

C3S: El Servicio de Cambio Climático de Copernicus



Climate Change

Joaquín Muñoz Sabater
European Centre for Medium-Range Weather Forecasts (ECMWF)

Introducción a los servicios climáticos – Universidad Politécnica de Valencia, 04 July 2024

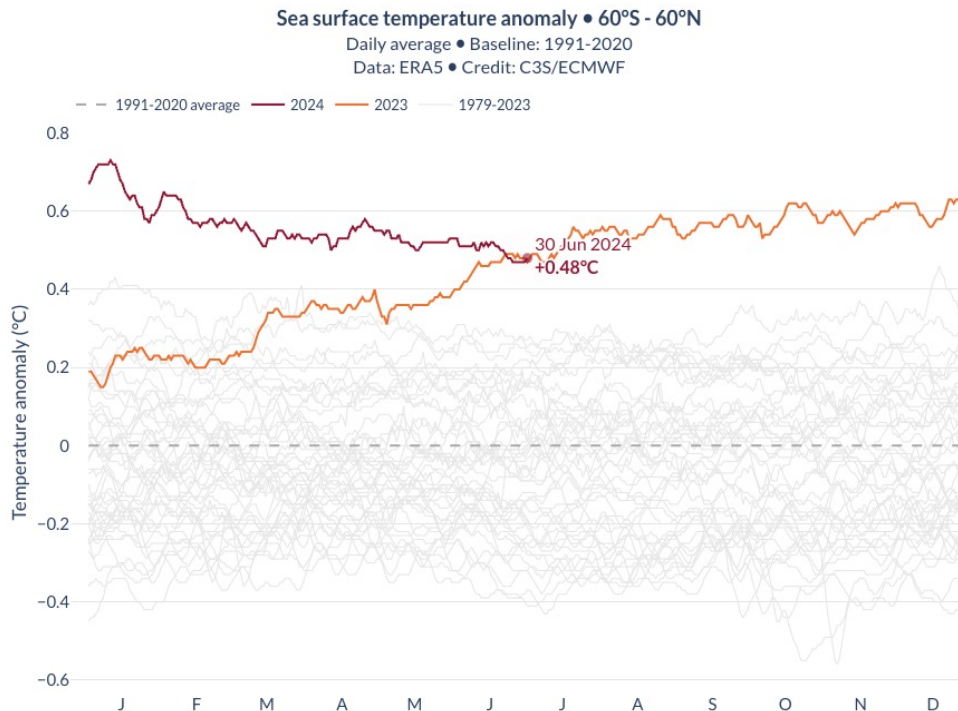
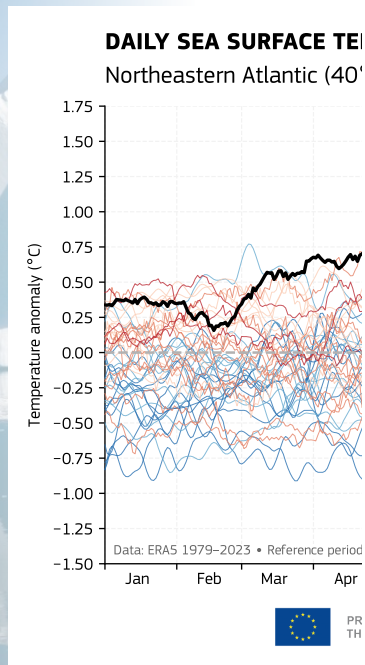




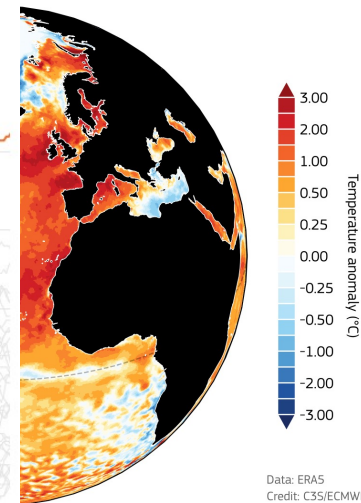
Climate Change

Living on uncharted territories

Absolute values Anomalies



ANOMALY • JUNE 2023
for 1991-2020



Copernicus
EUROPEAN COMMISSION

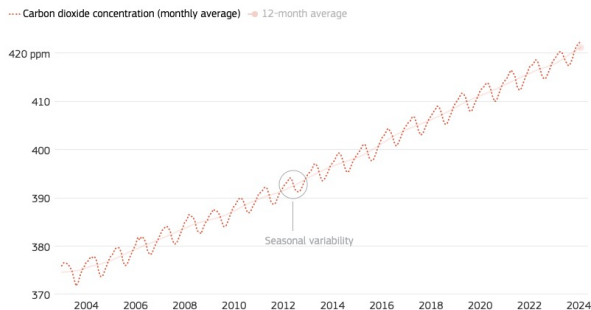
EUROPEAN COMMISSION
ECMWF



Climate Change

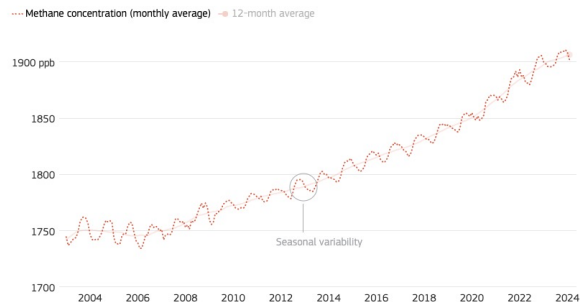
Are we still living on uncharted territories?

Atmospheric concentration of carbon dioxide globally



Data source: C3S/Obs4MIPs (v4.5) consolidated (2003–2022) and CAMS preliminary near real-time column-averaged data (2023) GOSAT-2 (CO₂) records - Credit: C3S/CAMS/ECMWF/University of Bremen/SRON

Atmospheric concentration of methane globally

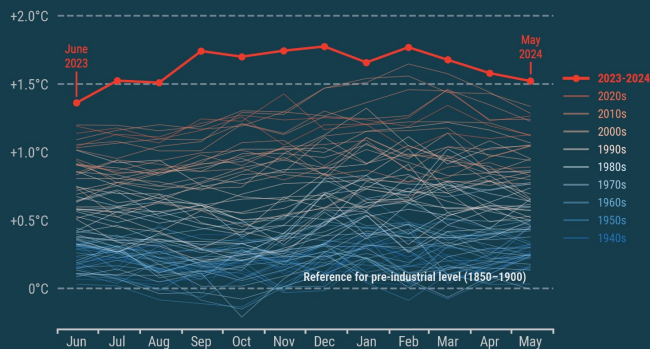


Data source: C3S/Obs4MIPs (v4.5) consolidated (2003–2022) and CAMS preliminary near real-time column-averaged data (2023) GOSAT (CH₄) records - Credit: C3S/CAMS/ECMWF/University of Bremen/SRON

Greenhouse gas concentrations reached new record high levels in 2023

Monthly global surface temperature increase above pre-industrial

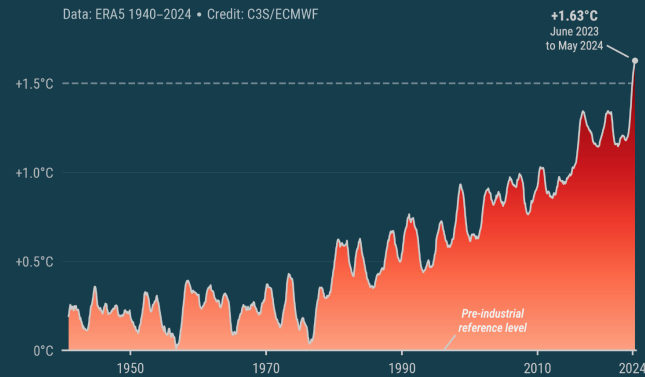
Data: ERA5 1940–2024 • Reference period: 1850–1900 • Credit: C3S/ECMWF



Global surface temperature increase above pre-industrial

12-month running mean anomalies relative to the 1850–1900 average

Data: ERA5 1940–2024 • Credit: C3S/ECMWF

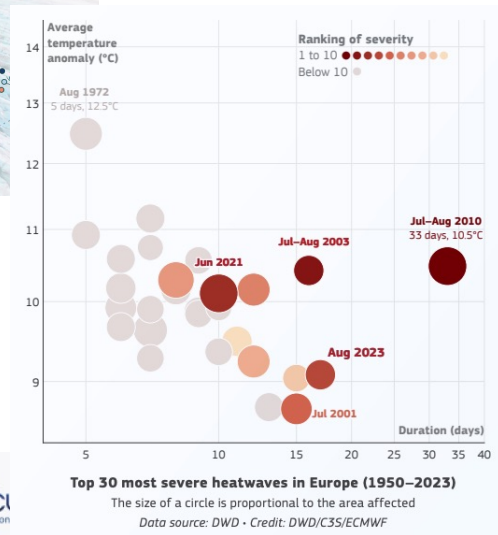
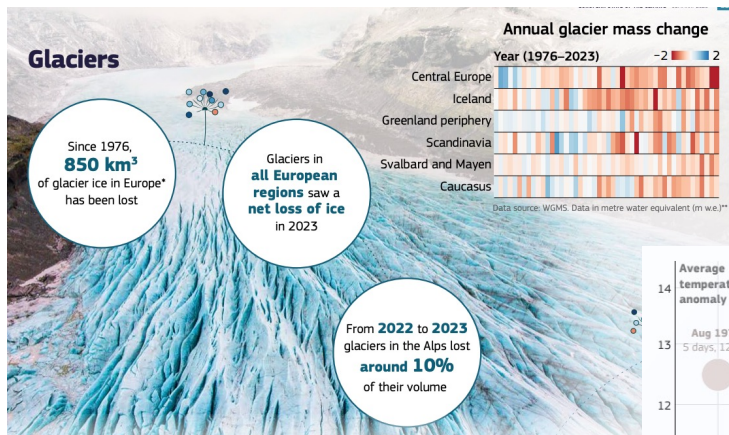
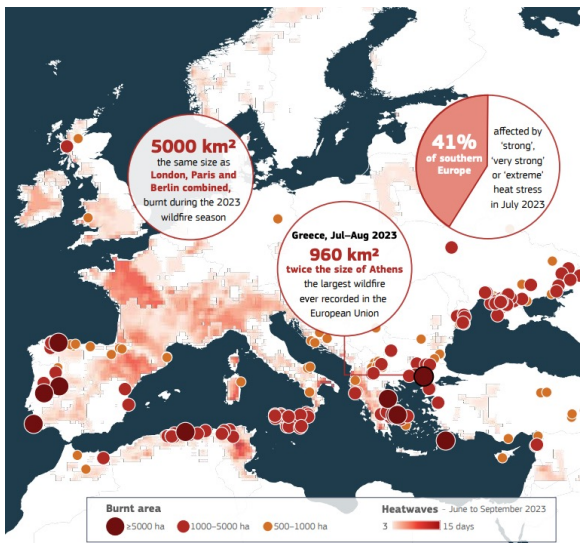




Climate Change

Living on uncharted territories

The consequences of the world continuing to warm are becoming ever more obvious. Stopping the warming requires reducing greenhouse gas emissions as quickly as possible





Climate
Change

Outline

¿ Qué es el Servicio Europeo de Cambio Climático (C3S) ?

¿ Qué productos se ofrecen ?

¿Cómo acceder a los productos de C3S y qué herramientas de apoyo existen ?


¿ Qué es y que hace la 'Climate Intelligence' componente de C3S?

¿ Algún otro componente en C3S ?

Open, complete, free

Earth Observation component of the EU Space Programme

Sentinels



CLIMATE CHANGE



MARINE MONITORING



ATMOSPHERE MONITORING



LAND MONITORING



SECURITY



EMERGENCY MANAGEMENT

1st MFF (2014-2020): ~ €4.3 billions

2nd MFF (2021-2027): ~ €5.4 billions

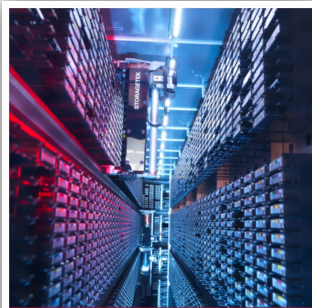


Climate Change

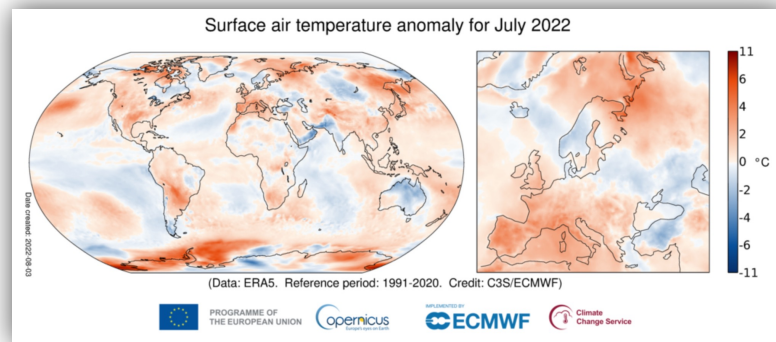
What is the Copernicus Climate Change Service (C3S)?

