

Climate Change

# Copernicus Climate Change Service

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Director, C3S

COP26 – 23<sup>rd</sup> November 2021



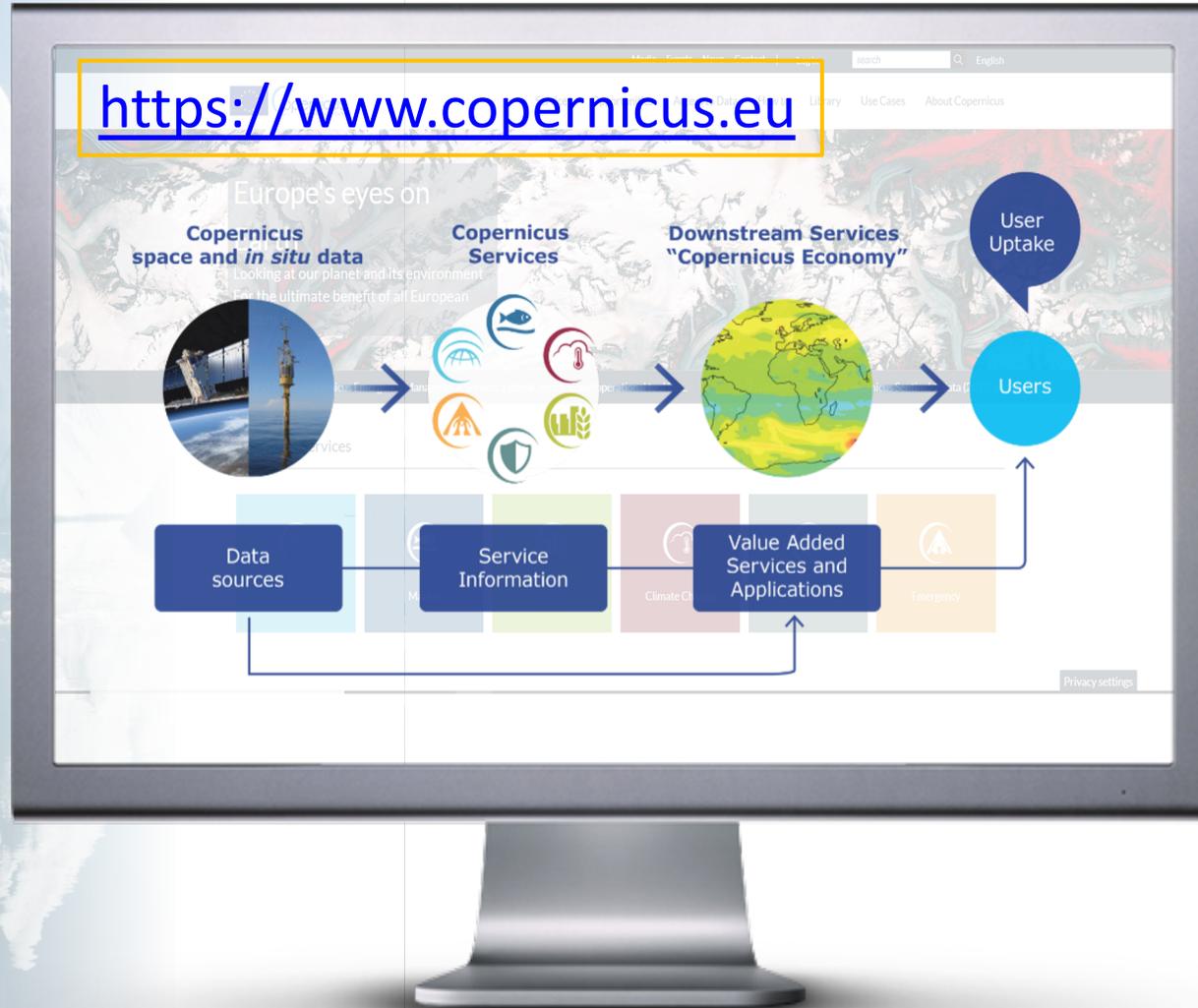


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# Copernicus - ECMWF



Atmosphere  
Monitoring



Copernicus is the **European Union's Earth Observation Programme**.

Combines **satellite** observations and **in-situ** measurements.

