



Climate Change

# The Copernicus Climate Data Store:

## Climate Data and Tools

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Climate  
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- The **Copernicus Climate Change** service provides information to increase the knowledge base to support **adaptation** and **mitigation** policies.
  - Health – e.g. prevalence of mosquitos
  - Tourism – e.g. length of ski season
  - Industry – e.g. efficiency of ports
  - Energy – e.g. strength of wind/tidal/river flow
  - Agriculture – e.g. length of growing season





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## The Climate Data Store: vision

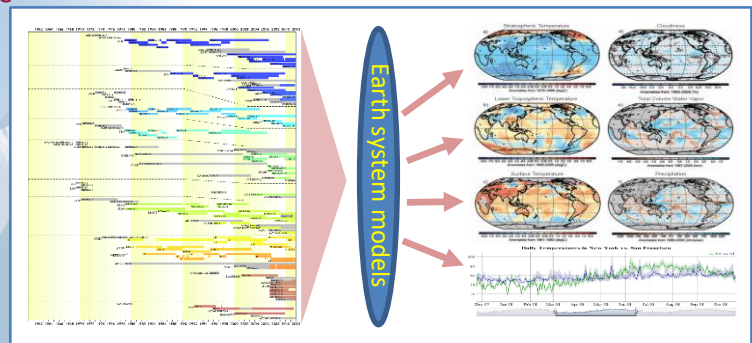
- Make data discovery, access easy and relevant for users
- Provide online capabilities to process the data to users
- Provide easy-to-use online applications for users



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# What kind of data?

## Access to past, present and future climate information

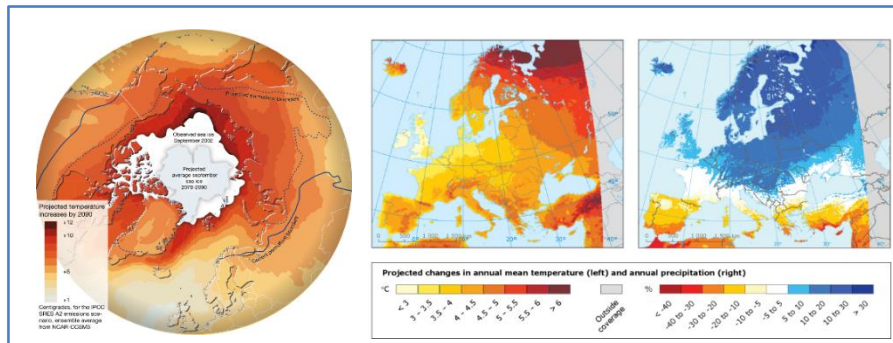
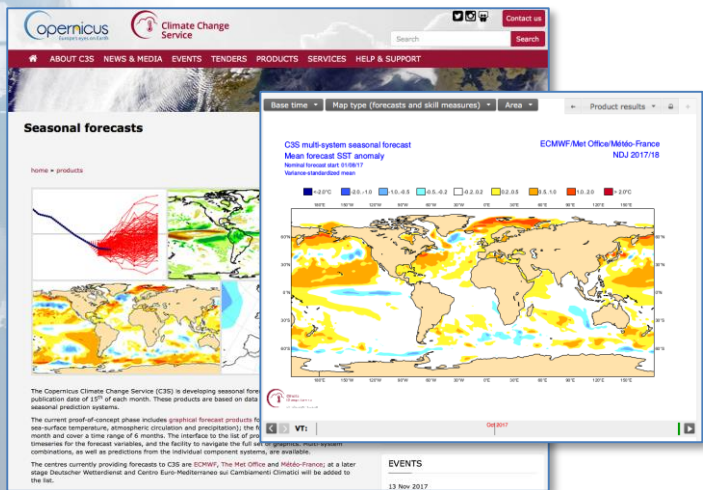


Observations (*in situ* and satellite)