<p>Water management</p> <p>We provide our users with the data and tools they need to prepare for climate variability and change in the water sector. For example, our data services provide information on changes in river discharge, droughts and floods.</p>	<p>Agriculture and forestry</p> <p>We use climate data to help the agricultural sector predict the climate-dependent variations in annual crop yields in the regions to which our data have been used to assess how long-term variations in the climate may affect investment decisions for woody crops and forests.</p>	<p>Insurance</p> <p>We use climate data to help the insurance sector with data that identifies the historical occurrence of some specific extreme weather events, such as windstorms.</p>	<p>Energy</p> <p>We support the energy sector, which is increasingly relying on renewable energy production, by providing climate-related information, such as forecasts of air temperature, atmospheric transparency, wind strength, and projections of wave size and frequency.</p>
<p>Infrastructure, Transport and Associated Standards</p> <p>We provide climate indicators that can be used to help build resilient cities able to mitigate the challenges that climate change pose to infrastructure.</p>	<p>Health</p> <p>We provide access to high-resolution maps of temperature and heat-wave frequency for major urban centres across Europe. We also provide forecasts of the distribution of pollen and vector-borne diseases.</p>	<p>Coastal areas</p> <p>Fisheries are an important part of the European economy. We provide information on the future distribution of key ocean variables and their impacts on the aquatic ecosystem, including species distribution and possible changes in fish stocks.</p>	<p>Disaster risk reduction</p> <p>We provide climate information to support policies related to disaster risk reduction, as well as practices to address weather emergencies.</p>
<p>Shipping</p> <p>We use seasonal indicators and climate projections to inform shipping companies of new opportunities and threats using up-to-date climatologies and future trends in key climate variables such as winds, wave and ice forecasts.</p>	<p>Tourism</p> <p>The warming climate has the potential to significantly affect the appeal of tourist destinations. Working with experts we provide indicators able to inform personal and business decisions on seasonal and multi-annual forecasts.</p>	<p>Biodiversity</p> <p>Climate change puts high pressure on global biodiversity and is likely to become one of the most significant drivers of biodiversity loss in the 21st century.</p>	<p>Global Users</p> <p>We aim to facilitate climate adaptation workbooks and offer an interactive web application with refined data, guidance and practical information.</p>

The Copernicus Climate Change Service (C3S) operationally provides information and data in support of adaptation decision and mitigation policies



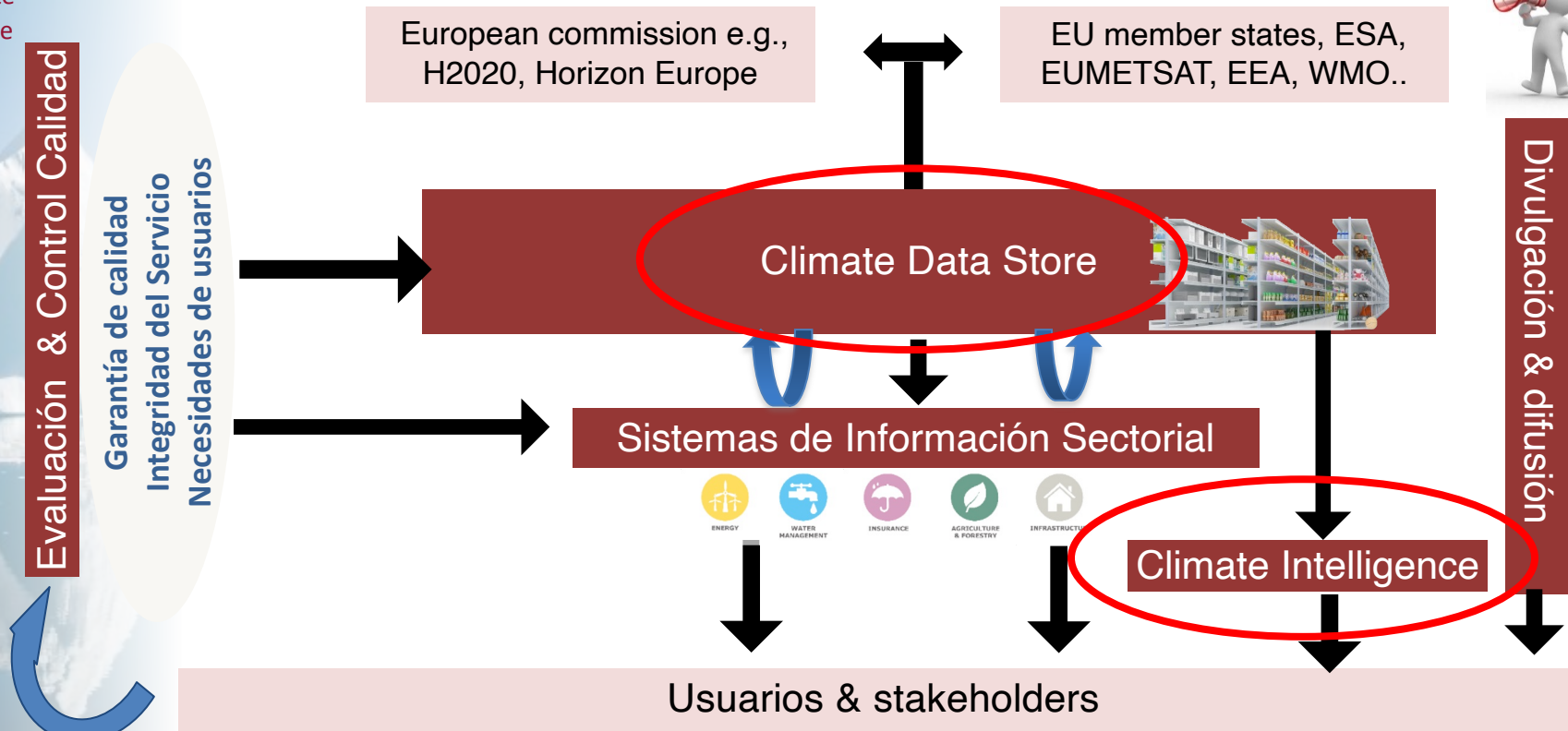
Climate Data Store





Climate
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Estructura de C3S





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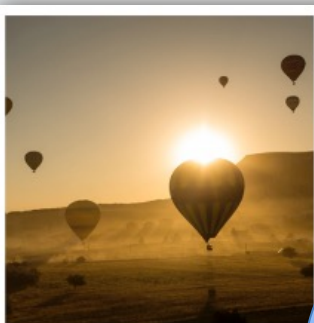
¿ Qué es y que hace la 'Climate Intelligence' componente de C3S?

¿ Algún otro componente en C3S ?



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



Observations

Observations are key to understanding the climate system. C3S users can access a vast variety of instrumental data records, ranging from historic weather observations to the latest measurements from space.

[Read more >](#)



Climate reanalyses

Climate reanalyses combine past observations with models to generate consistent time series for a large set of climate variables. Reanalyses are among the re-used data products in physical sciences.

[Read more >](#)

[Reanalysis data on the CDS >](#)

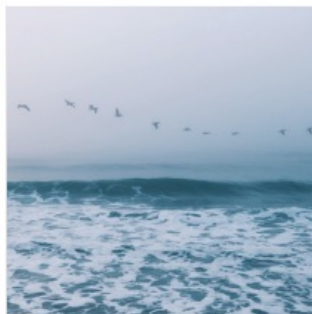


Seasonal forecasts

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THE EUROPEAN UNION



implemented by





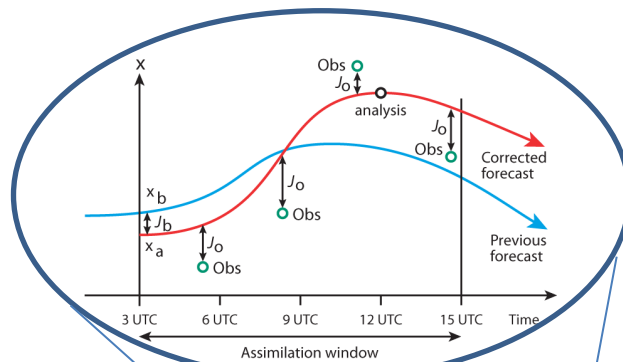
Climate
Change

What is the reanalysis?

MODELING

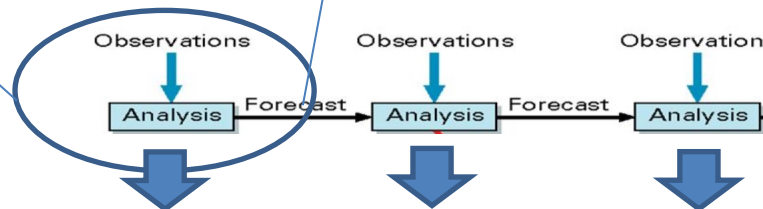


OBSERVATIONS



Data assimilation & reanalysis

Combining information from observations and models to provide an estimate of weather and climate over multi-decadal timescales



Types: **Global (ERA5)**

Regional (CARRA & UERRA)

Specialized (ERA5-Land)



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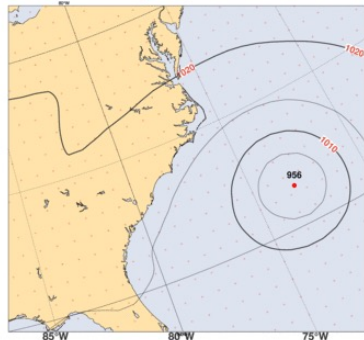
Climate Change

Maps without gaps: global atmospheric reanalysis ERA5

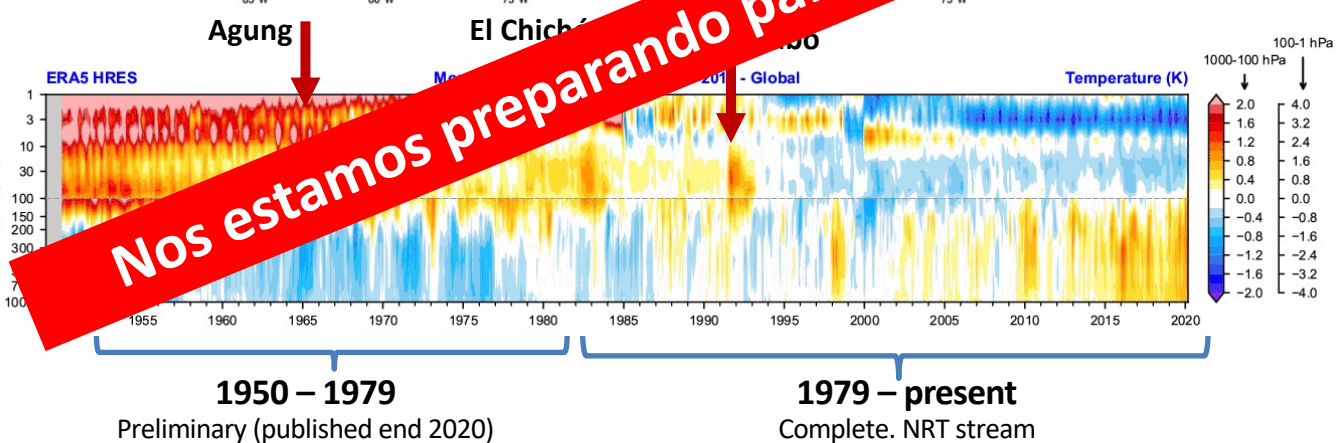
ERA5:

Spatial resolution: 31 km
Temporal resolution: hourly
Period: 1940-present

Florence Thu 13 Sep 2018, 01 UTC for ERA-Interim



Florence Thu 13 Sep 2018, 01 UTC for ERA5



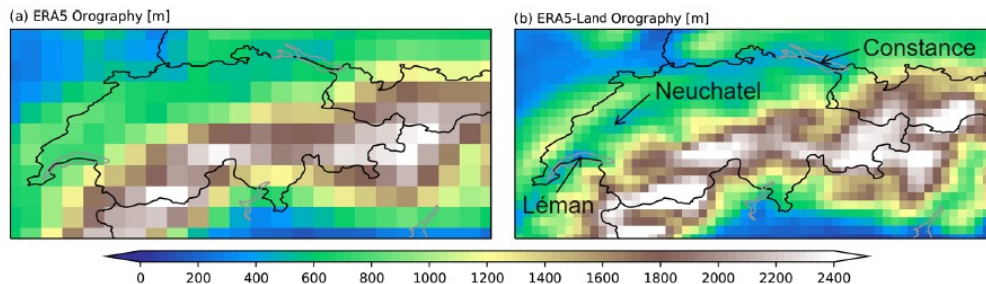
Hersbach et al., 2020 (Quart. J. Roy. Met. Soc.),
<https://doi.org/10.1002/qj.3803>



