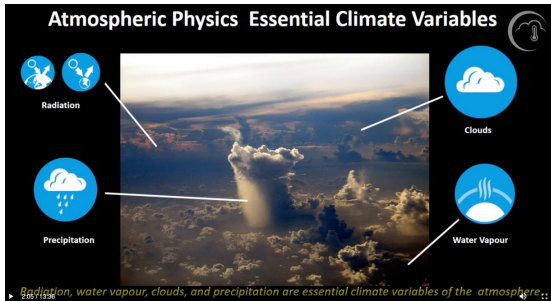




Climate Change

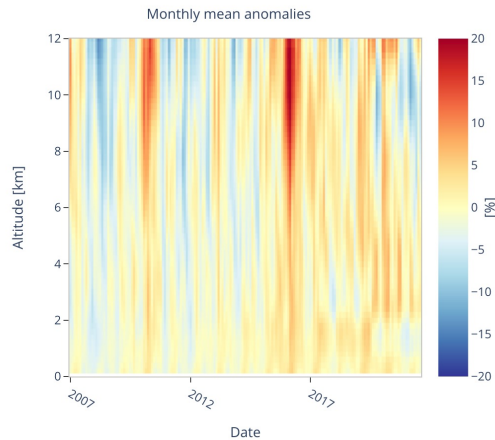
User-oriented material

Generation of educational Tutorials (e.g., tropospheric humidity)

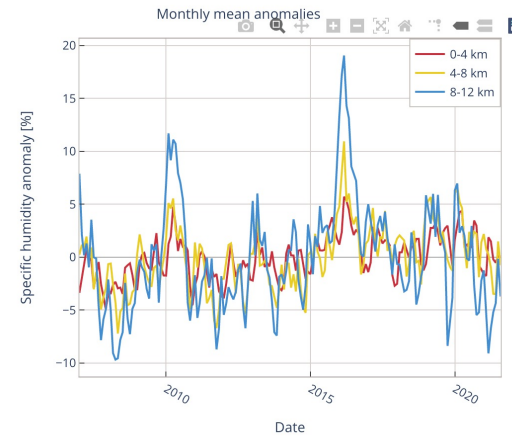


Toolbox applications to provide examples of data use

Region: 30°S-30°N
Specific humidity derived from radio occultation satellite data for the 30°S-30°N latitude band and the time period 2007 to 2021



Time evolution of specific humidity anomalies. The anomaly is calculated as the difference to the mean of the entire time-series, therefore the variation is primarily driven by seasonal effects.

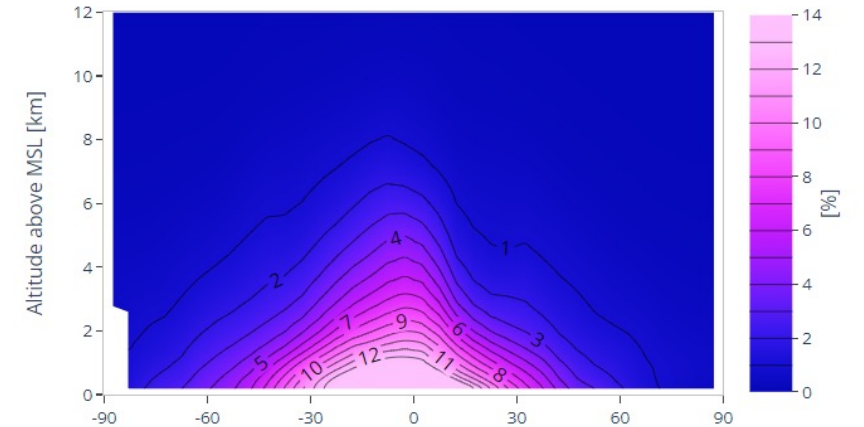


Time-series of the vertically aggregated mean of the specific humidity anomalies. The data are averaged vertically over 3 height layers: 0-4 km, 4-8 km and 8-12 km.

Seasonal variation of zonal humidity profiles

Year: 2020

Tropospheric humidity
January 2020
Zonal monthly mean



Global latitude-height distribution of tropospheric humidity



Climate Change

Contribution to the European State of the Climate 2021

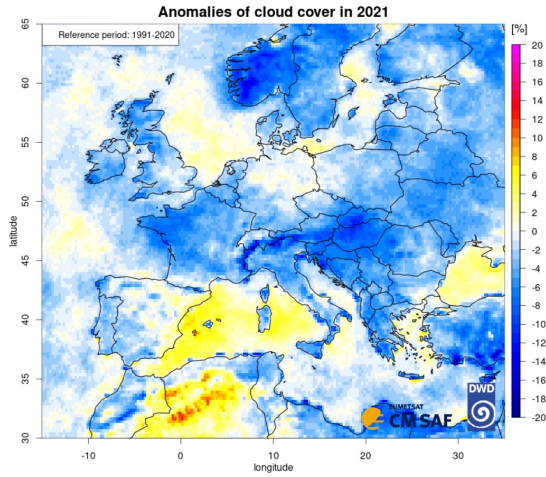


Figure 2. Annual mean cloud cover anomalies (%) over the European region for 2021, relative to the average for the 1991–2020 reference period. Data source: CLARA-A2.1 CDR & ICDR. Credit: EUMETSAT CM SAF.