Forecasts and reanalysis model output

Climate model simulations

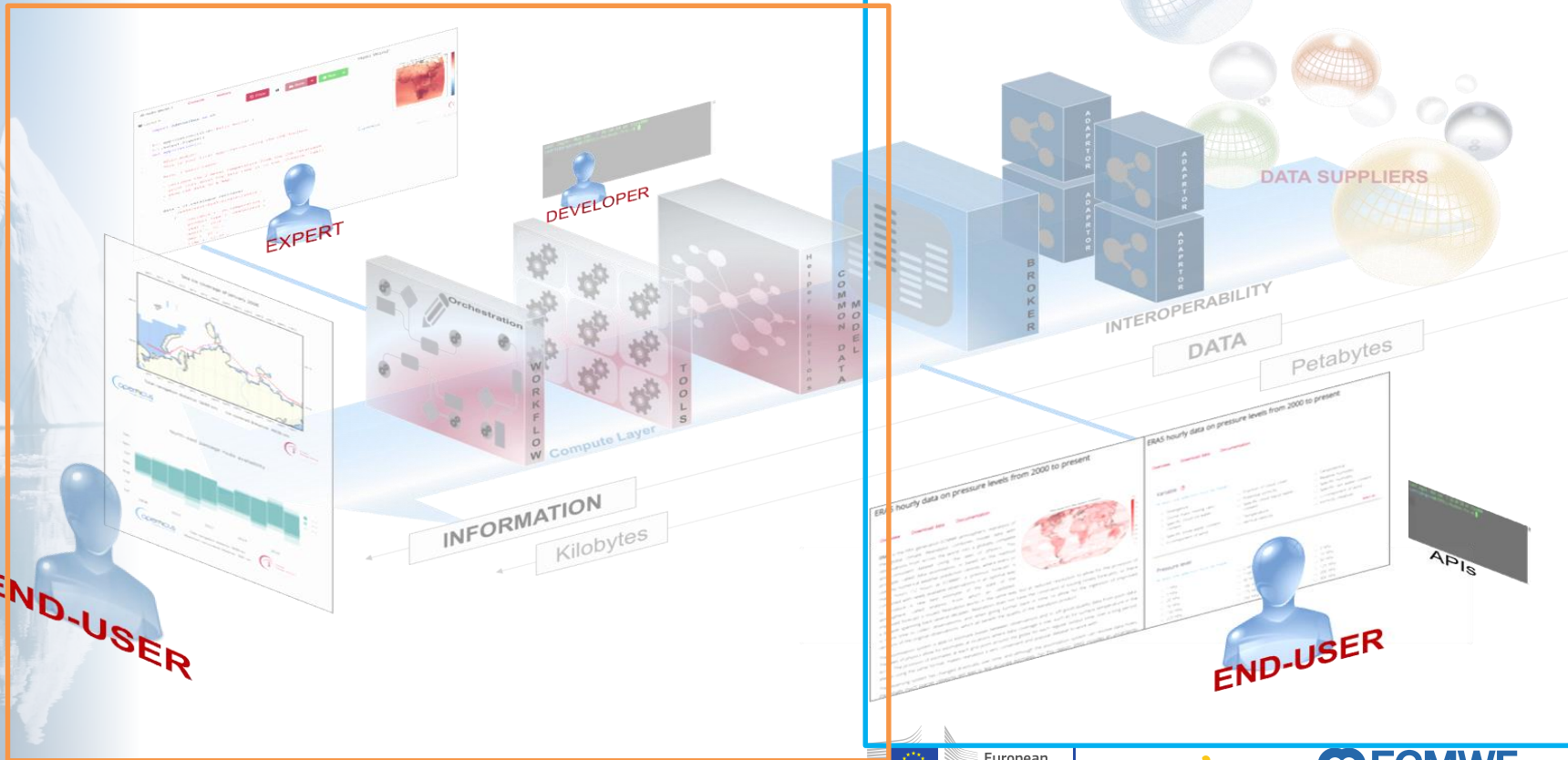
Global  
and pan European





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# The Climate Data Store: concept