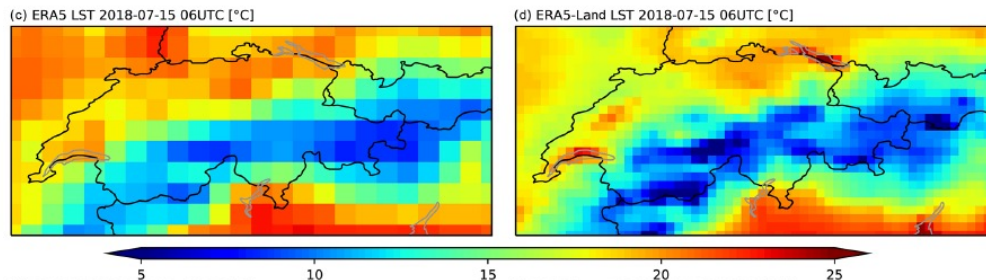
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High-resolution and consistency for the land evolution: ERA5-Land (1950-present)

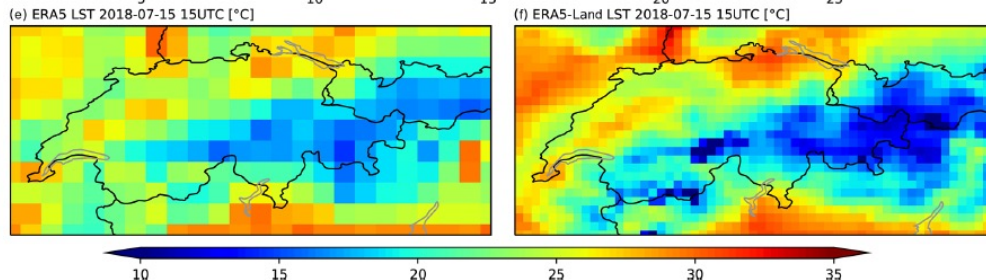
orography



Soil Temperature
(15 July 2018
06UTC)



Soil Temperature
(15 July 2018
15UTC)



ERA5-Land:
Spatial resolution: 9 km
Temporal resolution: hourly
Period: 1950-present
Land consistency
NRT stream – daily data

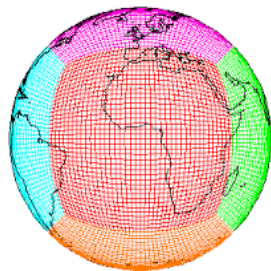
Muñoz-Sabater et al., 2021 (Earth Syst. Sc. Data),
<https://doi.org/10.5194/essd-13-4349-2021>





Climate Change

Regional reanalyses - Why do we need them?



Global reanalyses



Station		Date		Time		Temperature		Humidity		Wind		Pressure		Clouds		Precipitation		Other		
St. No.	Name	Year	Month	Day	Hour	Temp.	Humid.	Wind	Press.	Clouds	Precip.	Other	St. No.	Name	Year	Month	Day	Hour	Temp.	
1	2

local observations

Regional models at higher horizontal resolution

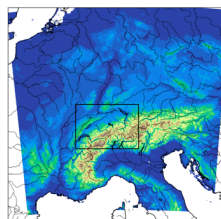
- 2.5 km in the Arctic or 5.5 km for Europe
- Wind field better account for to the local orography
- More detailed description of extreme events.

Additional (local) observations

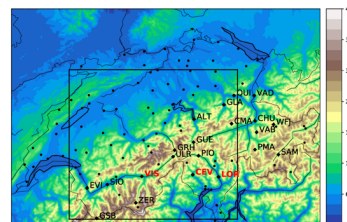
- Local surface observations and slightly different treatment of satellite data where possible

Better description of surface characteristics

- Sea surface temperature, sea ice concentration, glacier albedo, snow cover for the Arctic
- Additionally, orography and soil information and vegetation on 1 km resolution for Europe



(a)



(b)

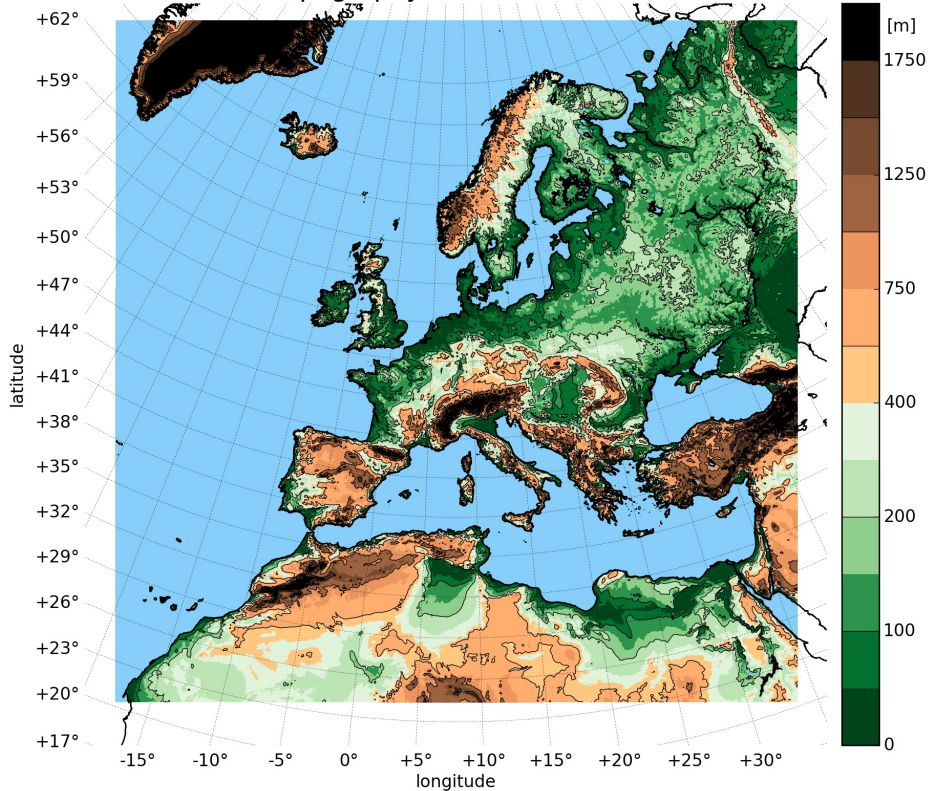


C3S regional reanalyses: domains (left: Europe, right: European part of the Arctic)

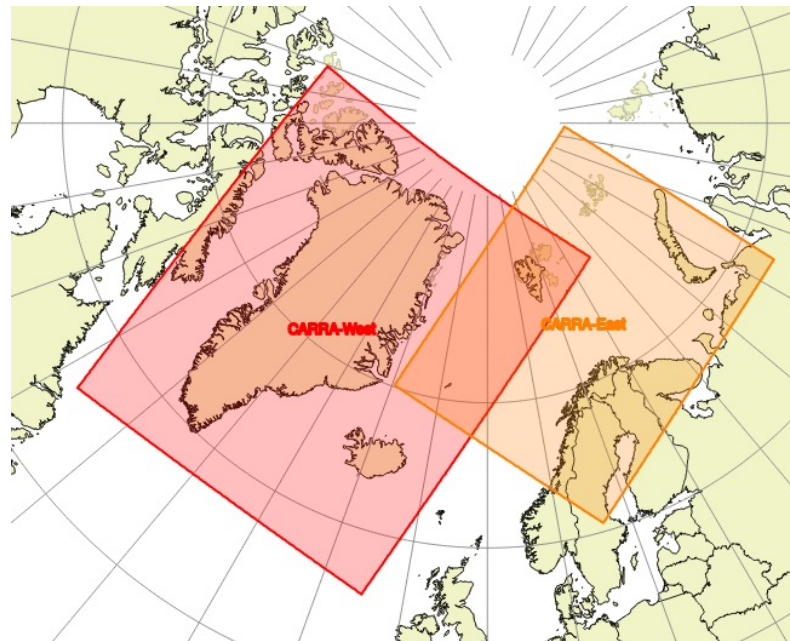
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UERRA

Topography and ocean mask



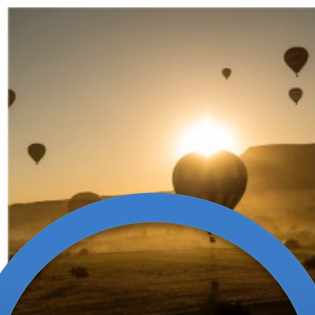
CARRA





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



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[Read more >](#)



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Climate reanalyses combine past observations with models to generate consistent time series for a large set of climate variables. Reanalyses are among the most-used datasets in the geophysical sciences.

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[Reanalysis data on the CDS >](#)

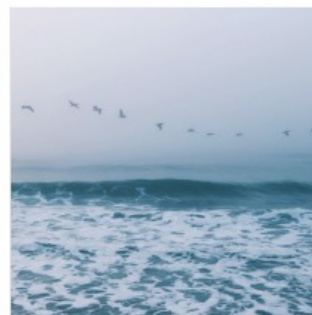


Seasonal forecasts

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Climate projections

Projections of future climate change are available for different scenarios for concentrations of greenhouse gases and aerosols, based on outputs from multiple global and regional climate models.

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Essential Climate Variables

We use historical observations from in-situ and satellite sensors to build Climate Data Records of Essential Climate Variables (ECVs)



Required to support the work of the UNFCCC and the IPCC

In total 55 ECVs
GCOS 2022 Implementation Plan



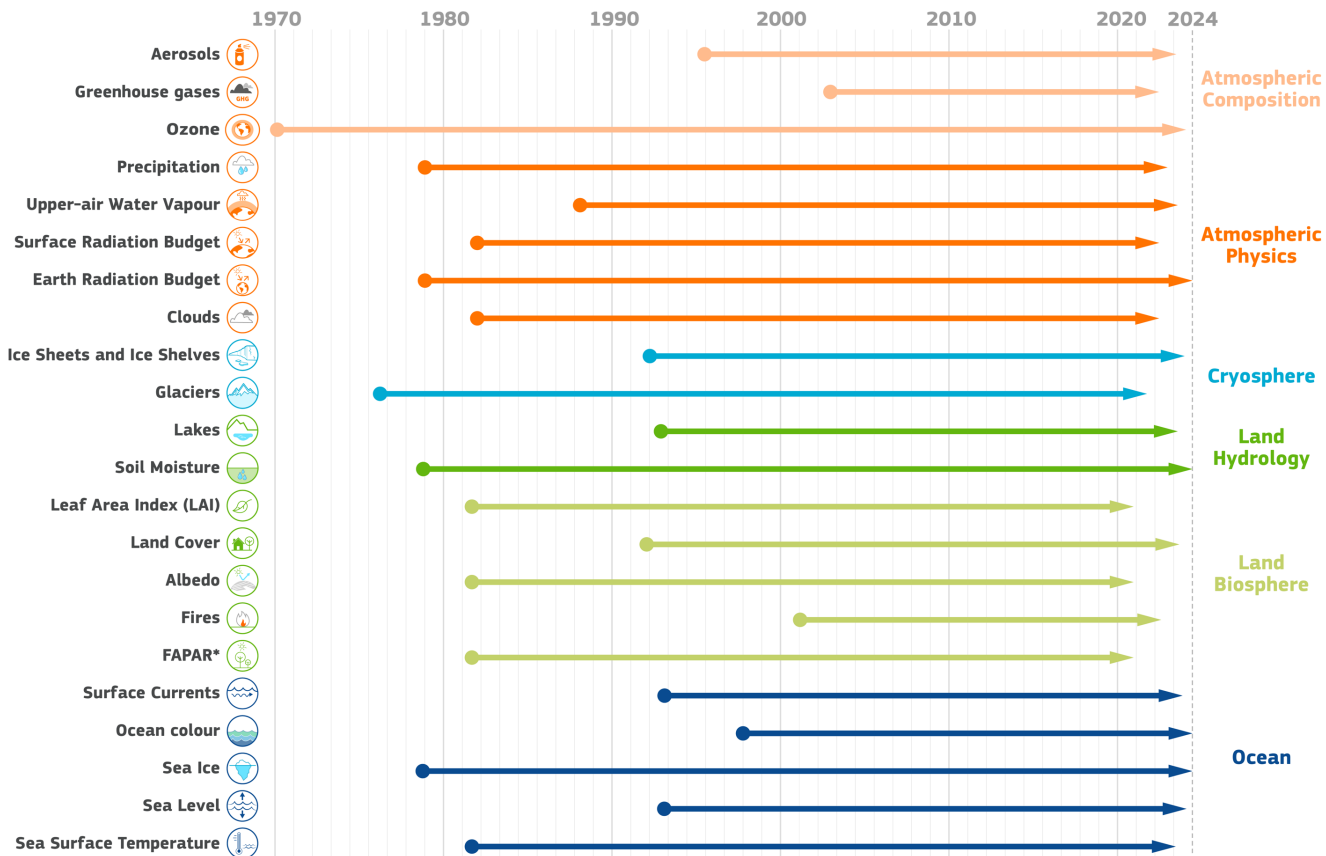
ECV – climate data records



Based on satellite data, they monitor trends and variability

Involve close coordination and collaboration with major providers (ESA, EUMETSAT) and Copernicus Services