**Services** transform this raw data into **value-added** geo-information **products**.

**ECMWF** entrusted to implement **Climate Change (C3S)** and **Atmosphere Monitoring (CAMS)** services.



Climate Change



Atmosphere Monitoring

# Data Store Infrastructure in a nutshell

**Simple, consistent, harmonized, intuitive, informative interfaces**

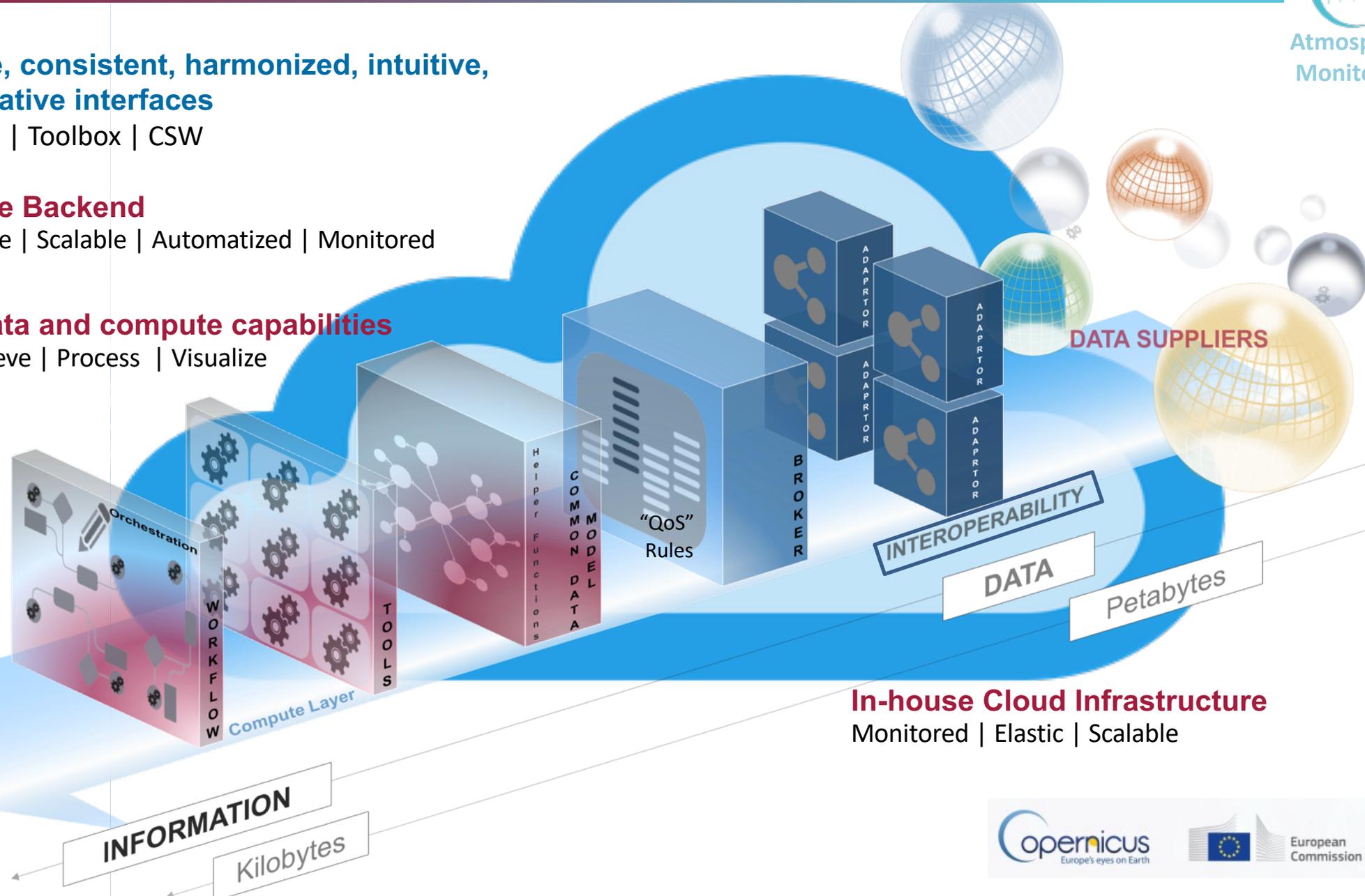
UI | API | Toolbox | CSW

**Robust, reliable Backend**

QoS | Interoperable | Scalable | Automatized | Monitored

**Access to data and compute capabilities**

Discover | Retrieve | Process | Visualize



**In-house Cloud Infrastructure**

Monitored | Elastic | Scalable

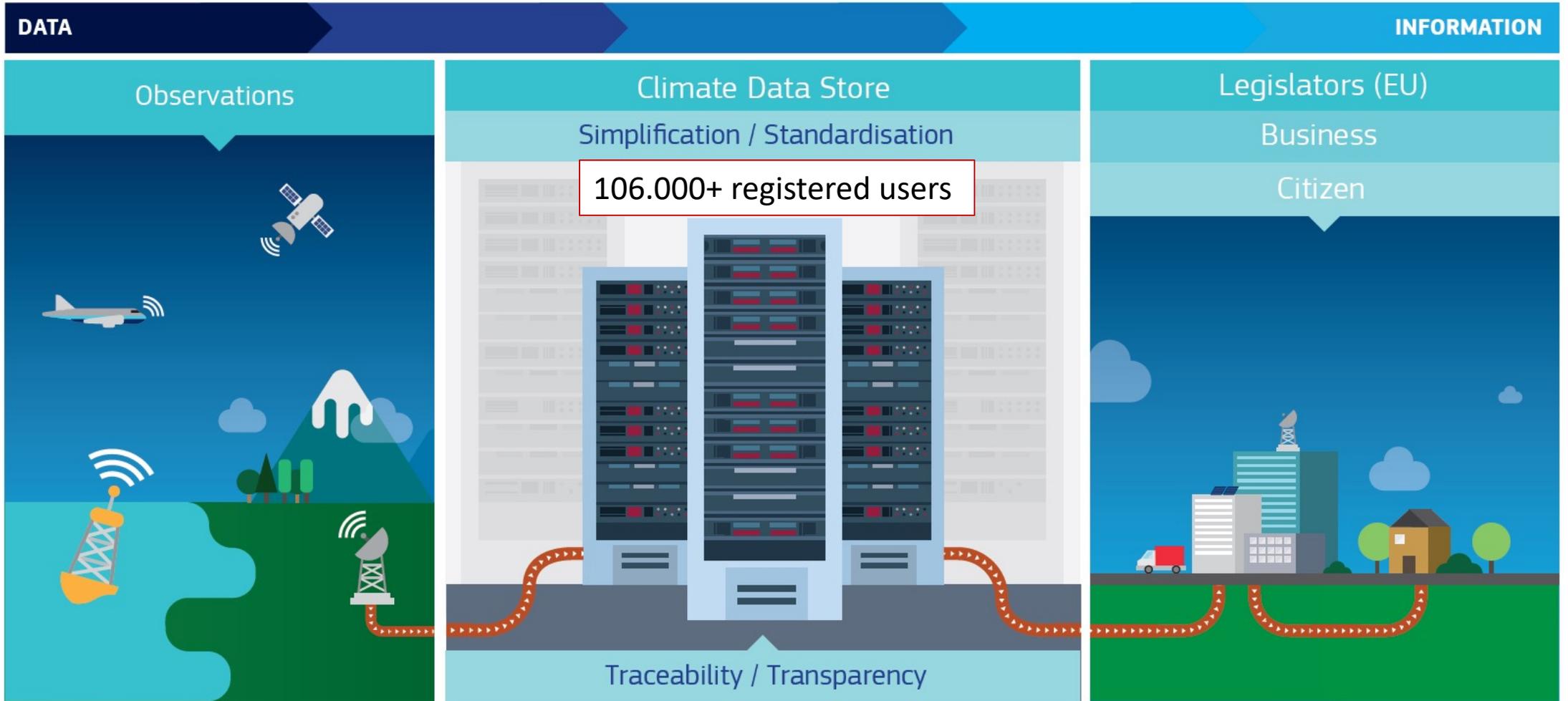




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# Copernicus Climate Change Service – the nexus between observations and society

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



PETABYTES

KILOBYTES

Free and open data that is traceable and transparent

109 Catalogued Datasets

24 catalogued public applications  
+ 19 available the European Climate Data Explore (EEA)





