



a brief overview on the latest user-oriented advancements

UEF2024, 5 June 2024

Stijn Vermoote

based on inputs from many ECMWF RD and FSD colleagues



COPERNICUS: EUROPE'S EYES ON EARTH

Six thematic streams of Copernicus services transform a wealth of satellite and in situ data into value-added information.

The data and services provided are **operational** and **quality assured**, **free** and **openly accessible** to all users

Copernicus@ECMWF:

- **CAMS** and **C3S** implemented as Entrusted Entity to the European Commission (2021-2027)
- **CEMS**: computational centre for floods and fire forecast products in contract to the EC JRC



CLIMATE CHANGE



MARINE MONITORING



ATMOSPHERE MONITORING



LAND MONITORING



SECURITY



EMERGENCY MANAGEMENT

a truly European effort...



Climate
Change Service

climate.copernicus.eu



Atmosphere
Monitoring Service

atmosphere.copernicus.eu

more than **70%** of the budget executed through **service provisions** by NMHSs, research institutes, universities, SMEs and large companies from +24 countries. **U.K. based entities eligible again since January 2024**

... with a **European and global reach**

A **recognised global voice** on climate and atmosphere; informing EU institutions, the IPCC and UN institutions.

+345.000 users doing research, develop business solutions, train AI/ML algorithms and make informed policy decisions based on **+10.000TB** of data products and applications per calendar quarter. Services come with performant **user support** and explanatory **documentation**.

A new way of **co-creating added-value for and with European countries** - the National Collaboration Programmes: [presentation Cristina Ananasso](#)

New advancements on **CAMS forecasts and emission products**: [presentation Laurence Rouil](#)

Big investments in improved data access and tools via **new Copernicus Data Stores**: [presentation Edward Comyn-Platt](#)

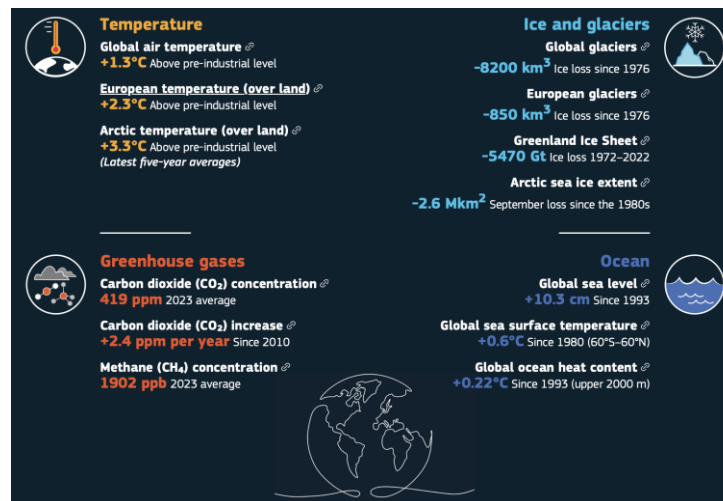
Copernicus Climate Change Service (C3S)

Support adaptation policies at national, EU and global level by providing consistent and authoritative information about climate change