Their production require the expertise of many public and private entities in Europe

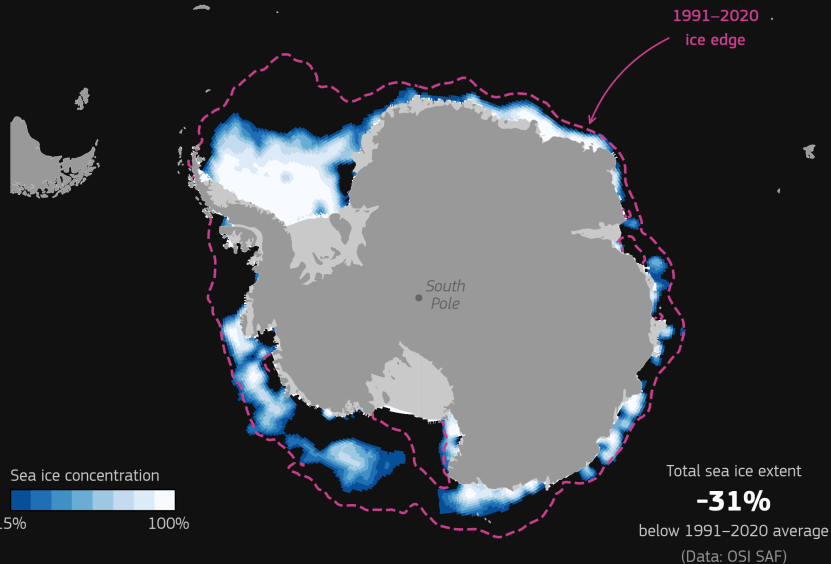




Ocean domain

ANTARCTIC SEA ICE • JANUARY 2023

Data: ERA5 & OSI SAF Sea Ice Index v2.2 • Credit C3S/ECMWF/EUMETSAT



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IMPLEMENTED BY



Monthly mean sea ice concentrations around Antarctica in 2023

Data: ERA5 (sea ice concentration), EUMETSAT OSI SAF Sea Ice Index v2.2 (sea ice extent anomaly).

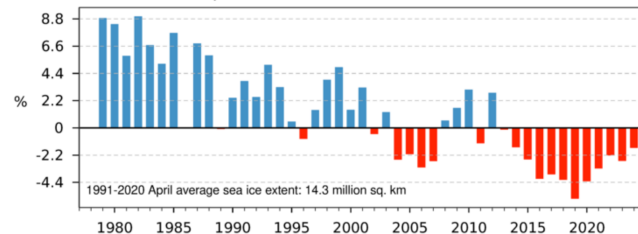
Credit: C3S/ECMWF/EUMETSAT

Arctic

1991-2020

1981-2010

April Arctic sea ice extent anomalies



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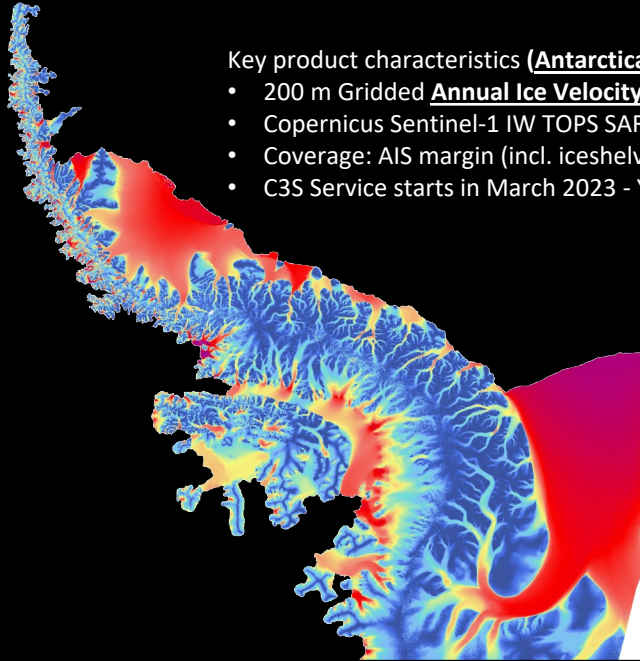


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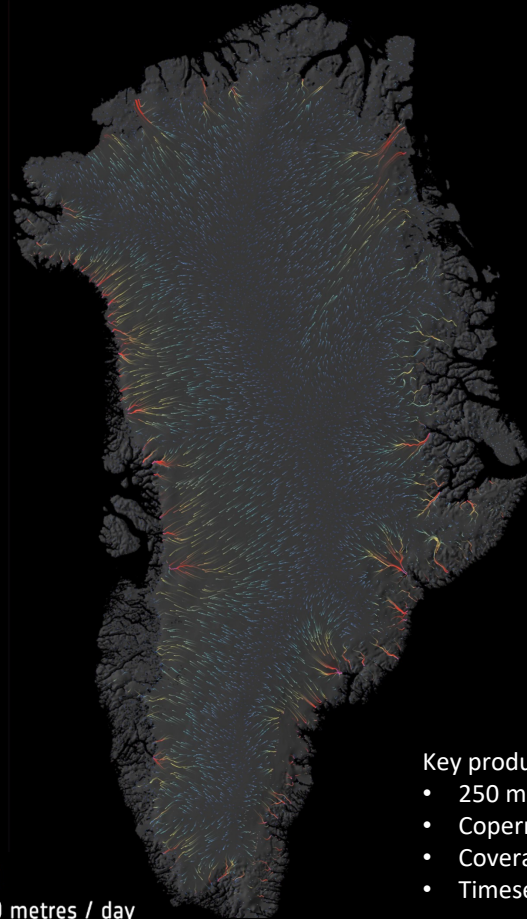




Cryosphere domain



- Key product characteristics (**Antarctica**)
- 200 m Gridded **Annual Ice Velocity Maps**
 - Copernicus Sentinel-1 IW TOPS SAR
 - Coverage: AIS margin (incl. iceshelves)
 - C3S Service starts in March 2023 - Yearly updates



- Key product characteristics (**Greenland**)
- 250 m Gridded **Annual Ice Velocity Maps**
 - Copernicus Sentinel-1 IW TOPS SAR
 - Coverage: AIS margin (incl. iceshelves)
 - Timeseries starts in 2014 - Yearly updates



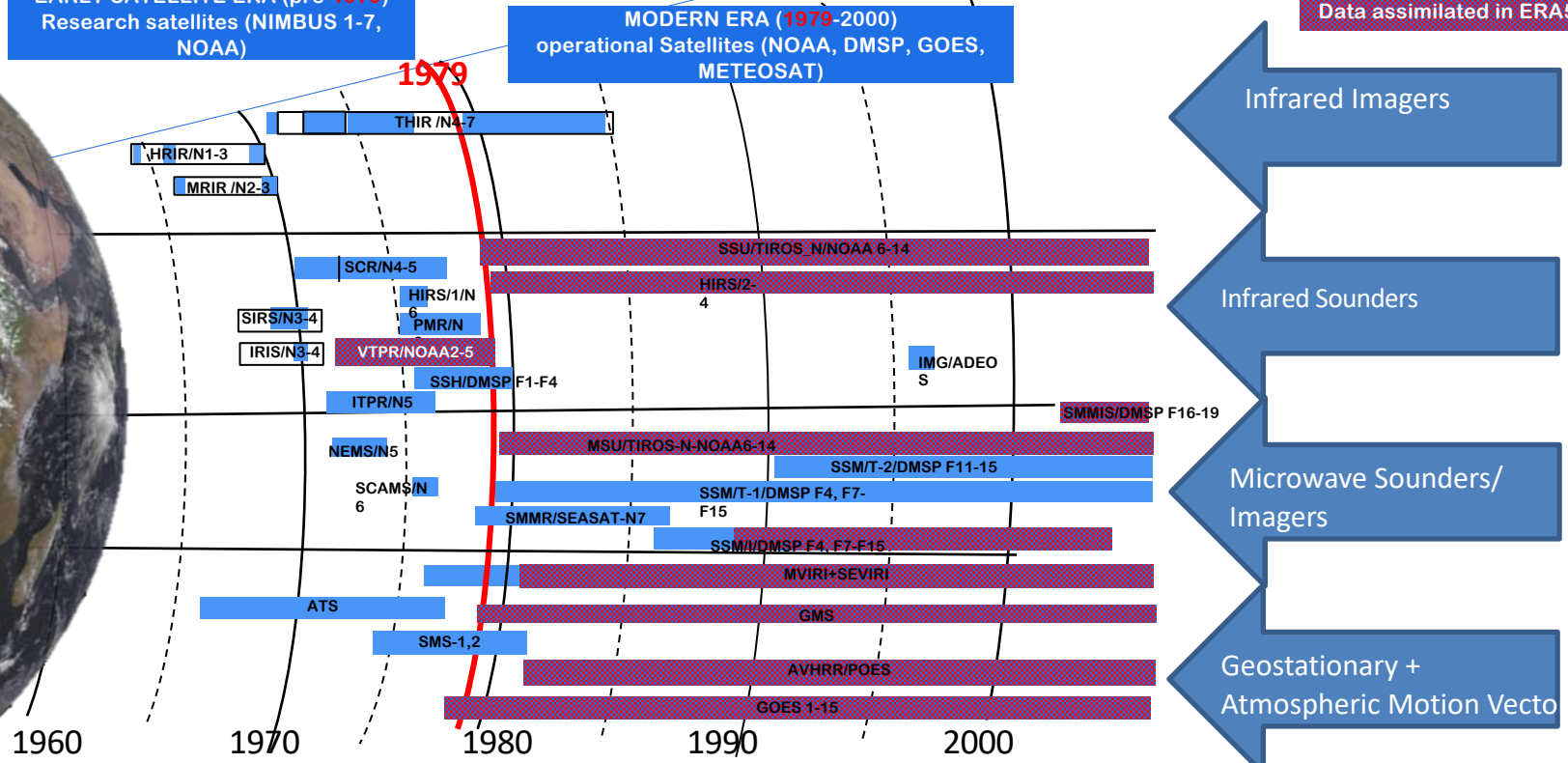
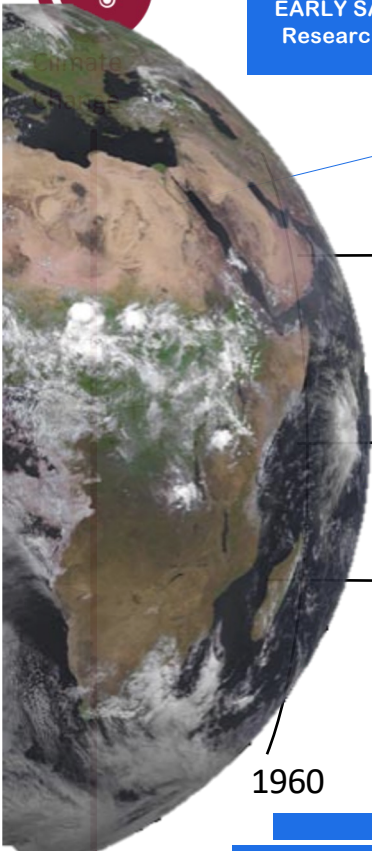
Satellite data rescue

EARLY SATELLITE ERA (pre-1979)
 Research satellites (NIMBUS 1-7, NOAA)

MODERN ERA (1979-2000)
 operational Satellites (NOAA, DMSP, GOES, METEOSAT)

Data not yet assimilated

Data assimilated in ERA5



Reprocessing (recalibration, navigation, ...), quality assessment

Data Rescue: decoding original data, reformatting, archiving & QC



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implemented by **ECMWF**



Climate Change

Importance of data rescue



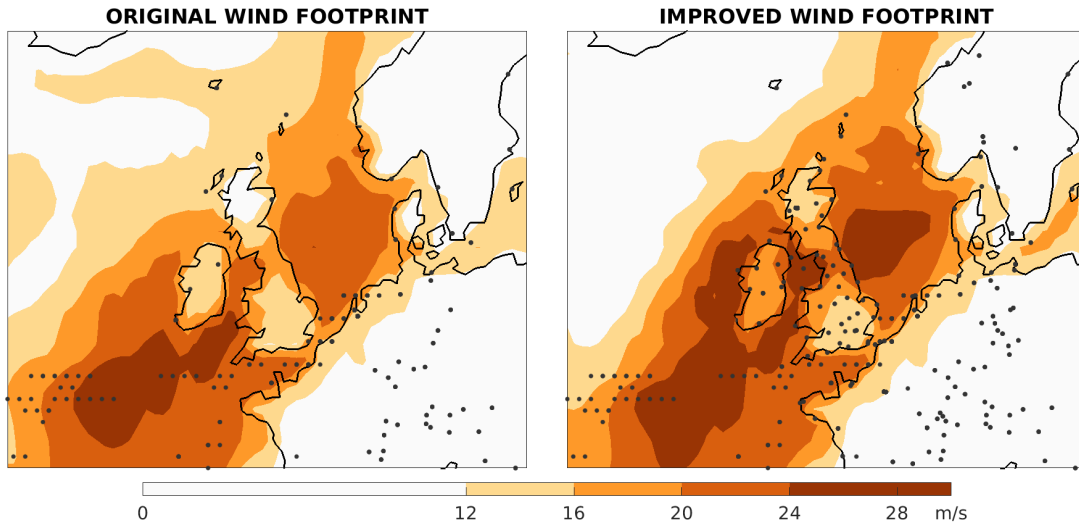
GREAT STORM, FEBRUARY 27, 1903.
Phoenix Park—2,048 Trees blown down (1,242 Forest Trees, 1,706 Thorns).