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# ECVs operational services

## C3S supports 22 ECV services grouped in 5 thematic areas:

### Atmospheric physics

- Precipitation
- Surface radiation budget
- Water vapour
- Cloud properties
- Earth radiation budget

### Atmospheric composition

- Carbon dioxide
- Methane
- Ozone
- Aerosol

### Ocean

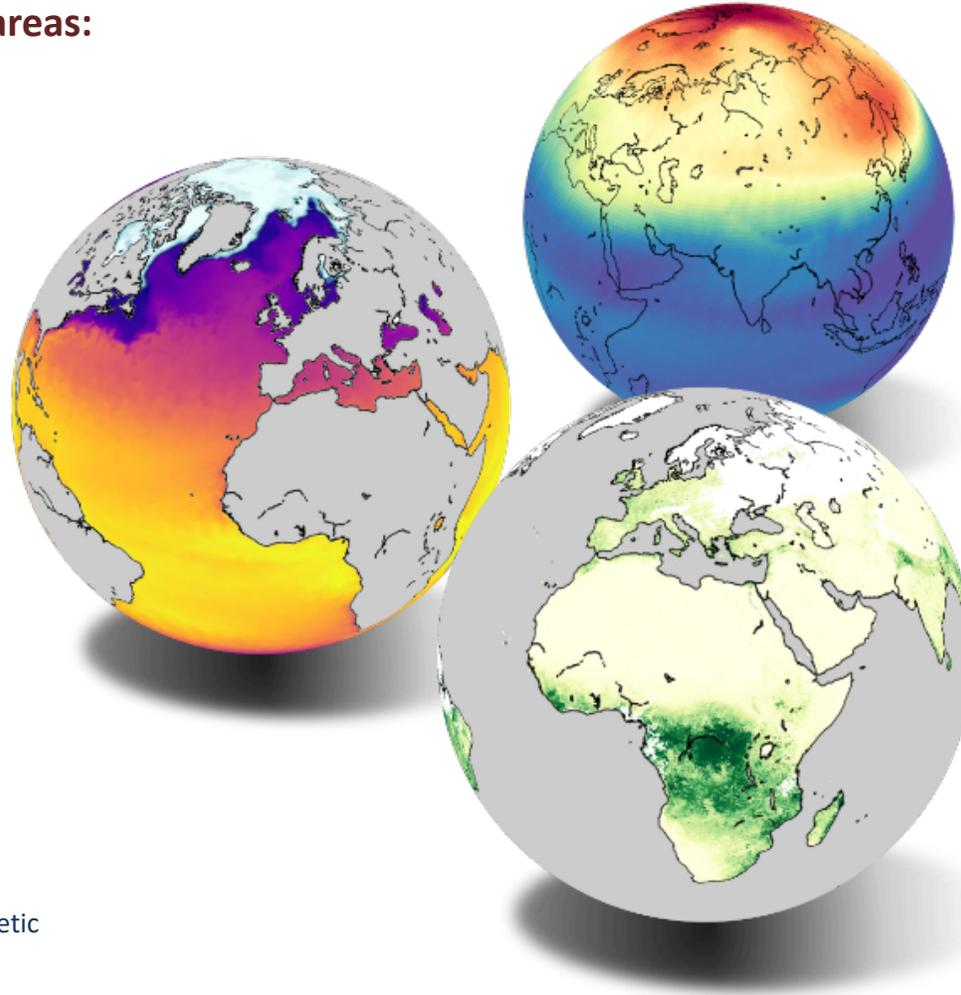
- Sea surface temperature
- Sea level
- Sea ice
- Ocean colour

### Land hydrology & cryosphere

- Lakes
- Glaciers
- Ice sheets & ice shelves
- Soil moisture

### Land biosphere

- Albedo
- Land cover
- Fraction of absorbed photosynthetic
- Leaf area index
- Fire



## ECV products that are

### State-of-the-art

- Coordination with ESA CCI, EUMETSAT/SAFs & Copernicus Services
- 

### Long-term, consistent, complete (CDR)

- Single/Multi sensor approach

### Regularly extended in time (ICDR)

- Frequent updates of data records

### Gridded, aggregated

- Meeting user requirements

### Accessible & Traceable

- Access through the Climate Data Store
- Documentation
- Quality Assurance
- User support

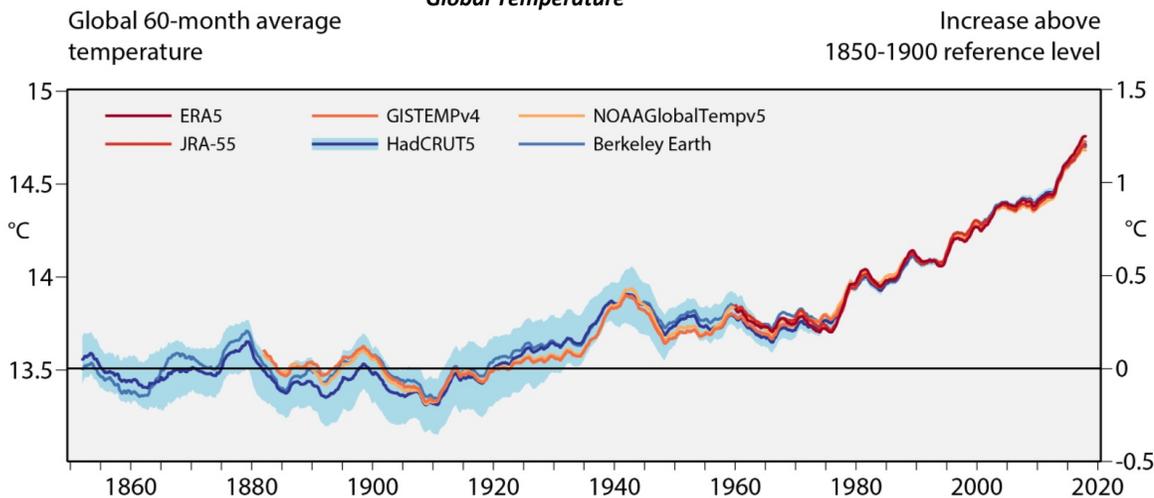
Scientific requirements are based on [Global Climate Observing System](#) (GCOS) framework.