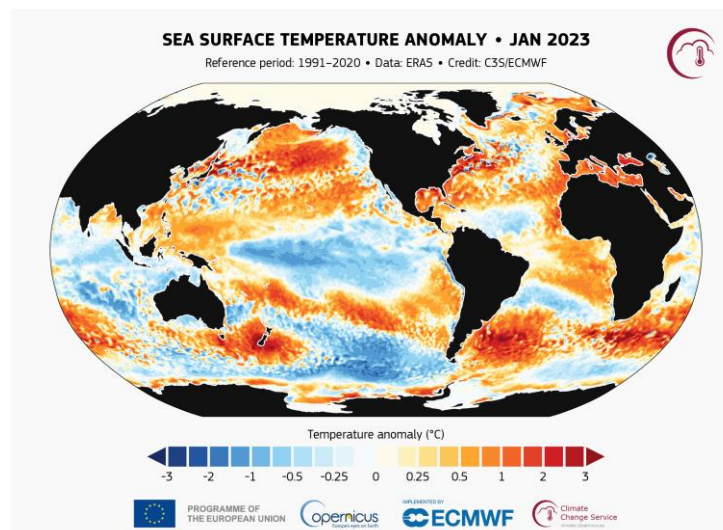
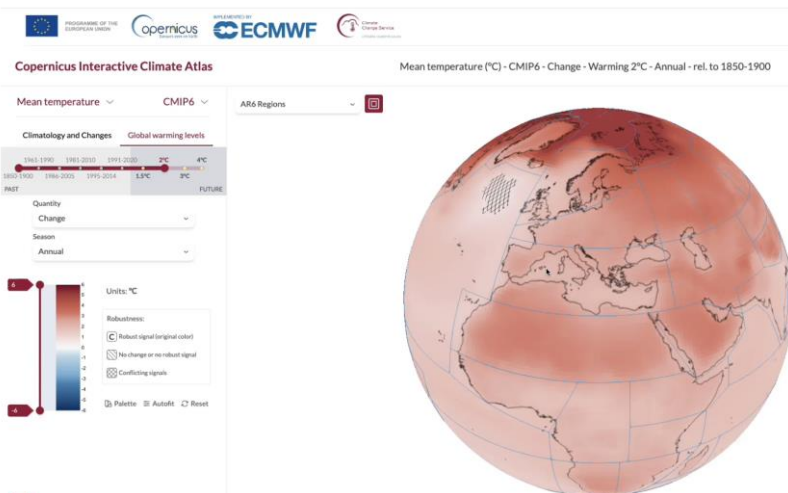
Climate
Change Service

climate.copernicus.eu



C3S provides reliable access to state-of-the-art data available on the **past, present, and potential evolution of climate.**

- **Climate Intelligence:** [European State of the Climate 2023 Report](#) and [Climate Bulletins](#)
- **User applications:** [Climate Pulse](#) and [C3S Climate Atlas](#)
- Move from **ERA5** to **ERA6**
- **Close engagements and partnerships** with **EIB**, **EEA** and **ENTSO-E**: on-demand applications, data interfaces, expertise and training