DAILY WEATHER REPORT
for 8 a.m. on Friday, 27th February, 1903.
Issued by the METEOROLOGICAL OFFICE, 68, Victoria Street, London. W. N. SHAW, Secretary.

STATIONS.	VELOCITY SYSTEM. (See note on last page)				WINDS RECORDING. (See note on last page)								PART M. RECORD.				
	Dir.	Force	Wind.	Wave.	Dir.	Force	Dir.	Force	Dir.	Force	Dir.	Force	Dir.	Force	Dir.	Force	
Hagstranda ...	27 27	2	W	0	29.35	10.2	32	7	10.2	2	0	—	—	—	—	—	—
Herringönd ...	27 26	2	W	0	29.36	10.2	32	7	10.2	2	0	—	—	—	—	—	—
Stockholm ...	27 26	2	W	0	29.46	10.2	32	7	10.2	2	0	—	—	—	—	—	—
Widby ...	27 27	2	W	0	29.73	10.2	32	7	10.2	2	0	—	—	—	—	—	—
Karlbad ...	27 27	2	W	0	29.73	10.2	32	7	10.2	2	0	—	—	—	—	—	—
Färder (Östn. Pann)	27 27	2	W	0	29.73	10.2	32	7	10.2	2	0	—	—	—	—	—	—
Bodo ...	27 27	2	W	0	29.73	10.2	32	7	10.2	2	0	—	—	—	—	—	—
Christiansund ...	27 27	2	W	0	29.73	10.2	32	7	10.2	2	0	—	—	—	—	—	—
Skudenesnes ...	27 27	2	W	0	29.73	10.2	32	7	10.2	2	0	—	—	—	—	—	—
Samburgh Head	27 26	2	W	0	29.73	10.2	32	7	10.2	2	0	—	—	—	—	—	—
Sornoway ...	27 26	2	W	0	29.73	10.2	32	7	10.2	2	0	—	—	—	—	—	—
Main Head	27 27	2	W	0	29.73	10.2	32	7	10.2	2	0	—	—	—	—	—	—
Blackrod Pt.	27 27	2	W	0	29.73	10.2	32	7	10.2	2	0	—	—	—	—	—	—
Valerick ...	27 27	2	W	0	29.73	10.2	32	7	10.2	2	0	—	—	—	—	—	—
Roche's Point ...	27 27	2	W	0	29.73	10.2	32	7	10.2	2	0	—	—	—	—	—	—
Parsonsstown ...	27 27	2	W	0	29.73	10.2	32	7	10.2	2	0	—	—	—	—	—	—
Dunashole ...	27 27	2	W	0	29.73	10.2	32	7	10.2	2	0	—	—	—	—	—	—
Liverpool Obay ...	27 27	2	W	0	29.73	10.2	32	7	10.2	2	0	—	—	—	—	—	—
Holyhead ...	27 27	2	W	0	29.73	10.2	32	7	10.2	2	0	—	—	—	—	—	—
Penrhynde (on Ass.)	27 27	2	W	0	29.73	10.2	32	7	10.2	2	0	—	—	—	—	—	—
Castle (on Marston)	27 27	2	W	0	29.73	10.2	32	7	10.2	2	0	—	—	—	—	—	—

'Ulysses' windstorm of February 1903, which hit Ireland and UK

- Data for many European locations rescued from paper.



- Wind footprint in a reanalysis of the event was not severe enough to cause known damage. Adding rescued data (new black dots) produced a credible reanalysis of the storm.



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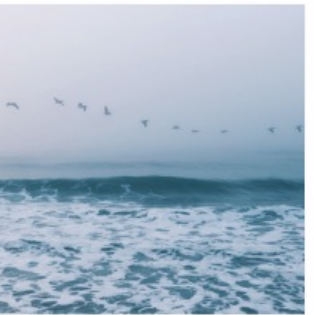
implemented by ECMWF



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



			
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Climate Change

C3S seasonal prediction: components



DATA PRODUCTS

cds.climate.copernicus.eu

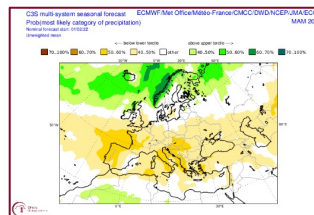


GRAPHICAL PRODUCTS

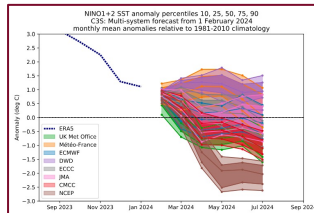
climate.copernicus.eu/charts/packages/c3s_seasonal/

- ❑ Datasets available in the Climate Data Store
 - Atmosphere
 - daily and subdaily data (6h, 12h, 24h)
 - monthly statistics (mean, max, min, standard deviation)
 - bias corrected data (monthly anomalies)
 - Ocean monthly means
- ❑ Multi-system retrospective forecasts and real-time forecasts, the latter published on 6th (ECMWF) and 10th day of month (the rest)

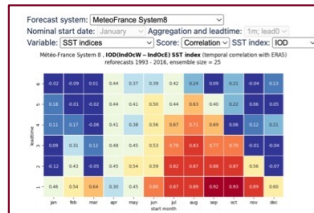
Products for individual contributing systems and multi-system combination



- Total precipitation
- Near-surface temperature and wind
- Mean sea-level pressure
- Sea surface temperature
- Sea ice concentration
- Geopotential height at 500 hPa
- Temperature at 850 hPa



- Sea surface temperature NINO regions
- Sea surface temperature Indian Ocean
- Zonal mean wind at 10hPa



- Temporal correlation
- Relative Operating Characteristic (ROC) score
- Ranked Probability Score (RPS)



CDS API

```
import cdsapi
c = cdsapi.Client()
c.retrieve(
  'seasonal-monthly-single-levels',
  {
    'format': 'grib',
    'originating_center': 'meteo_france',
    'variable': 'total_precipitation',
    'product_type': 'ensemble_mean',
    'ensemble_member': 'hindcast_climate_mean'
  },
  {
    'year': '2023',
    'month': '09',
    'leadtime_months': ['1', '2', '3', '4', '5', '6', '1'],
    'c3s_seasonal_output_grib'
  }
)
```