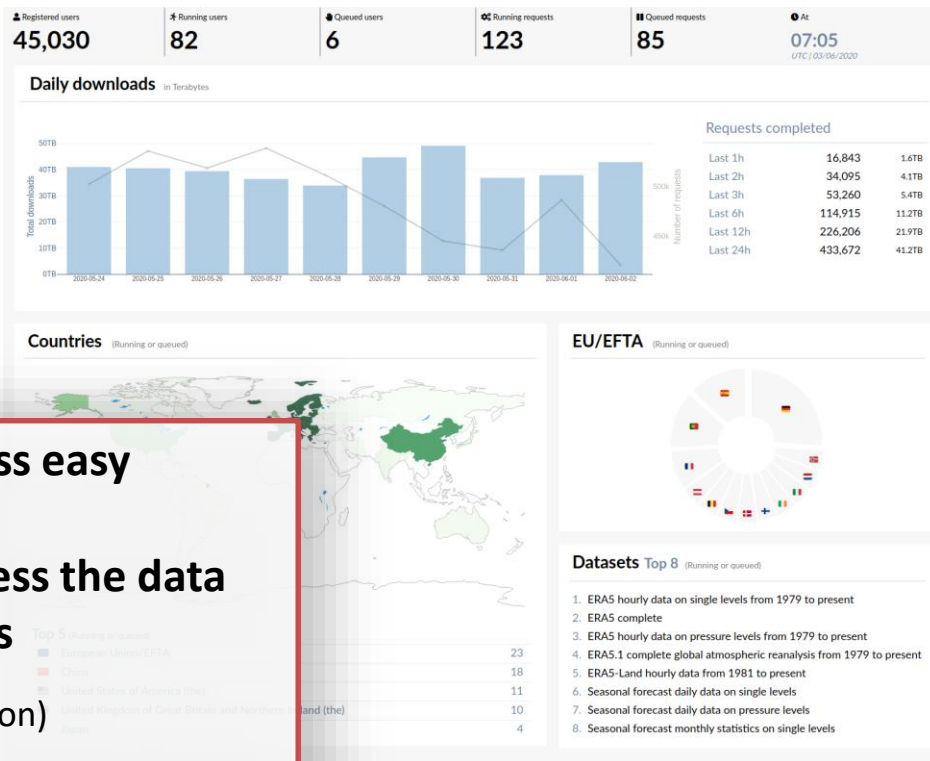
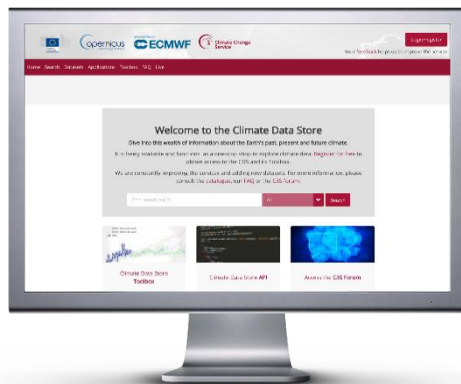




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# The Climate Data Store: performance

**45,000+**  
registered users



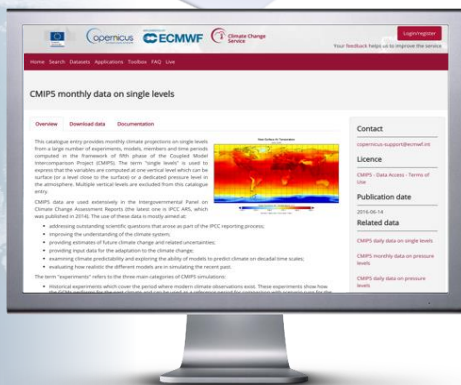
- **Make C3S datasets discovery, access easy and relevant for users**
- **Provide online capabilities to process the data and develop applications**
- **Provide scalability** (datasets, computation)
- **Enable reproducible research** (provenance, DOIs, etc)



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# The Climate Data Store: data access

## Distributed Data providers



Harmonised, simple, consistent and reliable online system





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# The Climate Data Store: Global reanalysis data

Simplicity and consistency are key

Quality Evaluation will come soon (2020)

Home Search Datasets Applications Your requests Toolbox Help & support

Search results

Search dataset   All Datasets

Sort by **Relevancy**

Showing 1-2 of 2 results for **Reanalysis x**

- Climate projections (4)
- Reanalysis (2)
- Satellite observations (11)
- Seasonal forecasts (6)
- Sectoral climate indices (2)

Spatial coverage

- Global (2)

Temporal coverage

- Past (2)



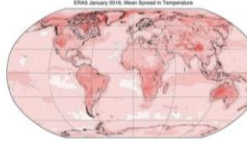
### ERA5 hourly data on pressure levels from 2000 to present

Overview Download data Documentation

ERA5 is the fifth generation ECMWF atmospheric reanalysis of the global climate. Reanalysis combines model data with observations from across the world into a globally complete and consistent dataset using the laws of physics. This principle, called data assimilation, is based on the method used by numerical weather prediction centres, where every so many hours (12 hours at ECMWF) a previous forecast is combined with newly available observations in an optimal way to produce a new best estimate of the state of the atmosphere, called analysis, from which an updated, improved forecast is issued. Reanalysis works in the same way, but at reduced resolution to allow for the provision of a dataset spanning back several decades. Reanalysis does not have the constraint of issuing timely forecasts, so it is more time to collect observations, and when going further back in time, to allow for the ingestion of improvements of the original observations, which all benefit the quality of the reanalysis product.