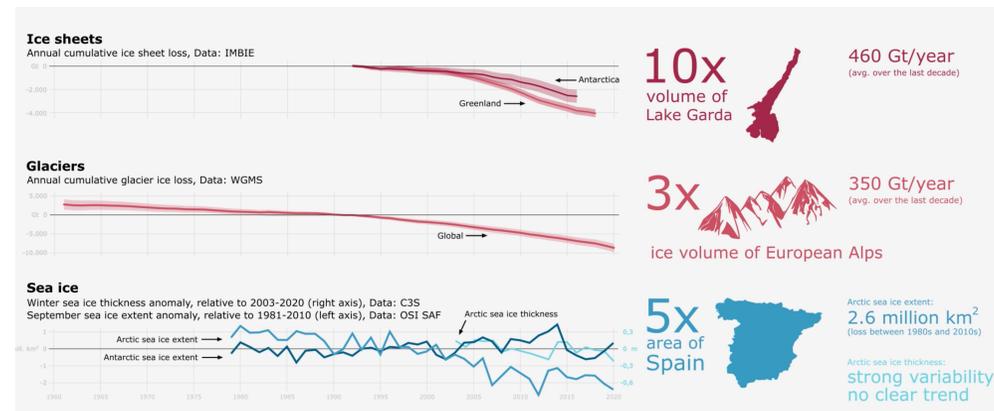
# Essential climate variables as climate indicators



## Global Temperature



## Cryosphere climate indicators



## C3S has 22 ECVs available



### Temperature



Since 1850–1900, an increase

Globally, of around **1.2°C ▲**

Europe, of around **2.2°C ▲**

Arctic, estimate of around **3°C ▲**

### Ice sheets



Between 1992 and 2018

In Greenland **-3800 ±340 Gt ▼**

Between 1992 and 2017

In Antarctica **-2720 ±1390 Gt ▼**

### Glaciers



Since 1992

Global loss of ice thickness of around **30 m ▼**

Since 1960s

European loss of ice thickness **4–35 m ▼**

Southwestern Scandinavia and the Alps, respectively

### Sea ice



In the Arctic during 1979–2020

March sea ice extent, per decade **-2.6% ±0.4% ▼**

September sea ice extent, per decade **-12.2% ±1.8% ▼**

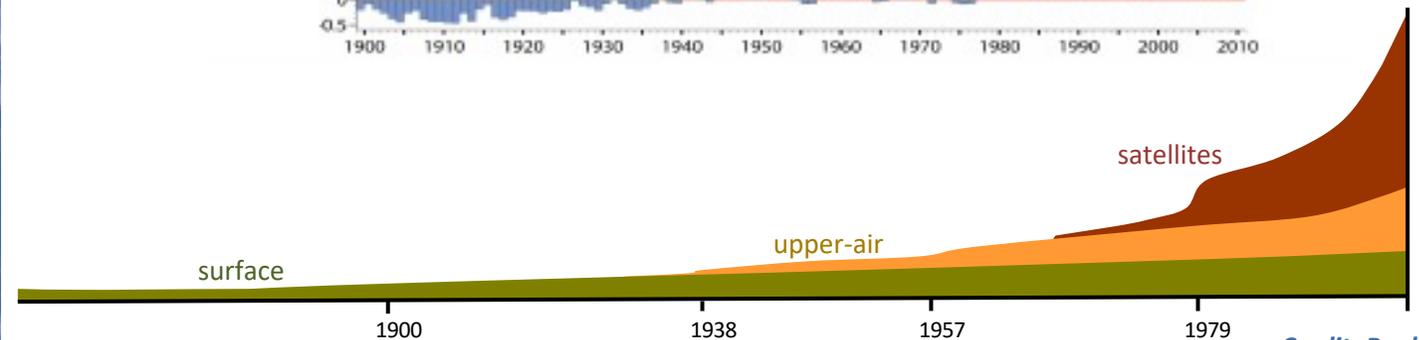
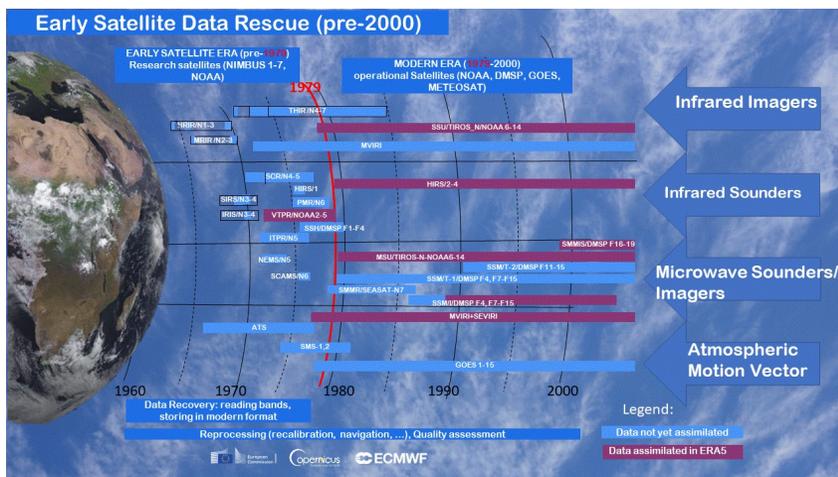
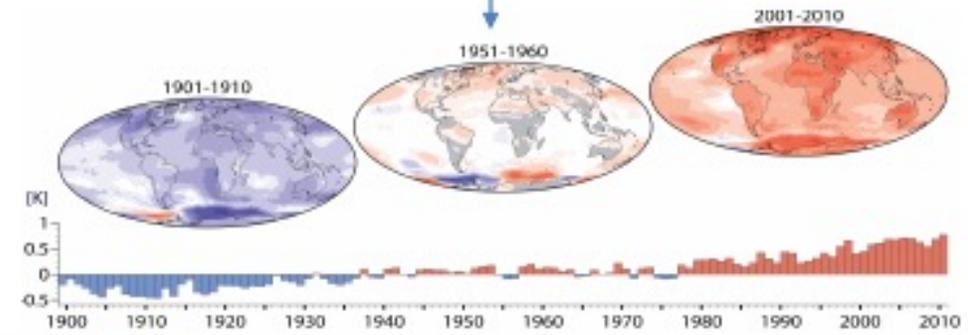
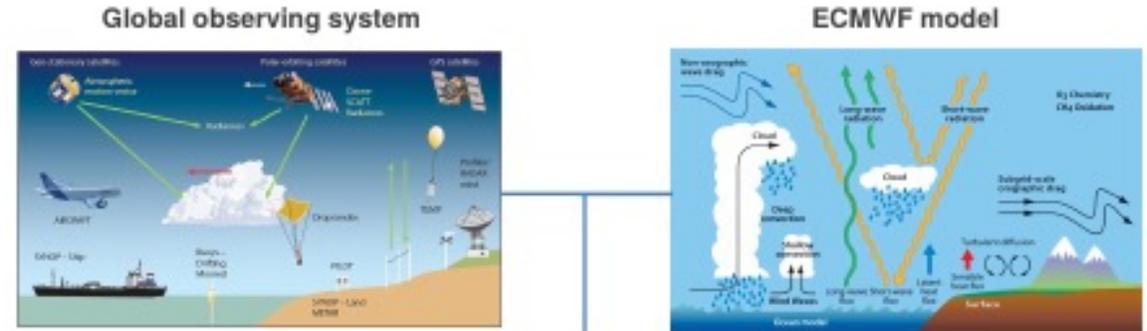
In the Antarctic