Climate Change

C3S seasonal prediction: components



DATA PRODUCTS

cds.climate.copernicus.eu

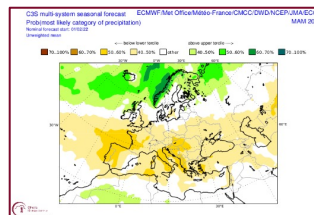


GRAPHICAL PRODUCTS

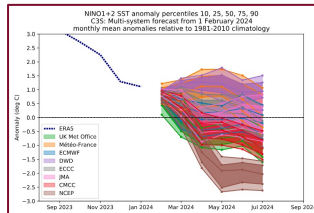
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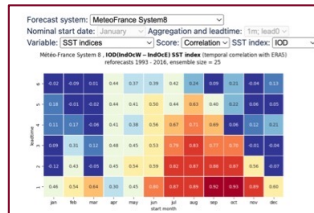
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        'originating_center': 'meteo_france',
        'variable': 'total_precipitation',
        'product_type': 'ensemble_mean',
        'ensemble_member': 'hindcast_climate_mean'
    },
    {
        'year': '2023',
        'month': '09',
        'time_slice_months': ['1', '2', '3', '4', '5', '6', '1'],
        'c3s_seasonal_output_grib'
    }
)
```

Python workflows



Coming soon



PROGRAMME OF THE EUROPEAN UNION

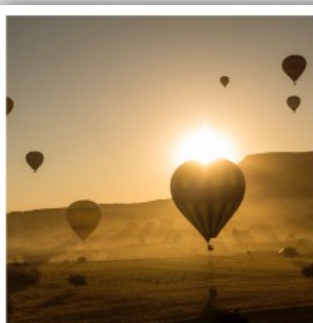


IMPLEMENTED BY



Climate
Change

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



Observations

Observations are key to understanding the climate system. C3S users can access a vast variety of instrumental data records, ranging from historic weather observations to the latest measurements from space.

[Read more >](#)



Climate reanalyses

Climate reanalyses combine past observations with models to generate consistent time series for a large set of climate variables. Reanalyses are among the most-used datasets in the geophysical sciences.

[Read more >](#)

[Reanalysis data on the CDS >](#)

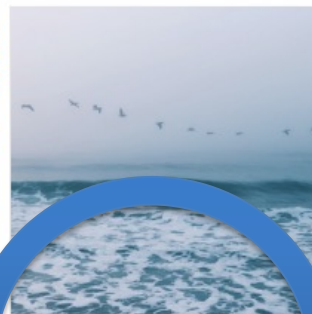


Seasonal forecasts

C3S seasonal forecasts combine outputs from several state-of-the-art seasonal prediction systems from providers in Europe and elsewhere. The latest data and products are published monthly on the Climate Data Store.

[Read more >](#)

[Seasonal forecast data on the CDS >](#)



Climate projections

Projections of future climate change are available for different scenarios for concentrations of greenhouse gases and aerosols, based on multiple global and regional models.

[Read more >](#)

[Climate projection data on the CDS >](#)



Climate
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Global climate projections

CMIP6 projections (CMIP5 data were in the CDS since 2018) published and updated in the CDS:

<https://cds.climate.copernicus.eu/cdsapp#!/dataset/projections-cmip6>

- This dataset is underpinning the IPCC AR6 report
- Compute processes are activated like temporal and spatial (horizontal and vertical) subsetting → reduction of data volumes
- CMIP6 decadal also available in the CDS

CMIP6 climate projections

Overview

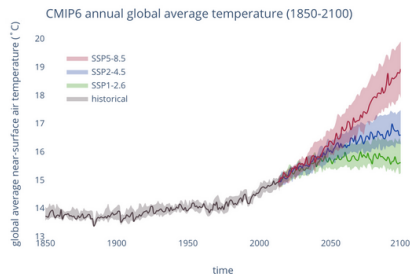
Download data

Documentation

This catalogue entry provides daily and monthly global climate projections data from a large number of experiments, models and time periods computed in the framework of the sixth phase of the Coupled Model Intercomparison Project (CMIP6).

CMIP6 data underpins the Intergovernmental Panel on Climate Change 6th Assessment Report. The use of these data is mostly aimed at:

- addressing outstanding scientific questions that arose as part of the IPCC reporting process;
- improving the understanding of the climate system;
- providing estimates of future climate change and related uncertainties;
- providing input data for the adaptation to the climate change;
- examining climate predictability and exploring the ability of models to predict climate on decadal time scales;
- evaluating how realistic the different models are in simulating the recent past.



Contact

copernicus-support@ecmwf.int

Licence

[CMIP6 - Data Access - Terms of Use](#)

Publication date

2021-03-23

References

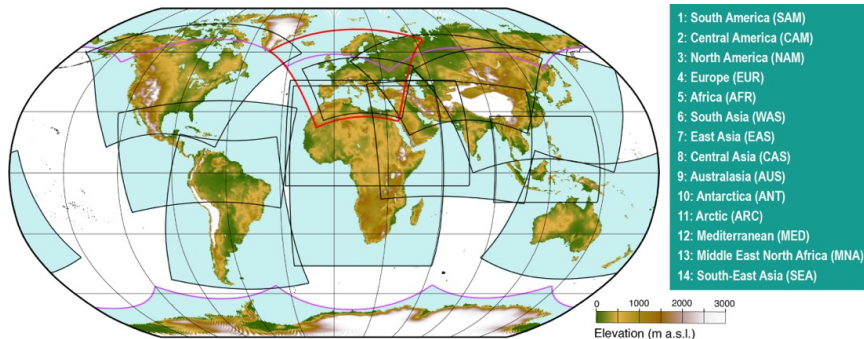
DOI: [10.24381/cds.d7eae3d](https://doi.org/10.24381/cds.d7eae3d)



Climate Change



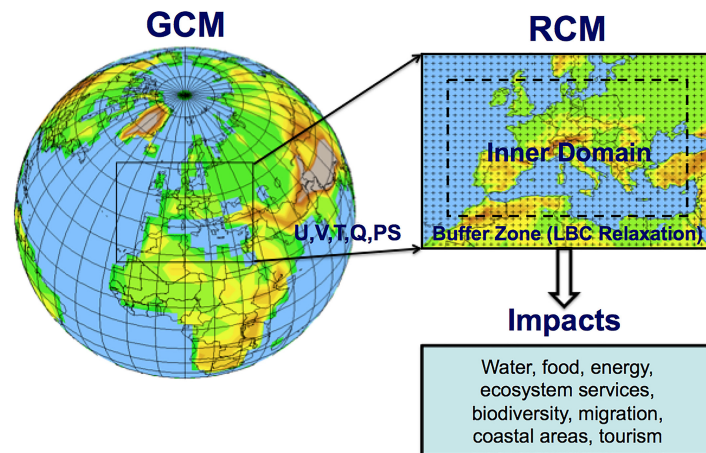
Regional climate projections: Europe and beyond



World-wide simulations: connected and aligned to the IPCC Climate Atlas.

Very large ensemble for Europe (130 simulations about half of which was funded by C3S)

New CORDEX simulations including high resolution EURO-CORDEX simulations and world-wide simulations for all 14 CORDEX domains published in the CDS



Copernicus Interactive Climate Atlas (C3S Atlas): demo of map features

Climate
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User guidance

Copernicus Interactive Climate Atlas

Mean temperature (°C) - CMIP6 - Change - Warming 2°C - Annual - rel. to 1850-1900

Mean temperature

CMIP6

AR6 Regions

Climatology and Changes

Global warming levels



PAST

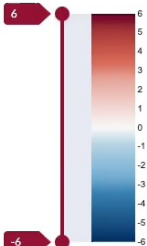
FUTURE

Quantity

Change

Season

Annual

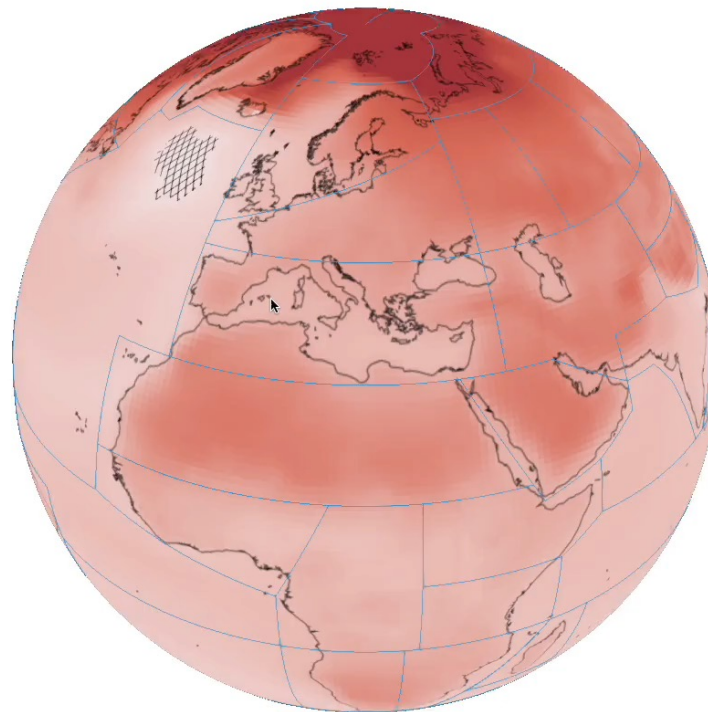


Units: °C

Robustness:

- Robust signal (original color)
- No change or no robust signal
- Conflicting signals

Palette AutoFit Reset





Climate
Change

Outline

¿ Qué es el Servicio Europeo de Cambio Climático (C3S) ?

¿ Qué productos se ofrecen ?

¿Cómo acceder a los productos de C3S y qué herramientas de apoyo existen ?

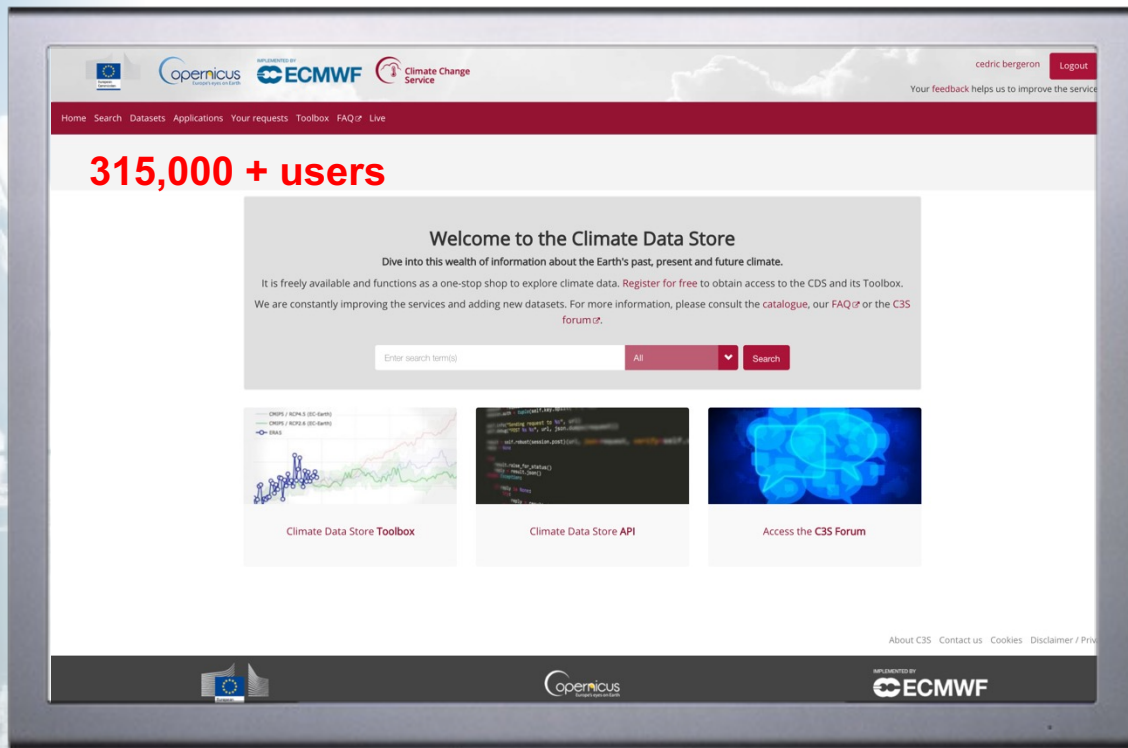
¿ Qué es y que hace la 'Climate Intelligence' componente de C3S?

¿ Algún otro componente en C3S ?



Climate
Change

The Climate Data Store



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

The **Climate Data Store** also called CDS, is an **online open and free service**.

It allows users to browse and access the wide range of climate datasets via a searchable catalogue...

... It allows users to build their own applications, maps and graphs

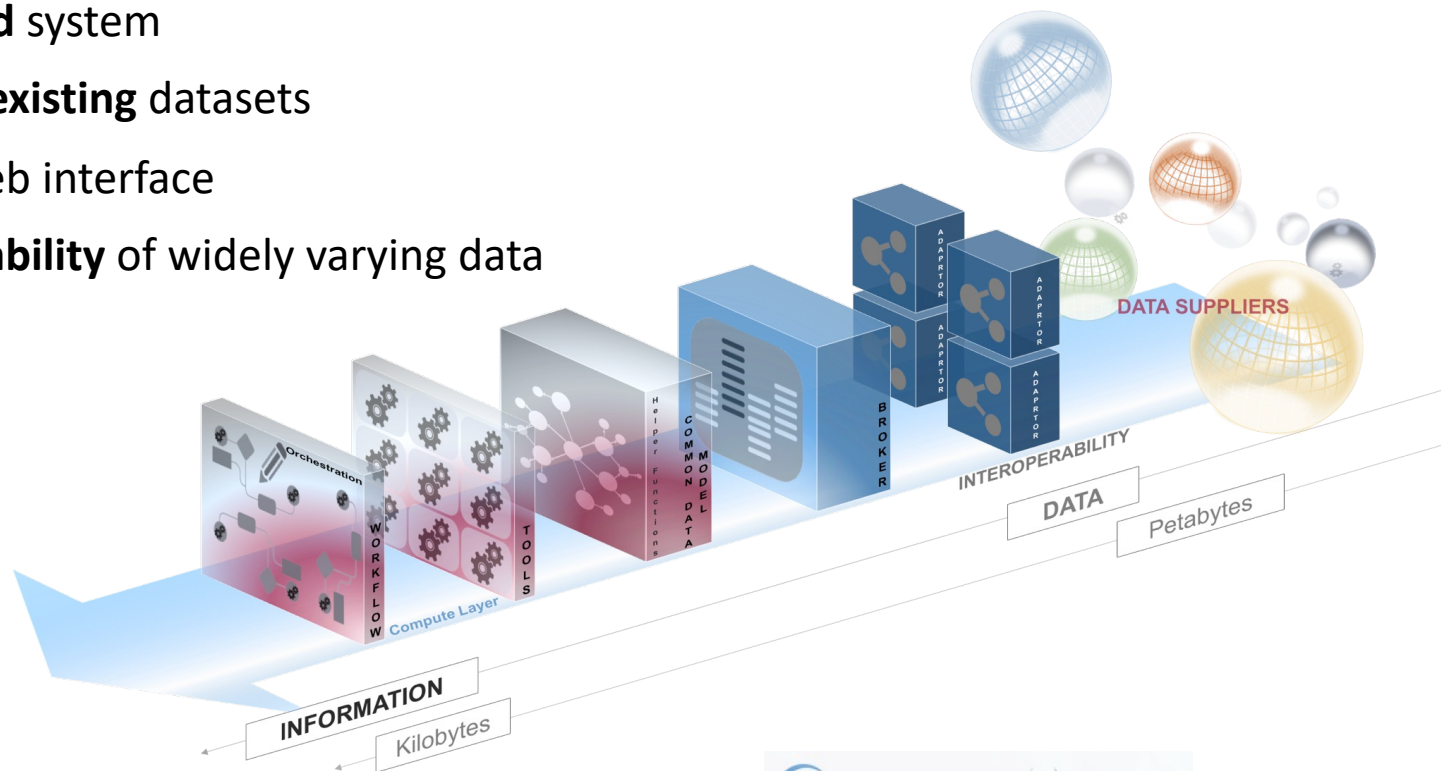




Climate
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The Climate Data Store

- **distributed** system
- access to **existing** datasets
- **unified** web interface
- **interoperability** of widely varying data





Climate
Change

The Climate Data Store

James Varndell Logout

Home Search Datasets Applications Your requests Toolbox Support Live

Search results

ERAS hourly single levels

Sort by
Relevancy
Title
Type

Showing 1-20 of 104 results for ERAS hourly single levels

ERAS hourly data on single levels from 1959 to present

ERAS is the fifth generation ECMWF reanalysis for the global climate and weather for the past 4 to 7 decades. Currently data is available from 1950, with Climate Data Store entries for 1950-1978 (preliminary back extension) and from 1959 onwards (final release plus timely updates, this page). ERA5 replaces the ERA-Interim reanalysis. Reanalysis combines model data with observations from across the...

Updated 2022-08-08

ERAS hourly data on single levels from 1950 to 1978 (preliminary version)