The assimilation system is able to estimate biases between observations and to sift good-quality data from poor. The laws of physics allow for estimates at locations where data coverage is low, such as for surface temperature Arctic. The provision of estimates at each grid point around the globe for each regular output time, over a long period always using the same format, makes reanalysis a very convenient and popular dataset to work with.

The observing system has changed drastically over time, and although the assimilation system can resolve data from the initially much sparser networks will lead to less accurate estimates. For this reason, ERA5 includes an uncertainty



### ERA5 hourly data on pressure levels from 2000 to present

Overview Download data Documentation

Variable

At least one selection must be made

<input type="checkbox"/> Divergence	<input type="checkbox"/> Fraction of cloud cover	<input type="checkbox"/> Geopotential
<input type="checkbox"/> Ozone mass mixing ratio	<input type="checkbox"/> Potential vorticity	<input type="checkbox"/> Relative humidity
<input type="checkbox"/> Specific cloud ice water content	<input type="checkbox"/> Specific cloud liquid water content	<input type="checkbox"/> Specific humidity
<input type="checkbox"/> Specific snow water content	<input type="checkbox"/> Temperature	<input type="checkbox"/> Specific rain water content
<input type="checkbox"/> V-component of wind	<input type="checkbox"/> Vertical velocity	<input type="checkbox"/> U-component of wind
		<input type="checkbox"/> Vorticity (relative)

Select all

Pressure level

At least one selection must be made

<input type="checkbox"/> 1 hPa	<input type="checkbox"/> 2 hPa	<input type="checkbox"/> 3 hPa
<input type="checkbox"/> 5 hPa	<input type="checkbox"/> 7 hPa	<input type="checkbox"/> 10 hPa
<input type="checkbox"/> 20 hPa	<input type="checkbox"/> 30 hPa	<input type="checkbox"/> 50 hPa
<input type="checkbox"/> 70 hPa	<input type="checkbox"/> 100 hPa	<input type="checkbox"/> 125 hPa
<input type="checkbox"/> 150 hPa	<input type="checkbox"/> 175 hPa	<input type="checkbox"/> 200 hPa
<input type="checkbox"/> 225 hPa	<input type="checkbox"/> 250 hPa	<input type="checkbox"/> 300 hPa
<input type="checkbox"/> 350 hPa	<input type="checkbox"/> 400 hPa	<input type="checkbox"/> 450 hPa
<input type="checkbox"/> 500 hPa	<input type="checkbox"/> 550 hPa	<input type="checkbox"/> 600 hPa
<input type="checkbox"/> 650 hPa	<input type="checkbox"/> 700 hPa	<input type="checkbox"/> 750 hPa
<input type="checkbox"/> 775 hPa	<input type="checkbox"/> 800 hPa	<input type="checkbox"/> 825 hPa
<input type="checkbox"/> 850 hPa	<input type="checkbox"/> 875 hPa	<input type="checkbox"/> 900 hPa
<input type="checkbox"/> 925 hPa	<input type="checkbox"/> 950 hPa	<input type="checkbox"/> 975 hPa
<input type="checkbox"/> 1000 hPa		

Select all

Product type

Reanalysis  Ensemble members  Ensemble mean

Ensemble spread

Select all Clear all

Year

At least one selection must be made

<input type="checkbox"/> 2000	<input type="checkbox"/> 2001	<input type="checkbox"/> 2002
<input type="checkbox"/> 2003	<input type="checkbox"/> 2004	<input type="checkbox"/> 2005
<input type="checkbox"/> 2006	<input type="checkbox"/> 2007	<input type="checkbox"/> 2008







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# The Climate Data Store: Seasonal forecasts

Simplicity and consistency are key

Home Search Datasets Applications Your requests Toolbox FAQ or Live

## Search results

Search dataset

All Applications Datasets

Sort by

Relevancy

Title

Product type

Satellite observations (4)