No clear trend in total sea ice extent



# Reanalysis uses past observations with today's weather forecast model

- ✓ **Complete:** combining vast amounts of observations into (global) fields  
“reanalysis is a smart machine”
- ✓ **Consistent:** use the same physical model and data assimilation system throughout
- ✓ **Convenient:** “maps without gaps”, always available in the same way
- provide an uncertainty estimate

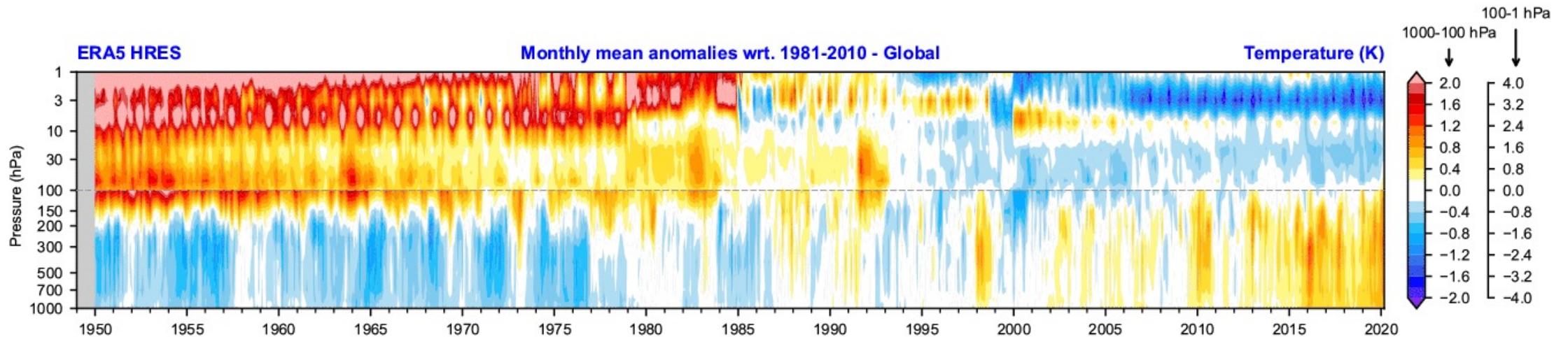


Credit: Paul Poli

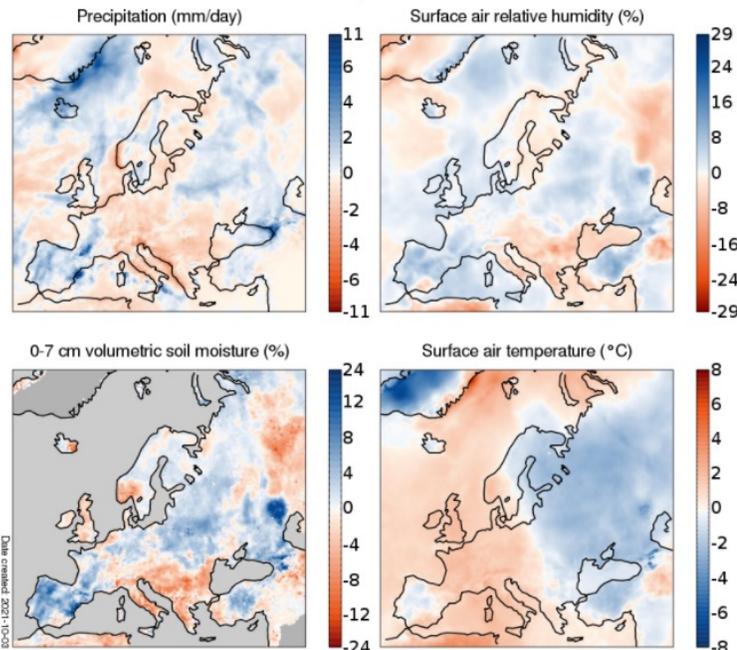


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# A new tool for monitoring a warming climate



## Anomalies for September 2021



(Data: ERA5. Reference period: 1991-2020. Credit: C3S/ECMWF)

Single The Climate Indicator pages describe individual indicators and how they are changing globally, in Europe and in the polar regions.

- Temperature
- Sea level
- Greenhouse gas concentrations
- Greenhouse gas fluxes
- Glaciers
- Ice sheets
- Sea ice

Thematic The interplay between these indicators is explored in thematic sections.

- Greenhouse gases
- Cryosphere

[climate.copernicus.eu/climate-indicators](https://climate.copernicus.eu/climate-indicators)

[climate.copernicus.eu/esotc/2020](https://climate.copernicus.eu/esotc/2020)

## European State of the Climate 2020

Welcome to the summary of the European State of the Climate 2020, compiled by the Copernicus Climate Change Service (C3S), implemented by the European Centre for Medium-Range Weather Forecasts (ECMWF) on behalf of the European Commission.