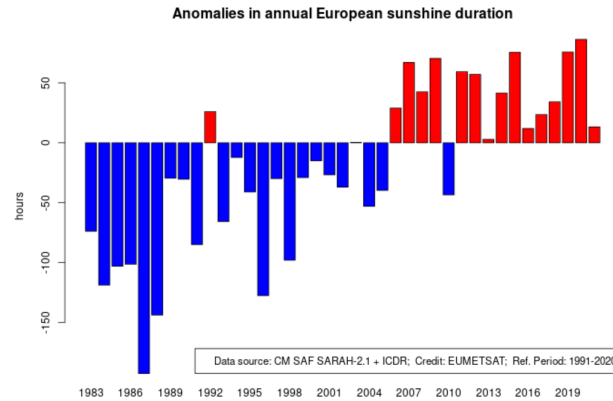


Figure 3. European annual sunshine duration anomalies (hours) for 1983–2021, relative to the average for the 1991–2020 reference period. The region covered is shown in Figure 4. Data source: SARAH-2.1 CDR & ICDR. Credit: EUMETSAT CM SAF.

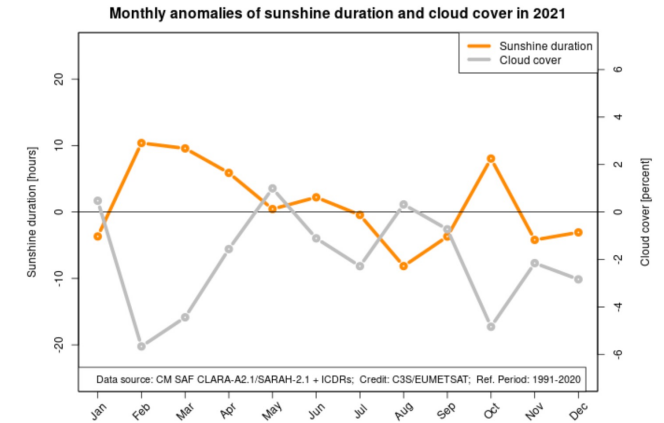
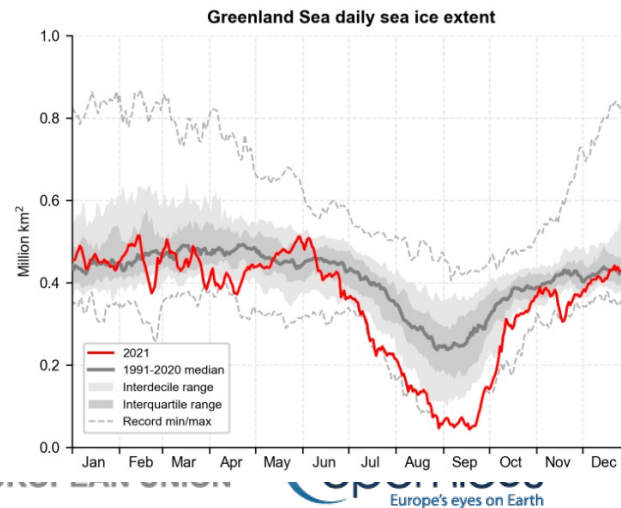


Figure 5. European monthly sunshine duration (hours - in orange) and cloud cover (% - in grey) anomalies in 2021, relative to the average for the 1991–2020 reference period. The region covered is shown in Figures 2 and 4. Data source: SARAH-2.1 CDR & ICDR; CLARA-A2.1 CDR & ICDR). Credit: EUMETSAT CM SAF.

<https://climate.copernicus.eu/esotc/2021>



PROG THE LONG... Europe's eyes on Earth

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Future EUMETSAT-ECMWF commitments based on a Federated Activity

Scope: To set up and to maintain the effective re-distribution of CM SAF and ROM SAF data records through the Climate Data Store

Benefits:

- CM SAF / ROM SAF products via the CDS increases visibility and potential number of users
- Increase the number of applications beyond the data distribution service.
- CM SAF / ROM SAF benefit from C3S experience and requirements
- C3S benefits from sustained support from CM SAF / ROM SAF & timely updates of CDRs

Work packages WP1 (CM SAF) / WP2 (ROM SAF)

- C3S: Provide independent quality assessment information related to SAF products reports to CM SAF when available for review and for potential inclusion in the SAF product assessment report (Operations Review) as complementary information to the standard SAF assessment.
- SAF: Review C3S independent quality assessment reports and provide feedback to C3S.
- C3S: Participation in or contributing to Requirements Reviews, Product Consolidation Reviews and Delivery Readiness Reviews for products identified in Table 12.
- C3S: Provide TRGAD on discussion of requirements and ideas on future evolution of CM SAF / ROM SAF products.
- SAF: Review TRGAD and provide feedback to C3S CM SAF:
- SAF: Include links to use cases and tutorials on its webpage.



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Further notes & summary

- C3S uses historical observations from satellite sensors to **build Climate Data Records of Essential Climate Variables (ECVs)**
- **CM-SAF, ROM-SAF and OSI-SAF contributing to operational C3S ECV services** (datasets, documentation, reports, user-oriented material and user support)
- **COP2: Commitment of SAF contributions until 2024** (based on the C3S & FA frameworks), and likely beyond. Lot of **focus on users**
- **C3S also involved in SAF products review**, and feedback sent to the SAF operational development phases
- **Potential of new SAF products being included in the CDS** (AC SAF, H SAF, LSA SAF)



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