Variable domain

Atmosphere (composition) (4)

Land (biosphere) (2)

Land (cryosphere) (2)

Land (hydrology) (2)

Ocean (physics) (7)

Spatial coverage

Global (4)

Temporal coverage

Past (4)

Showing 1-4 of 4 results for **Satellite observations** x **Atmosphere (composition)** x

**Carbon dioxide data from 2002 to present derived from satellite sensors**

Carbon dioxide (CO<sub>2</sub>) is a naturally occurring Greenhouse gas, but one whose abundance has been increased substantially above its pre-industrial value of some 280 ppm by human activities, primarily bec...

**Aerosol properties gridded data from 1995 to present derived from satellite observations**

This data set provides observational records of aerosol properties obtained from observations collected by various satellite instruments. Aerosols are minor constituents of the atmosphere by mass, but...

**Ozone monthly gridded data from 1970 to present**

This dataset provides estimates of the montly mean values of the ozone concentration, mixing ration and mole content over the globe from a large set of satellite sensors. Most of the ozone data produc...

**Methane data from 2002 to present derived from satellite sensors**

Methane (CH<sub>4</sub>) is the second most significant greenhouse gases that has increased in concentration in the atmosphere directly due to human activities, from the viewpoint of the radiative forcing of cl...

## Aerosol properties gridded data from 1995 to present derived from satellite observations

Overview Download data Documentation

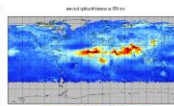
This data set provides observational records of aerosol properties obtained from observations collected by various satellite instruments. Aerosols are minor constituents of the atmosphere by mass, but critical components in terms of impact on climate. Aerosols influence the global radiation balance directly by scattering and absorbing radiation, and indirectly through influencing cloud reflectivity, cloud cover and cloud lifetime.

The main variables provided by this dataset are: aerosol optical depth, fine mode aerosol optical depth, dust aerosol optical depth, single scattering albedo, aerosol layer height and aerosol extraction coefficient. These variables are derived from observations from several sensors using a set of different processing techniques. This provides the possibility to derive a large set of complementary aerosol properties needed to describe the complex nature of atmospheric aerosols. Furthermore, different algorithms have their specific strengths and weaknesses, meaning that datasets originating from the same sensor but processed by different algorithms provide a way to evaluate uncertainties (e.g. areas of good or bad agreement between them). Although the aerosol properties dataset is very extensive and offers a choice of complementary options - which is appropriate depends on the intended application.

Selected observational records in this dataset are extended in time on a semi-annual basis. At the moment of extending, these records are up-to-date until five months behind present time.

This dataset is produced on behalf of CES.

More details about the products are given in the Documentation section.



DATA DESCRIPTION	
Data type	Gridded
Horizontal coverage	Global
Horizontal resolution	2.5° x 2.5° for aerosol extraction coefficient 1° x 1° for all other variables.
Temporal coverage	June 1995 to present with 5 month delay
Temporal resolution	5-daily composite for the aerosol extraction coefficient Daily and monthly for all other variables
File format	NetCDF
Conventions	Climate and Forecast (CF) Metadata Convention v1.6 Attribute Convention for Dataset Discovery (ACDD) v1.3
Update frequency	6 months Full mission reprocessing every 2-3 years