[About >](#) [Summary >](#) [Video overview >](#)

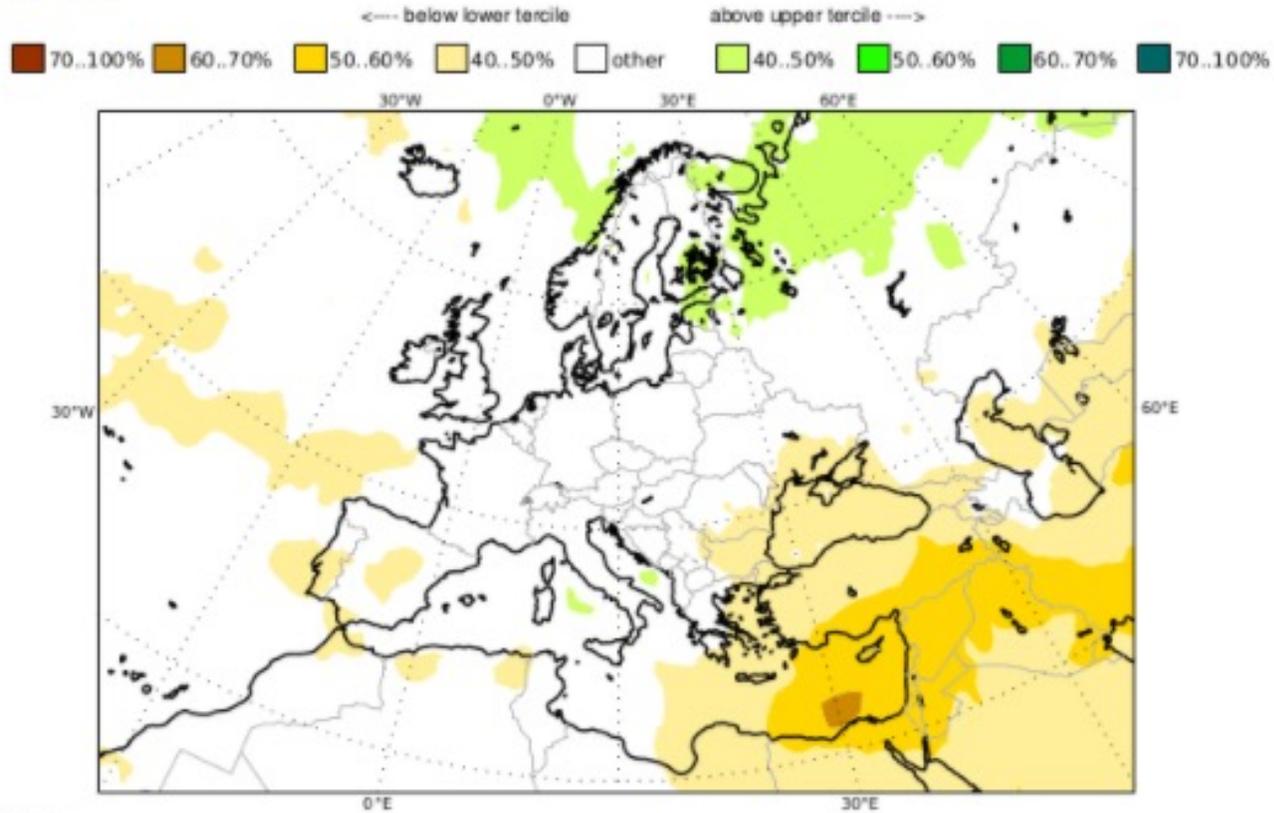




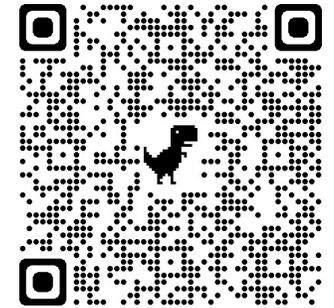
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## Seasonal predictions

C3S multi-system seasonal forecast    ECMWF/Met Office/Météo-France/CMCC/DWD/NCEP/JMA/ECCG  
Prob(most likely category of precipitation)    NDJ 2021/22  
Nominal forecast start: 01/10/21  
Unweighted mean