CDS User Statistics – Q1 2024



Climate
Change Service

climate.copernicus.eu

C3S Headline Statistics

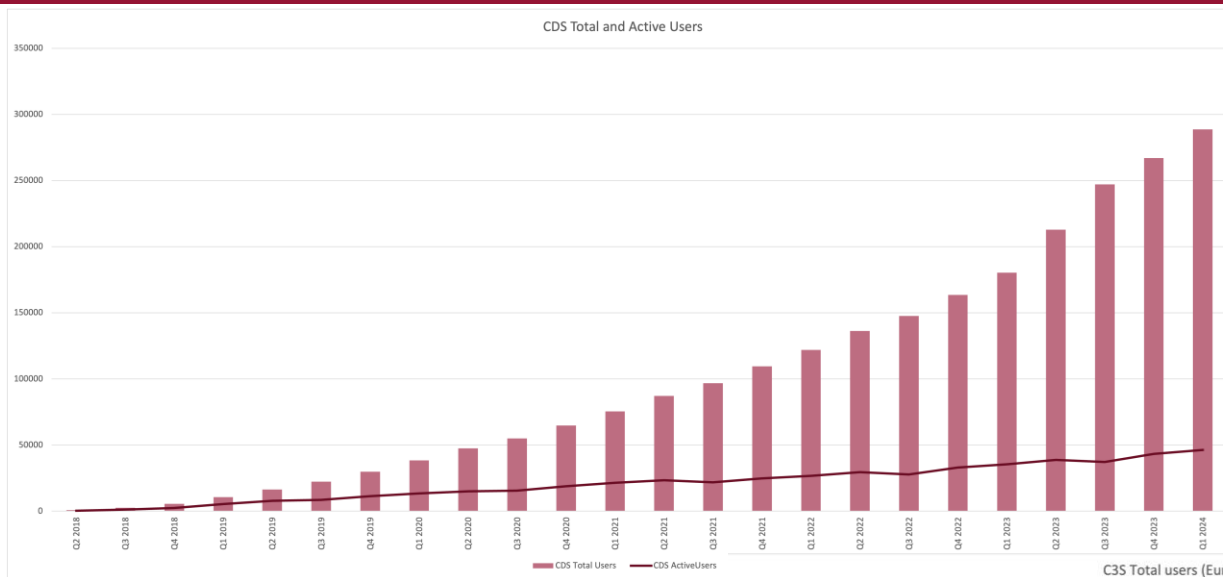
288,724 total registered users by

311.000 today... it's increasing fast

21,641 new registrations in Q1 2024

46,326 active users in Q1 2024

10734.73 TB data delivered in Q1 2024



C3S Total users (European) by Q1 2024

CDS Top 5 Dataset groups - by downloaded volume

ERA5

(all era5 datasets)

CORDEX

(projections-cordex-domains-single-levels)

Seasonal Forecast

(seasonal-original-single-levels)

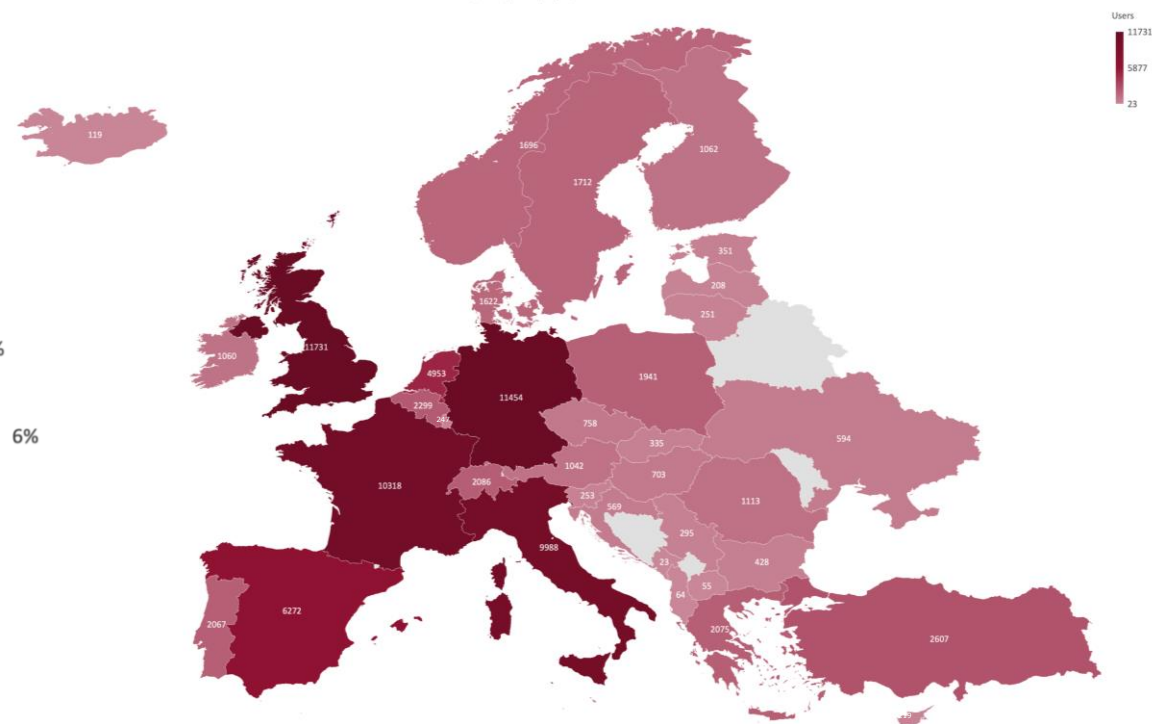
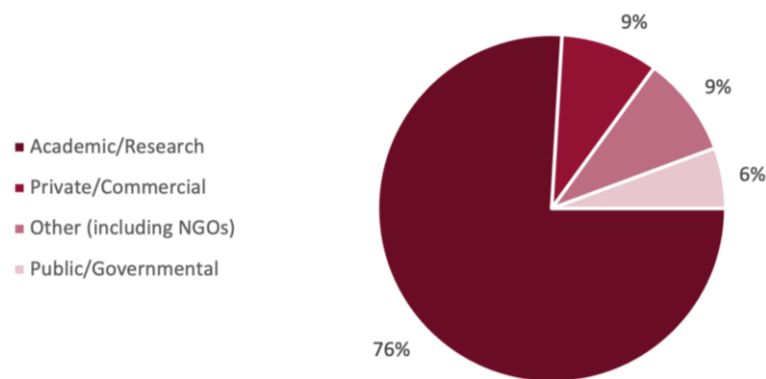
Thermal Comfort Indices