MAIN VARIABLES		
Name	Units	Description
Aerosol extinction coefficient	Dimensionless	Aerosol extinction coefficient (AEX) is the fraction of radiant flux (or light) absorbed and scattered by aerosol present in a volume of atmosphere, per unit length. Extinction coefficients are provided on multiple levels through the atmosphere.
Aerosol layer height	km	Aerosol layer height (ALH) provides the average altitude of the aerosol loading. It can be interpreted as the height level at which the largest aerosol extinction is observed. Aerosol layer height is derived from observations collected by different sensors.
Aerosol optical depth	Dimensionless	Aerosol optical depth (AOD), or sometimes Aerosol optical thickness is a measure of the degree to which transmission of light through a volume of atmosphere is reduced due to extinction (scattering and absorption) by aerosol. It is equivalent to the integral of the extinction coefficient over a vertical column of unit cross section. Typical global average aerosol optical depth is about 0.1%. In rare cases, atmospheric aerosol optical depth can reach 3. Typically aerosol optical depth observations are reported at the end-of-mission reference value of 500 km.
Dust aerosol layer height	km	Aerosol layer height specific to dust type aerosol.
Dust aerosol optical depth	Dimensionless	Dust aerosol optical depth (DAOD) is the part of total aerosol optical depth resulting from the presence of mineral dust particles (derived from deserts such as the Sahara and potentially transported in the atmosphere over thousands of kilometers). Dust aerosol optical depth is helpful for constraining the type of aerosol.
Fine mode aerosol optical depth	Dimensionless	Fine mode aerosol optical depth (FMAOD) is the part of total aerosol optical depth resulting from the presence of aerosol particles with diameter smaller than 1 micrometer (this includes mostly secondary aerosols from combustion and fires such as sulfates, nitrates, black and brown carbon). Fine mode aerosol optical depth is helpful for constraining the type of aerosol.
Single scattering albedo	Dimensionless	Single scattering albedo (SSA) provides the fraction of total aerosol extinction that results from scattering (as opposed to absorption) of light by aerosol particles. Typical values range from 0.8 for strongly absorbing aerosol types (e.g. soot) to 1 for non-absorbing aerosol types (e.g. sea salt). Single scattering albedo is helpful for constraining aerosol the type of aerosol.

## Aerosol properties gridded data from 1995 to present derived from satellite observations

Overview Download data Documentation

Time aggregation

At least one selection must be made

- Daily average
- 5-daily composite

Monthly average

Variable

At least one selection must be made

- Aerosol optical depth
- Dust aerosol optical depth
- Aerosol layer height
- Aerosol extinction coefficient

- Fine mode aerosol optical depth
- Single scattering albedo
- Dust aerosol layer height

Select all

Sensor on satellite

At least one selection must be made

- AATSR on ENVISAT
- SLSTR on SENTINEL 3A
- POLDER on PARASOL
- IASI on METOPA
- GOMOS on ENVISAT

- ATSR2 on ER2
- SLSTR on SENTINEL 3B
- MERIS on ENVISAT
- OLCI on SENTINEL 3A

Algorithm

At least one selection must be made

ADV (AATSR dual view)

BRAC (Optimal Retrieval of Aerosols and Clouds)

SWANSEA (Swanee University)

ULB (Universite Libre de Bruxelles)

AERGOIN (Algorithm for stratospheric Aerosol extinction retrieval from GOMOS observations)

IMAPS (Infrared Mineral Aerosol Retrieval Scheme)

ENS (Product based on an ensemble of algorithms)

GRASP (General Retrieval of Aerosol and Surface Properties)

SDV (SLSTR dual view)

S4M (SeaWiFS algorithms for MERIS sensor)

MAPIR (Multiscale Aerosol Profiling from thermal infrared Radiance)

DLR (DLR0000000000)

XBAER (Extensible Bremen Aerosol Retrieval)

LMD (Laboratoire de Météorologie Dynamique)

Year

At least one selection must be made

- 1995
- 1997
- 1999
- 2001
- 2003
- 2005
- 2007
- 2009
- 2011
- 2013
- 2015

- 1996
- 1998
- 2000
- 2002
- 2004
- 2006
- 2008
- 2010
- 2012
- 2014
- 2016



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# The Climate Data Store: API data access

<input type="checkbox"/> 07	<input type="checkbox"/> 08	<input checked="" type="checkbox"/> 09	<input type="checkbox"/> 10
<input type="checkbox"/> 13	<input type="checkbox"/> 14	<input type="checkbox"/> 15	<input type="checkbox"/> 16
<input type="checkbox"/> 19	<input type="checkbox"/> 20	<input type="checkbox"/> 21	<input type="checkbox"/> 22
<input type="checkbox"/> 25	<input type="checkbox"/> 26	<input type="checkbox"/> 27	<input type="checkbox"/> 28
<input type="checkbox"/> 31			

Format ⓘ

Zip file (.zip)

Com

Terms of use

GHG-CCI Licence

[View terms](#)

[Hide API request](#)

[Show Toolbox request](#)