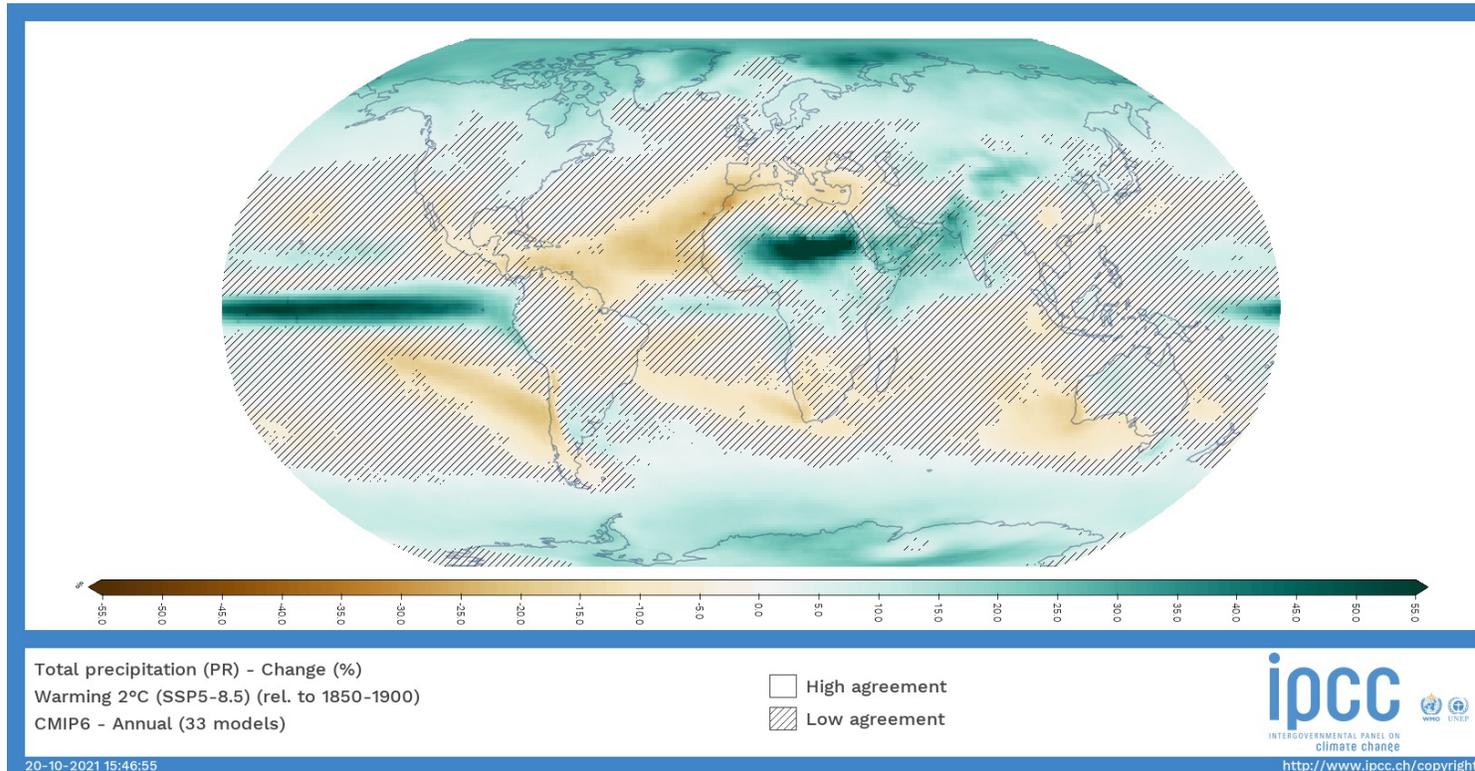


Forecast and hindcast data  
are openly available here: →





# New climate projection data and operating capability in the CDS



**CMIP6 simulations:** historical simulations and scenario runs;

- new functionality (e.g. WPS for sub-setting on download)
- Pre-calculated ETCCDI nearly ready to be published

**World-wide CORDEX simulations for the CDS**

- including non-European regions (EURO-CORDEX, Med-CORDEX, Arctic, Africa, North America, South America are already available, others will come soon)
- Give access to data already available at ESGF (and align it to C3S requirements)
- Give access to data not yet available at ESGF
- Make available data from multi-region experiments (e.g. CORDEX-CORE)
- Establish operational connection with the IPCC Climate Atlas



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# Applications published since July 2021

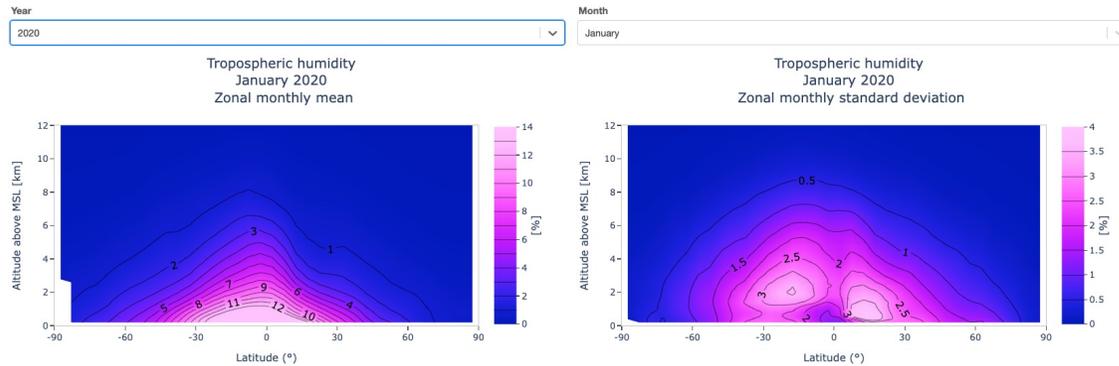
Applications		
Date of Publication	Contract	Application Title
01/07/2021	C3S-422-Lot2-VITO	Urban climate for cities in Europe from 2008 to 2017 <a href="https://cds.climate.copernicus.eu/cdsapp#!/software/app-health-urban-climate?tab=overview">https://cds.climate.copernicus.eu/cdsapp#!/software/app-health-urban-climate?tab=overview</a>
01/07/2021	C3S-429d-CMCC	Soil erosion explorer for Italy from 1981 to 2080 <a href="https://cds.climate.copernicus.eu/cdsapp#!/software/app-soil-erosion-explorer-italy?tab=overview">https://cds.climate.copernicus.eu/cdsapp#!/software/app-soil-erosion-explorer-italy?tab=overview</a>
01/07/2021	C3S-429d-CMCC	What-if analysis tool for soil erosion in Italy from 1981 to 2080 <a href="https://cds.climate.copernicus.eu/cdsapp#!/software/app-soil-erosion-what-if-analysis?tab=overview">https://cds.climate.copernicus.eu/cdsapp#!/software/app-soil-erosion-what-if-analysis?tab=overview</a>
01/10/2021	C3S_312b_Lot1	Global latitude-height distribution of tropospheric humidity <a href="https://cds.climate.copernicus.eu/cdsapp#!/software/app-satellite-humidity-latitude-distribution?tab=app">https://cds.climate.copernicus.eu/cdsapp#!/software/app-satellite-humidity-latitude-distribution?tab=app</a>
04/11/2021	C3S_435_Lot6_WEMC	European energy and climate data explorer <a href="https://cds.climate.copernicus.eu/cdsapp#!/software/app-energy-explorer-europe?tab=overview">https://cds.climate.copernicus.eu/cdsapp#!/software/app-energy-explorer-europe?tab=overview</a>
04/11/2021	C3S_427-VITO	Thermal suitability for fish species habitat <a href="https://cds.climate.copernicus.eu/cdsapp#!/software/app-biodiversity-thermal-suitability-fish?tab=overview">https://cds.climate.copernicus.eu/cdsapp#!/software/app-biodiversity-thermal-suitability-fish?tab=overview</a>
05/11/2021	C3S_422_Lot2-DELTAES	Indicators of water level change for European coasts in the 21st Century <a href="https://cds.climate.copernicus.eu/cdsapp#!/software/app-coastal-indicators-waves-projections?tab=app">https://cds.climate.copernicus.eu/cdsapp#!/software/app-coastal-indicators-waves-projections?tab=app</a>
05/11/2021	Internal	C3S monthly climate bulletin explorer <a href="https://cds.climate.copernicus.eu/cdsapp#!/software/app-c3s-monthly-climate-bulletin-explorer?tab=app">https://cds.climate.copernicus.eu/cdsapp#!/software/app-c3s-monthly-climate-bulletin-explorer?tab=app</a>
10/11/2021	Internal	Climate monitoring and volcanic eruptions <a href="https://cds.climate.copernicus.eu/cdsapp#!/software/app-climate-monitoring-volcanoes?tab=overview">https://cds.climate.copernicus.eu/cdsapp#!/software/app-climate-monitoring-volcanoes?tab=overview</a>



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# New Applications: Global tropospheric humidity explorer & European Coastal Areas

This application depicts the latitude-height distribution of humidity and its variability in the lowest 12 kilometers of Earth's atmosphere. The variability is quantified by the standard deviation of the humidity within 5° latitude bands. All data is taken from the [Tropospheric humidity profiles averaged monthly and zonally from 2006 to present derived from satellite observations](#) dataset. Users can select the time period to display data from and are given the option to download the displayed data.