(derived-utci-historical)

ORAS5

(reanalysis-oras5)

% C3S Users by Sector





Essential Climate Variables

Climate Change

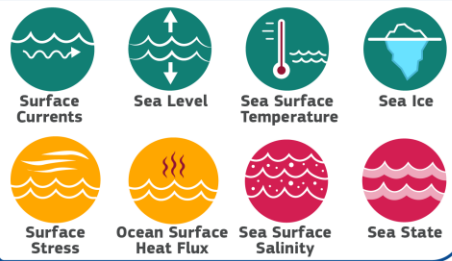
CRYOSPHERE



Legend

- Satellite ECVs
- ECVs from reanalysis
- Planned/ambition
- Unavailable

SURFACE OCEAN PHYSICS



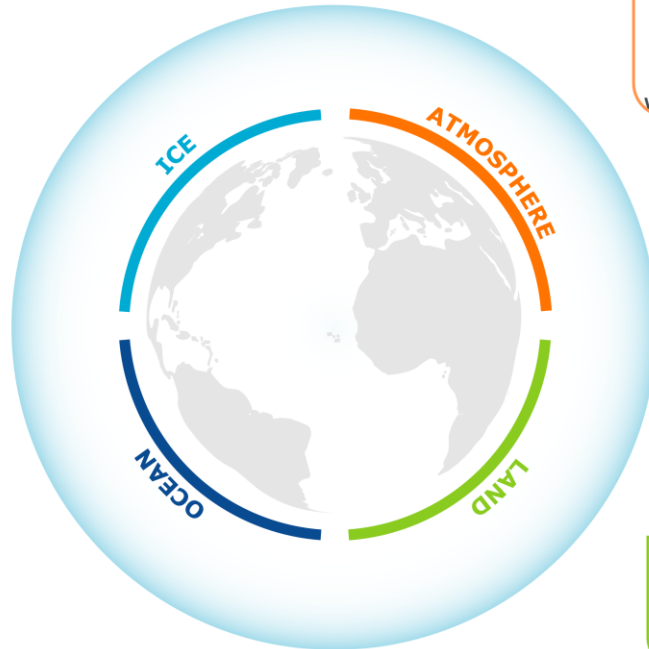
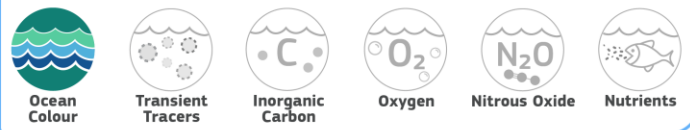
OCEAN BIOLOGY, ECOSYSTEMS



SUBSURFACE OCEAN PHYSICS



OCEAN BIOGEOCHEMISTRY



SURFACE ATMOSPHERE



UPPER-AIR ATMOSPHERE



ATMOSPHERIC COMPOSITION



ANTHROPOSHERE



HYDROSPHERE



BIOSPHERE



*Fraction of Absorbed Photosynthetically Active Radiation

Crucial to understand changes in our climate.

C3S responds to GCOS and UNFCCC implementation needs.

Check out our open ITTs !