This entry is a preliminary version of the ERA5 reanalysis back extension from 1950 to 1978. Although in many other respects the quality of this dataset is quite satisfactory (Bell et al., 2021), this preliminary data does suffer from tropical cyclones that are sometimes unrealistically intense. This is in contrast with the ERA5 product from 1959 onwards. For more details see the articles, ERA5 ba...

Overview Download data Quality assessment Documentation

- [ERAS data documentation](#)
- [The ERA5 global reanalysis: Preliminary extension to 1950](#)
Journal article describing the ERA5 preliminary extension.
- [The ERA5 global reanalysis](#)
Journal article describing ERA5.
- [Renamed variable: form ocean waves 10m wind to ocean surface stress equivalent 10m neutral wind](#)
The reason for the change was a parameter name clash between variables in ERA5 wind and ERA5 ocean waves.

Simplicity and consistency are key



The Climate Data Store

Climate

Seasonal forecast monthly statistics on single levels

Overview Download data Quality assessment Documentation

Originating centre

ECMWF CMCC UK Met Office NCEP Météo France JMA

System

1 2 3 4 7 8 12 13 21 35 60 601

Variable

- 10m u-component of wind
- 10m wind gust since previous post-processing
- 2m dewpoint temperature
- East-west surface stress rate of accumulation
- Maximum 2m temperature in the last 24 hours
- Mean sub-surface runoff rate
- Minimum 2m temperature in the last 24 hours
- Sea-ice cover
- Snow depth
- Soil temperature level 1
- Surface latent heat flux
- Surface solar radiation
- Surface thermal radiation
- Top solar radiation
- Total cloud cover
- 10m v-component of wind
- 10m wind speed
- 2m temperature
- Evaporation
- Mean sea level pressure
- Mean surface runoff
- North-south surface stress rate of accumulation
- Sea surface temperature
- Snowfall
- Solar insolation rate of surface
- Surface sensible heat flux
- Surface solar radiation
- Surface thermal radiation
- Top thermal radiation
- Total precipitation

Select all Clear all

Surface radiation budget from 1982 to present derived from satellite observations

Overview Download data Quality assessment Documentation View

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

- CES (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

- Surface upwelling shortwave flux
- Surface upwelling longwave flux
- Surface downwelling shortwave flux
- Surface downwelling longwave flux
- Surface net downward shortwave flux
- Surface net downward longwave flux
- Surface net downward radiative flux
- All variables (CCI product family)
- Hydro power generation reservoirs
- Solar photovoltaic power generation
- Wind power generation onshore

Select all Clear all

Climate and energy indicators for Europe from 2005 to 2100 derived from climate projections

Overview Download data Documentation

Variable

Meteorology

- Electricity demand
- Hydro power generation rivers
- Wind power generation offshore
- Wind power generation onshore

Spatial aggregation

- Country level
- Maritime country level
- Original grid
- Sub-country level
- Maritime sub-country level

Energy product type

- Capacity factor ratio
- Energy
- Power

Temporal aggregation

- 3 Hourly
- Monthly
- Annual
- Daily
- Seasonal

CMIP6 climate projections

Overview Download data Documentation

Temporal resolution

- Monthly
- Daily
- Fixed (no temporal resolution)

Experiment

- Historical
- SSP4-6.0
- SSP1-1.9
- SSP3-7.0
- SSP5-2.6
- SSP5-8.5
- SSP4-3.4
- SSP5-3.4OS
- SSP2-4.5

Level

- Single levels
- 1 hPa
- 5 hPa
- 10 hPa
- 20 hPa
- 30 hPa
- 50 hPa
- 70 hPa
- 100 hPa
- 150 hPa
- 200 hPa
- 250 hPa
- 300 hPa
- 400 hPa
- 500 hPa
- 600 hPa
- 700 hPa
- 850 hPa
- 925 hPa
- 1000 hPa

Variable

- Air temperature
- Daily maximum near-surface air temperature
- Daily minimum near-surface air temperature
- Eastward near-surface wind
- Eastward wind
- Geopotential height
- Evaporation including sublimation and transpiration
- Grid-cell area for atmospheric grid variables
- Grid-cell area for ocean variables
- Land ice area percentage
- Moisture in upper portion of soil column
- Near-surface air temperature
- Capacity of soil to store water
- Eastward wind
- Grid-cell area for ocean variables
- Near-surface relative humidity

Simplicity and consistency are key



Climate
Change

The Climate Data Store

The screenshot displays the Climate Data Store (CDS) web interface. At the top, there are logos for the European Union, Copernicus, and ECMWF, along with the text 'Climate Change Service' and a 'Logout' button. Below the navigation bar, the 'Toolbox Editor' is active, showing a Python script for 'climate-strips'. The script uses the CDS API to retrieve climate data for a specific month and city, and then generates a visualization of 'warming stripes'. On the right side of the interface, there is a 'GUI' for configuring the application, with fields for 'Month' (set to 'January') and 'City' (set to 'Bonn (DE)'). Below the GUI, a live visualization shows a bar chart of 'warming stripes' for the selected month and city. The bottom of the interface shows a 'dataset catalogue' with various data products like 'climatology_mean', 'climatology_percentile', etc.

share applications

simple Python editor
in your web browser

configurable GUI
elements

dataset catalogue API
no downloads needed

interactive
visualisations

wide range of tools

backend caching

The CDS infrastructure is changing !

help and support

<https://cds-beta.climate.copernicus.eu/#!/home>

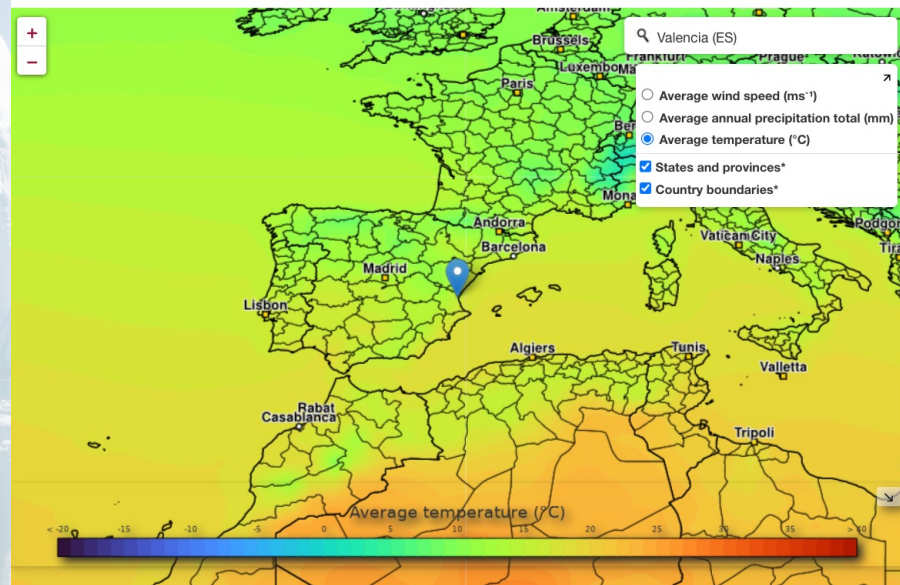


Climate Change

The Climate Data Store

Click anywhere on the map or search for a city to discover a range of local climate statistics for the period 1979-2020.

This application is driven by [ERA5](#), the fifth generation ECMWF atmospheric reanalysis of the global climate. Inspired by [Lobelia's Past Climate Explorer](#).



The designations employed and the presentation of material on the map do not imply the expression of any opinion whatsoever on the part of the European Union concerning the legal status of any country, territory or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

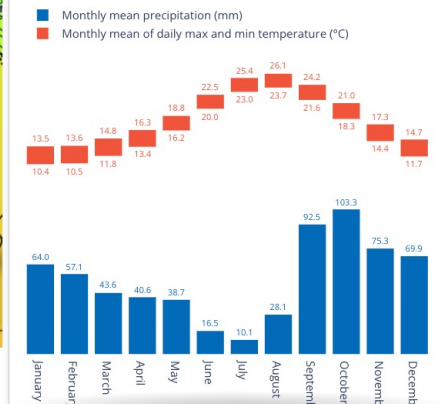
Valencia (39.47°N, 0.38°W)

Temporal aggregation: Monthly (climatologies)

Variable: Overview

Valencia had a hot-summer Mediterranean climate over the 1981-2010 period.