Zonal monthly mean latitude-height distribution of specific humidity (left panels) and the corresponding variability (right hand panels).

### Data Description

Zonal tropospheric humidity profiles from 2006 to present derived from satellite observations

Property	Description
Data type	Gridded
Horizontal coverage	Global zonal means
Horizontal resolution	5.0° in latitude
Vertical coverage	0-12 km
Vertical resolution	0.2 km
Temporal coverage	From 2006 to present
Temporal resolution	Monthly
File format	NetCDF 3
Update frequency	Quarterly updates

### Get more information about specific humidity:

- [About zonal tropospheric humidity profiles from 2006 to present derived from satellite observations data](#)
- [About ROM SAF](#)
- [About the Climate Data Store](#)

Latitude-height distribution of humidity and its variability in the lowest 12 kilometers of Earth's atmosphere, from Earth observations <https://bit.ly/3bT2L1o>

European Storm Surge climate data on the storminess in European coastal seas  
Dataset of storm surge, tide and wave conditions, including the effect of sea level rise, for all of Europe's coastal waters.

<https://bit.ly/3mPIwbf>

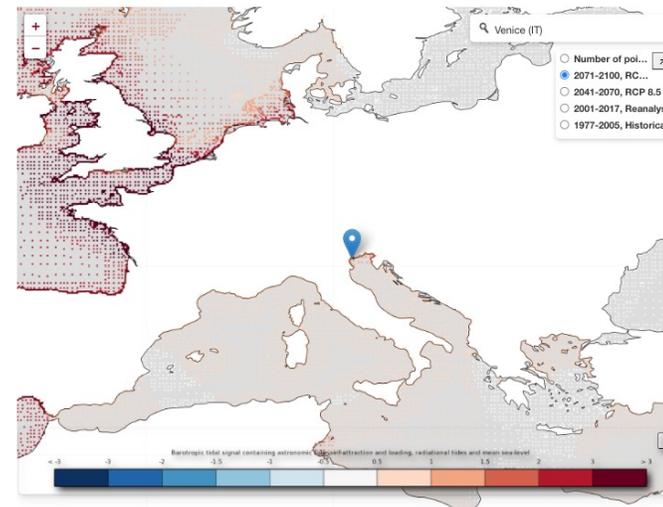
Overview Application Documentation Source code

Full screen

Indicator: Annual Highest High Water Level  
Spatial aggregation: Fine grid

Annual highest high tide including mean sea level and sea level rise. Storm surges caused by atmospheric forcing are not taken into account

The station data has been averaged on to a regular latitude-longitude grid with a resolution 0.1°. Clicking on a point or selecting a city from the search searchbar will produce a box plot of all the stations within a given radius (default = 1.0°) of that point and a line plot of the closest station.



Venice (45.44°N, 12.33°E)

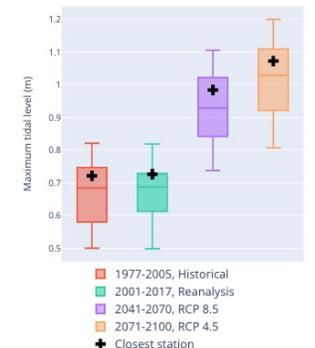
Radius (in degrees)

1.0

### Yearly maximum tidal level.

The box displays the median and interquartile range and the whiskers display full range for all station within 1.0 degree(s) of 45.43713° N, 12.33265° E.

The black cross represents the closest data point located at: 45.37° N, 12.34° E.





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# Evaluation and Quality Control (EQC)

## Status of EQC integration into CDS catalogue

Dataset category	#EQC tabs	Progress	#Total QARs* published	#Scientific assessments**
Seasonal forecasts	6/6		787	417
Climate projections (global)	5/6		1499	1499
Climate projections (regional)	1/1		330	330
Satellite observations	22/30		404	45
In situ observations	2/2		57	5
Reanalysis	14/18		376	332

\*QAR: Quality Assurance Report; \*\*not all published yet

**+** over 30 EQC tabs for SIS datasets and applications becoming available in Q4/2021



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## Future of reanalysis



Apollo 17 image of the Earth, 07/12/1972  
Credit - NASA



ECMWF forecast initialized from ERA5 reanalysis for  
the same date. Credit – Philippe Lopez, ECMWF

### ERA6:

- Coupled ocean-atmosphere
- Better representation of key atmosphere-ocean processes and feedbacks
- C3S satellite data rescue
- ERA6L with enhanced land data assimilation



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# Operational service for users....

## Help and support

We provide a dedicated user support service to aid Climate Change Service data discovery, dissemination, understanding and use by all users. The user support service currently includes a Knowledge Base accessible 24/7 and a friendly manned helpdesk.

<p><b>24/7 Knowledge Base</b></p> <p>The Knowledge Base provides documentation and answers to frequently asked questions.</p>	<p><b>Forum</b></p> <p>For users of the C3S services</p> <p>Become part of the community, work together and support each other.</p>	<p><b>Contact us</b></p> <p>Can't find the answer you're looking for? Get in touch!</p> <p>Login to the <b>C3S Enquiry Portal</b></p>
<p><b>User Satisfaction Surveys</b></p> <p>We run user satisfaction surveys every year.</p> <ul style="list-style-type: none"> <li>- 2020 Report</li> <li>- 2019 Report</li> <li>- 2018 Report</li> <li>- 2017 Report</li> </ul>	<p><b>Your user story</b></p> <p>We collect user stories to show the diversity and wide-range usage of our data and services. You will find here some examples. Contact us directly to share your user story with us.</p>	<p><b>User Training</b></p> <p>C3S User Learning Services offers free training in how to use the Climate Data Store platform and its content.</p>

[ECMWF SUPPORT GUIDELINES >](#)

FINDING YOUR WAY TO THE RIGHT DATA:



**Find us:**

[climate.copernicus.eu](https://climate.copernicus.eu)

[cds.climate.copernicus.eu](https://cds.climate.copernicus.eu)

[atmosphere.copernicus.eu](https://atmosphere.copernicus.eu)

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