Please go to [the documentation page](#) for information as to how to use the CDS API.

```
import cdsapi

c = cdsapi.Client()

c.retrieve(
  'satellite-methane',
  {
    'format': 'zip',
    'processing_level': 'level_2',
    'variable': 'xch4',
    'sensor_and_algorithm': 'sciamachy_wfmd',
    'year': '2004',
    'month': '03',
    'day': '09'
  },
  'download.zip')
```

```
import cdsapi
```

```
c = cdsapi.Client()
```

```
c.retrieve(
```

```
  'satellite-methane',
```

```
  {
```

```
    'format': 'zip',
```

```
    'processing_level': 'level_2',
```

```
    'variable': 'xch4',
```

```
    'sensor_and_algorithm': 'sciamachy_wfmd',
```

```
    'year': '2004',
```

```
    'month': '03',
```

```
    'day': '09'
```

```
  },
```

```
  'download.zip')
```

<https://cds.climate.copernicus.eu/api-how-to>

pip install cdsapi

ECMWF

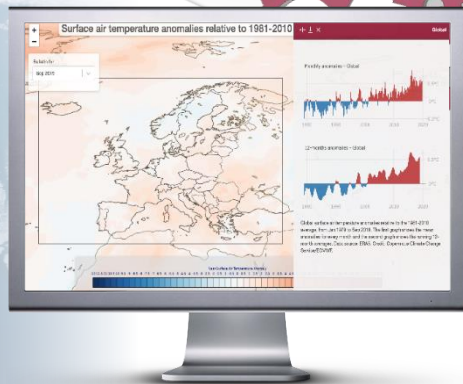


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# The Climate Data Store: online processing

## Distributed Data providers

[My First Workflow demonstration document](#)



**Online capabilities to process the data  
and develop applications**



Europe's eyes on Earth





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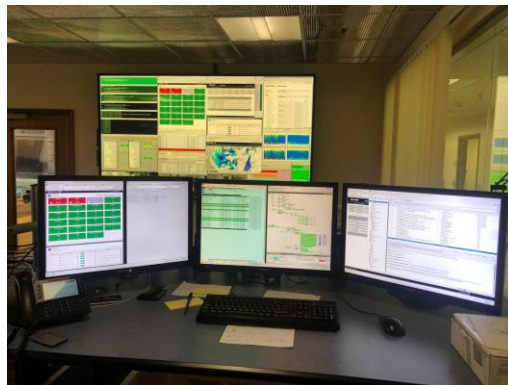
# The Climate Data Store: an operational system



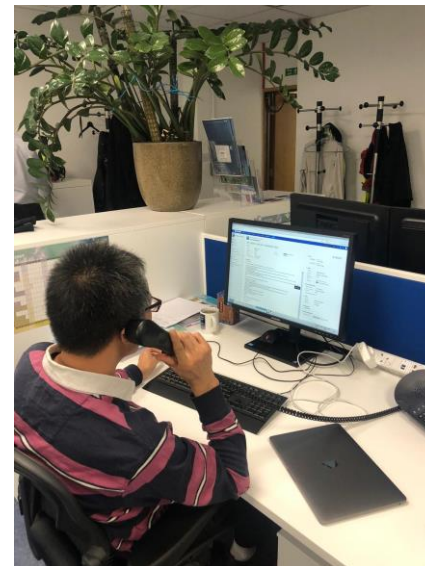
## On-Premises Private Cloud

72+ nodes, 4000+ CPUs, 13TB RAM

3.9 PB usable (of which 380TB SSD)



Monitoring, Capacity building,  
reporting, backups, ...



Support, help desk

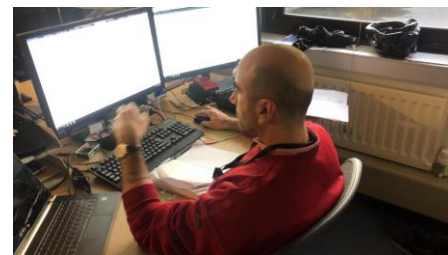


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# The Climate Data Store: an operational system



## A dedicated DevOps team



EMS

European Meteorological Society

EMS  
Technology Achievement  
Award 2019

awarded by the  
European Meteorological Society  
to the

Copernicus Climate  
Data Store

The Copernicus Climate Data Store supports  
climate services in Europe by providing  
seamless access to high-quality climate  
datasets, past, present and future.

*Bob Ridgway*  
Bob Ridgway  
President

European Meteorological Society



Europe's eyes on Earth





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# Thank you

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