The climatology plot below shows the average daily maximum and minimum temperatures for each month of the year, along with typical monthly precipitation totals - all averaged over the 1981-2010 reference period.



<https://cds.climate.copernicus.eu/apps/c3s/app-era5-explorer>



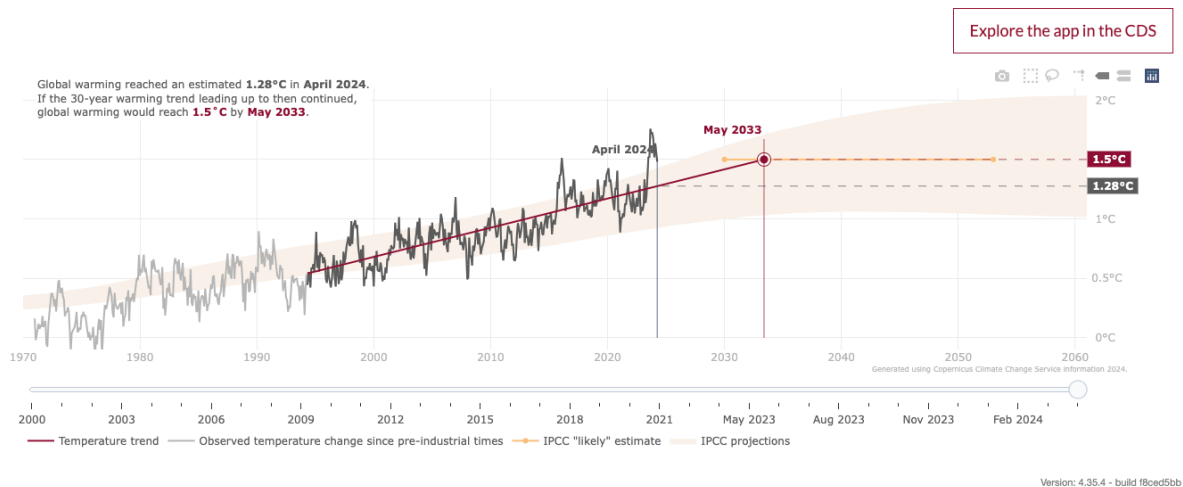


Climate
Change

The Climate Data Store

How close are we to reaching a global warming of 1.5°C?

Reaching 1.5°C of global warming - a limit agreed under the Paris agreement - may feel like a very distant reality, but it might be closer than you think. Experts suggest it is likely to happen between 2030 and the early 2050s. See where we are now and how soon we would reach the limit if the warming continued at today's pace. **Use the slider to explore how the estimate changes in time.**



<https://cds.climate.copernicus.eu/cdsapp#!/software/app-c3s-global-temperature-trend-monitor>



Climate
Change

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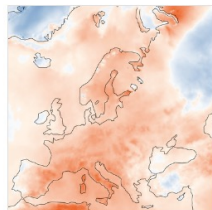
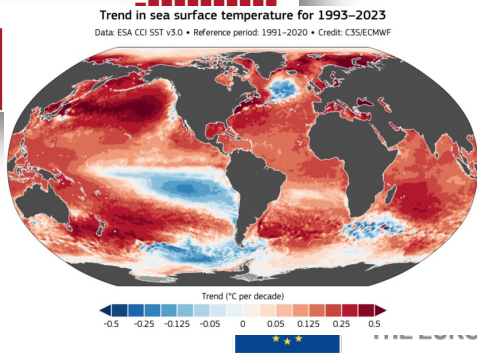
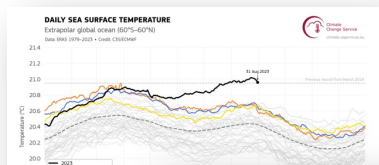
¿ Algún otro componente en C3S ?



Climate
Change

Climate Intelligence component

C3S Climate Intelligence provides information for a broad audience: policy makers, hydrological and meteorological agencies, the press, and the general public

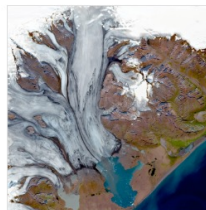


Climate Bulletins

A snapshot of climate conditions of the previous month or season, based on latest data on temperature, hydrological variables and sea ice for the Globe, Europe and the Polar regions. It is typically published between the 5th and the 8th of the following month.

[Read the latest Climate Bulletin](#)

[Read previous issues](#)

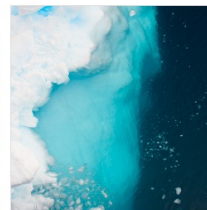


European State of the Climate (ESOTC)

A more in-depth publication than the monthly Climate Bulletins, the ESOTC provides information about the climate conditions of the previous year for Europe and the Arctic. The ESOTC is based on a wide range of climate data, including reanalysis, satellite- and in-situ observations, model estimates and on the expertise from across the C3S community, as well as other Copernicus services and external partners. It is typically published in April of the following year.

[Read ESOTC 2023](#)

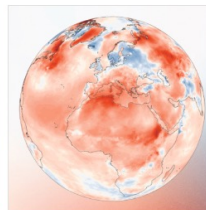
[Read previous issues](#)



Climate Indicators

Several key variables showing the long-term evolution used to assess the global and regional trends of a changing climate. They are updated at least once a year, for the publication of the European State of the Climate.

[Read more](#)



Annual Global Climate Highlights

Published during the first two weeks of January, this report provides an early, concise analysis of the climate of the past year. It includes information on temperature and greenhouse gas (GHG) concentrations in the single and multi-year context and summarises noteworthy events from across the globe.

[Read Global Climate Highlights 2023](#)

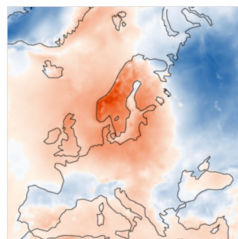
[Read previous issues](#)



Climate Change

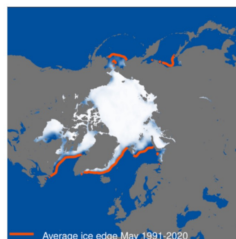
Climate Bulletins

Monthly summaries



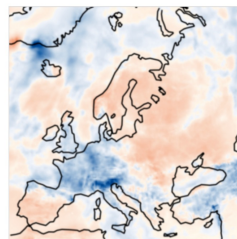
Surface air temperature

This series of monthly maps and charts, generated from ERA5 data, covers global and European surface air temperatures.



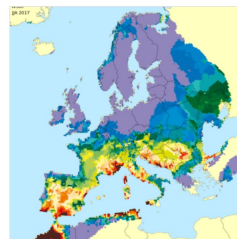
Sea Ice

We produce sea ice maps every month. Based on ERA5 reanalysis data, these provide near real-time monitoring of the polar ice caps.



Hydrological variables

This series of monthly maps and charts, based on ERA5 data, covers several variables: precipitation, humidity, and soil moisture for Europe and the extra-tropical regions.

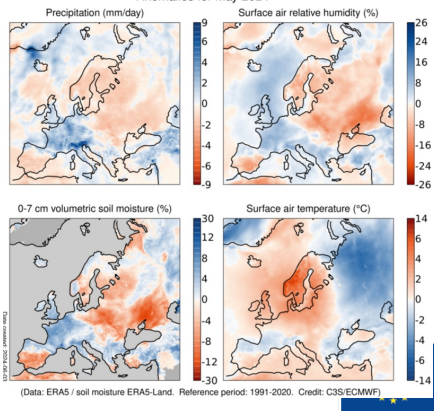


Surface in-situ monitoring for Europe

Monthly and yearly State-of-the-European-climate reports provided by C3S partners

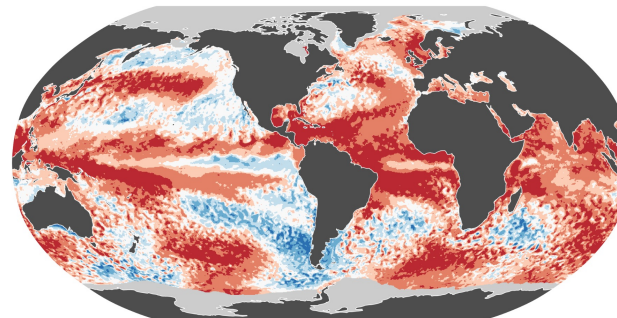
They provide a snapshot of climate conditions of the previous month or season, based on latest data on temperature, hydrological variables and sea ice for the Globe, Europe and the Polar regions. It is typically published between the 5th and the 8th of the following month.

Anomalies for May 2024



Anomalies and extremes in sea surface temperature in May 2024

Data: ERA5 1979-2024 • Reference period: 1991-2020 • Credit: C3S/ECMWF



PROGRAMME OF THE EUROPEAN UNI

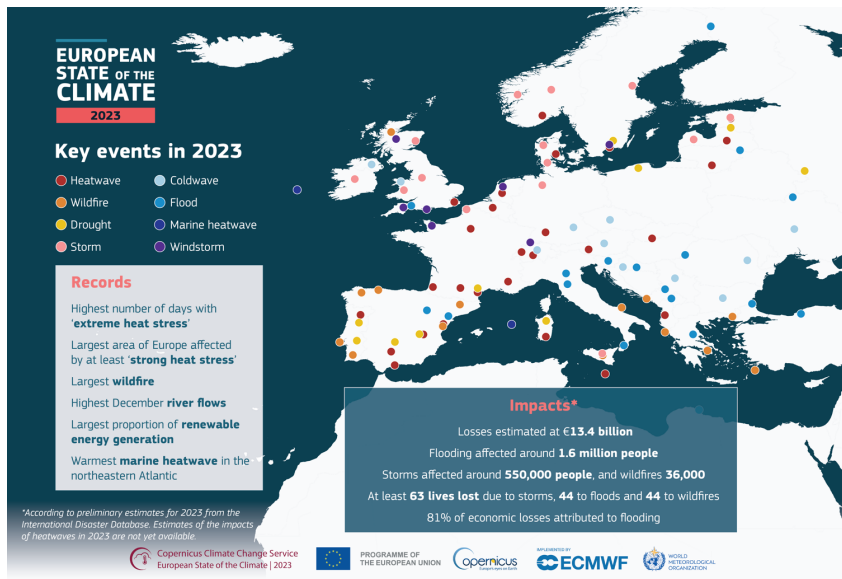


ECMWF



Climate
Change

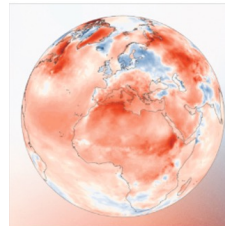
European State of the Climate



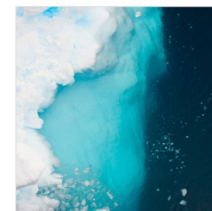
<https://climate.copernicus.eu/esotc/2023>

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Annual Global Climate Highlights



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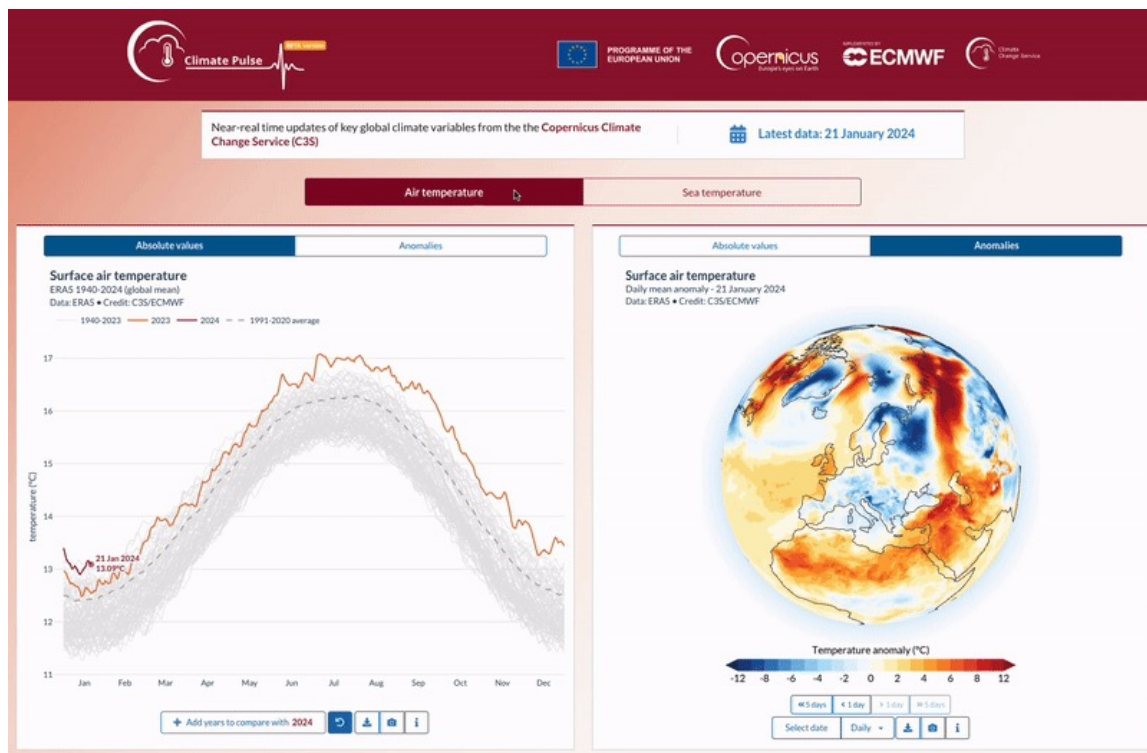


Climate
Change

Climate Pulse – A tool for climate monitoring in NRT

Climate Pulse is a new interactive web application developed and maintained by the Copernicus Climate Change Service (C3S) to **make climate monitoring more accessible to a broad audience**. It provides daily charts and maps of global surface air temperature and sea surface temperature updated close to real-time, as well as an archive of past daily, monthly and annual maps.

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



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Outline

¿ Qué es el Servicio Europeo de Cambio Climático (C3S) ?

¿ Qué productos se ofrecen ?

¿Cómo acceder a los productos de C3S y qué herramientas de apoyo existen ?

¿ Qué es y que hace la 'Climate Intelligence' componente de C3S?

¿ Algún otro componente en C3S ?



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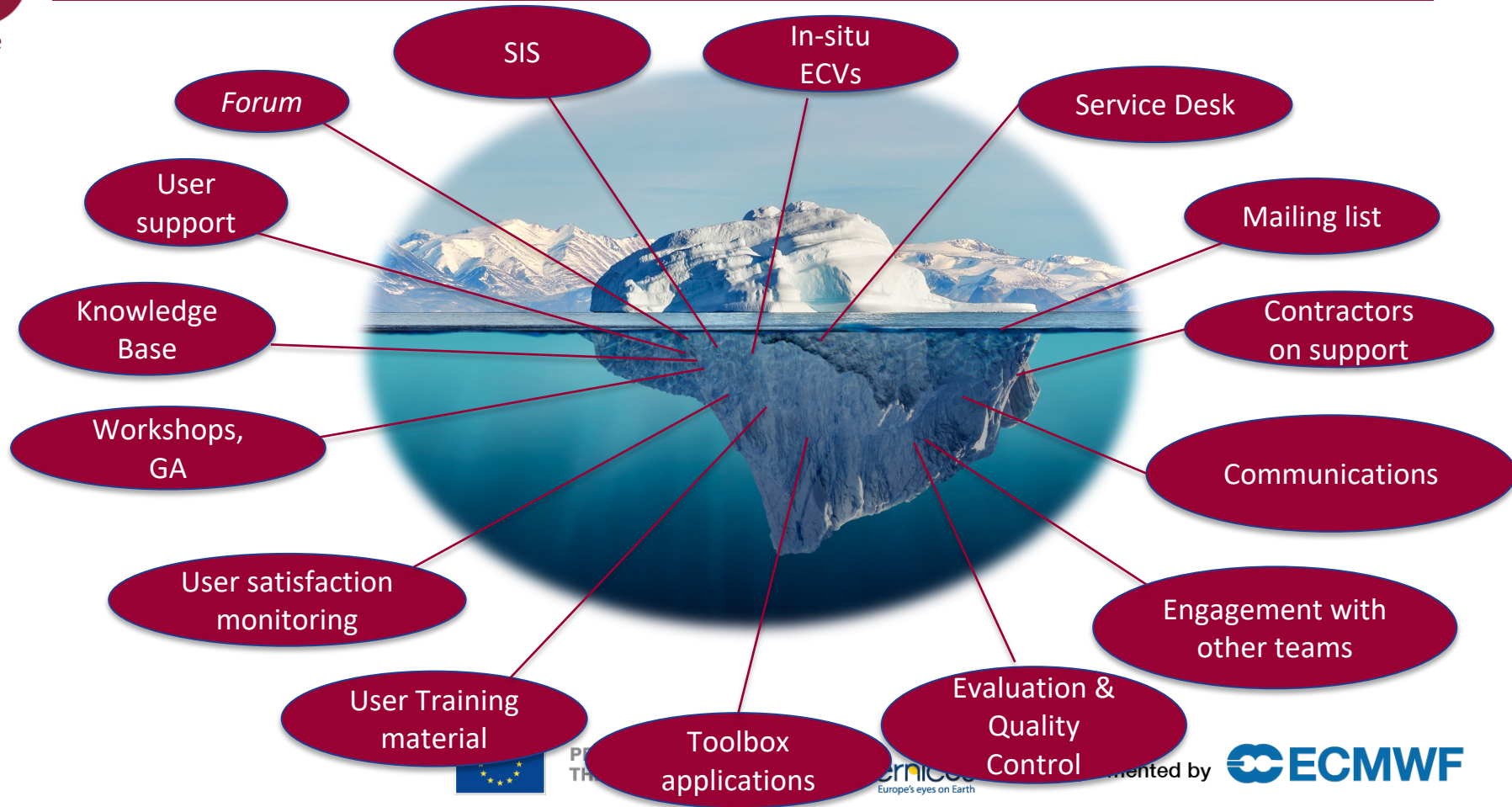


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Climate Change

There is much more than you can see...



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Europe's eyes on Earth

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Climate Change

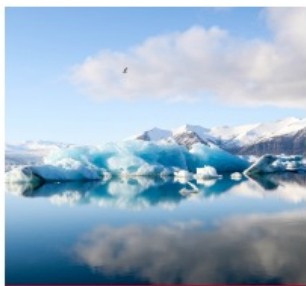
We provide authoritative information about the past, present and future climate, as well as enable climate change mitigation and adaptation strategies by policy makers and business.

<https://climate.copernicus.eu>

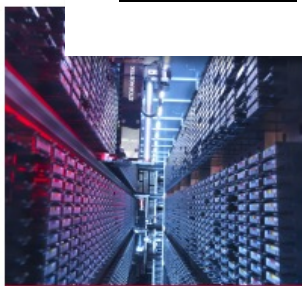


@j_munoz_sabater
@CopernicusECMWF

Key products and services



Climate bulletins



Climate Data Store



Data in action



The European State of the Climate 2020, an essential snapshot of the region and a useful benchmark for future assessments of the environment.

In focus