PROGRAMME OF THE EUROPEAN UNION

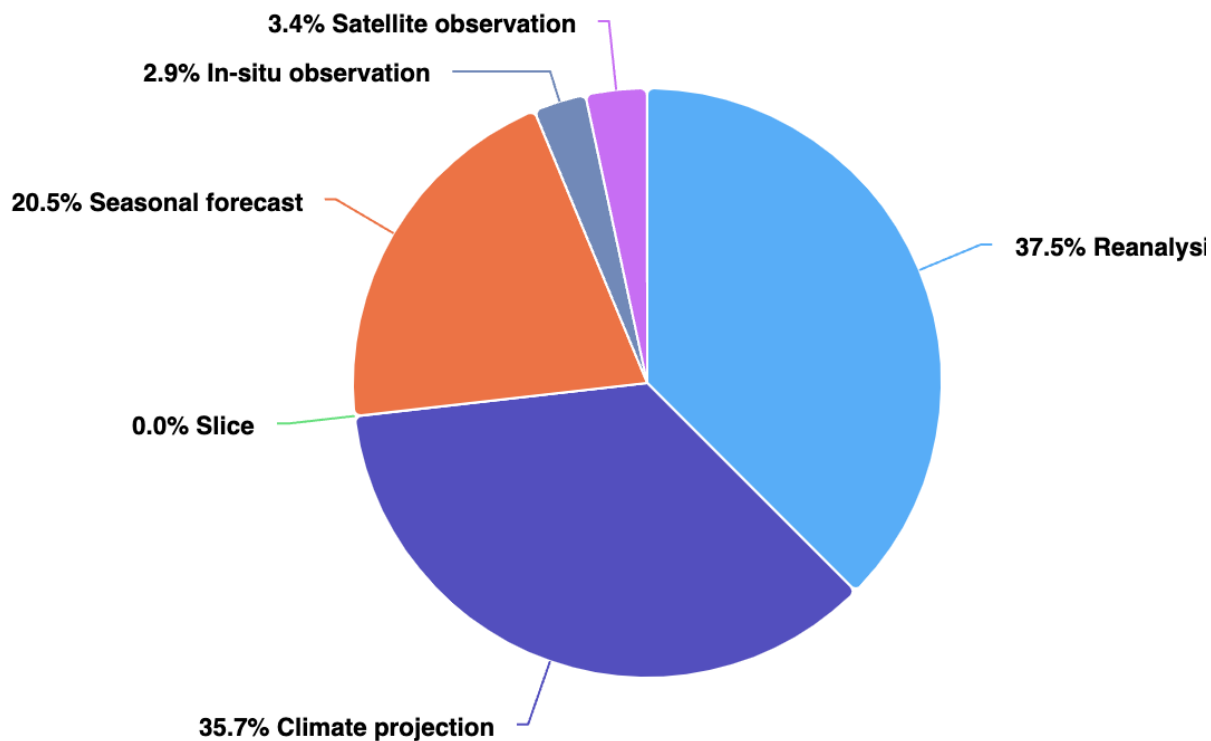




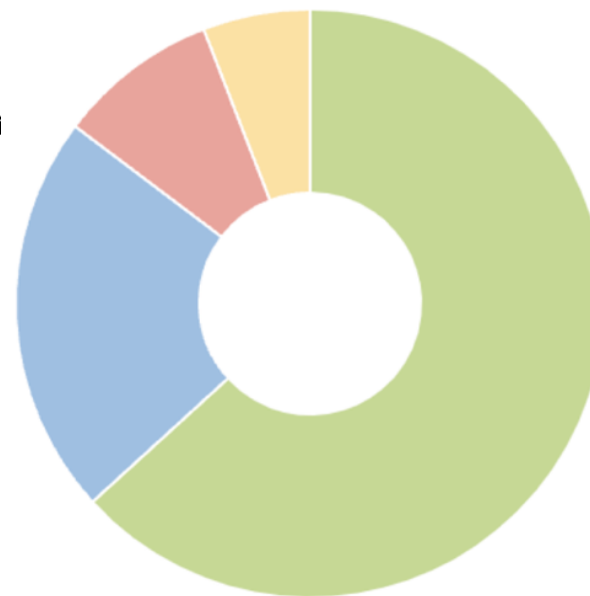
User requirements predominantly concerns reanalysis and projections

Climate Change

Dataset categories



On **reanalysis**: 68 actionable recommendations were derived from the 800+ reanalysis requirements; 43 requests have been implemented over the past years



Status

Total Issues: 68

Implemented	43
Technical Officer check	15
Wishlist	6
Under Review	4



PROGRAMME OF THE EUROPEAN UNION





Climate Change

Moving to ERA6: essential & high-priority user needs (Ma

Downscaling global reanalysis using ML/AI: **new ITT published soon**



Position Paper - ERA6 User Community Needs

March 2024

Issued by: Delphine Deryng, Paul Poli, Carlo Buontempo, Samantha Burgess, Chiara Cagnazzo, Hans Hersbach, Andre Obregon and Stijn Vermoote

Essential features	Other high priority needs
<ul style="list-style-type: none"> - Higher spatial resolution: 14km - Diagnostics by ECMWF for smaller regions - Early release of ERA6 data beyond real time for ML applications - Validations against specific conditions - Storm catalogue 	<ul style="list-style-type: none"> - Downscaled ERA6 products - Open-source machine learning-based downscaling methods - Bias-corrected datasets and methods - Detailed observation coverage - Use of analysis increments - Uncertainty products (e.g., ensemble mean and spread) - Tools for comparing and merging with national datasets - User-friendly post-processing workflows

[Position paper ERA6 User Community Needs](#)





Application: Copernicus Interactive Climate Atlas

Climate Change



User guidance

Copernicus Interactive Climate Atlas

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

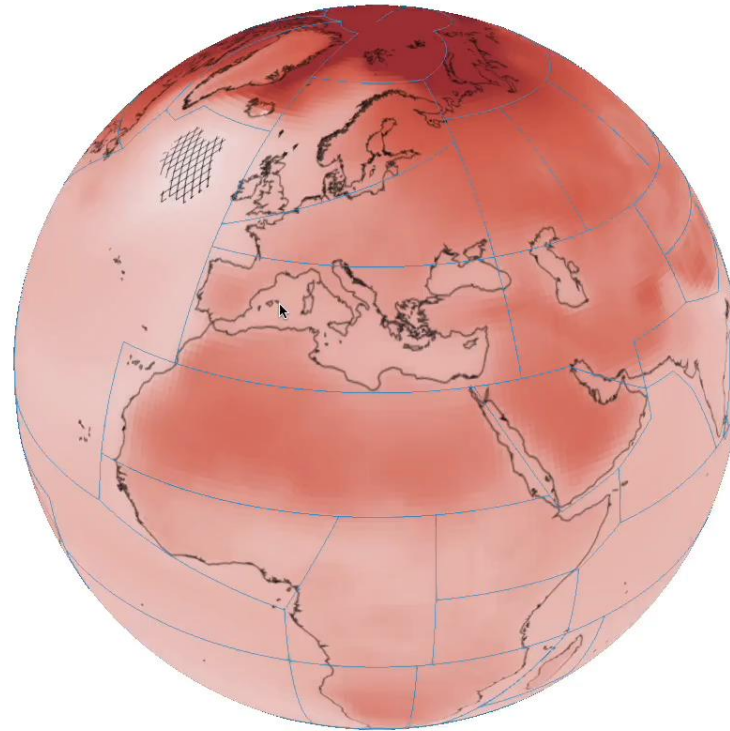
Mean temperature ▼ CMIP6 ▼

Climatology and Changes Global warming levels

Quantity: Change ▼

Season: Annual ▼

AR6 Regions ▼



Further advancements based on the **IPCC WGI Interactive Atlas** (<https://interactive-atlas.ipcc.ch>):
 A novel tool (data and viewer) for IPCC AR6 for flexible spatial and temporal analyses of observed and projected climate change information

About C3S About the Atlas Contact us Privacy policy

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



PROGRAMME OF THE EUROPEAN UNION

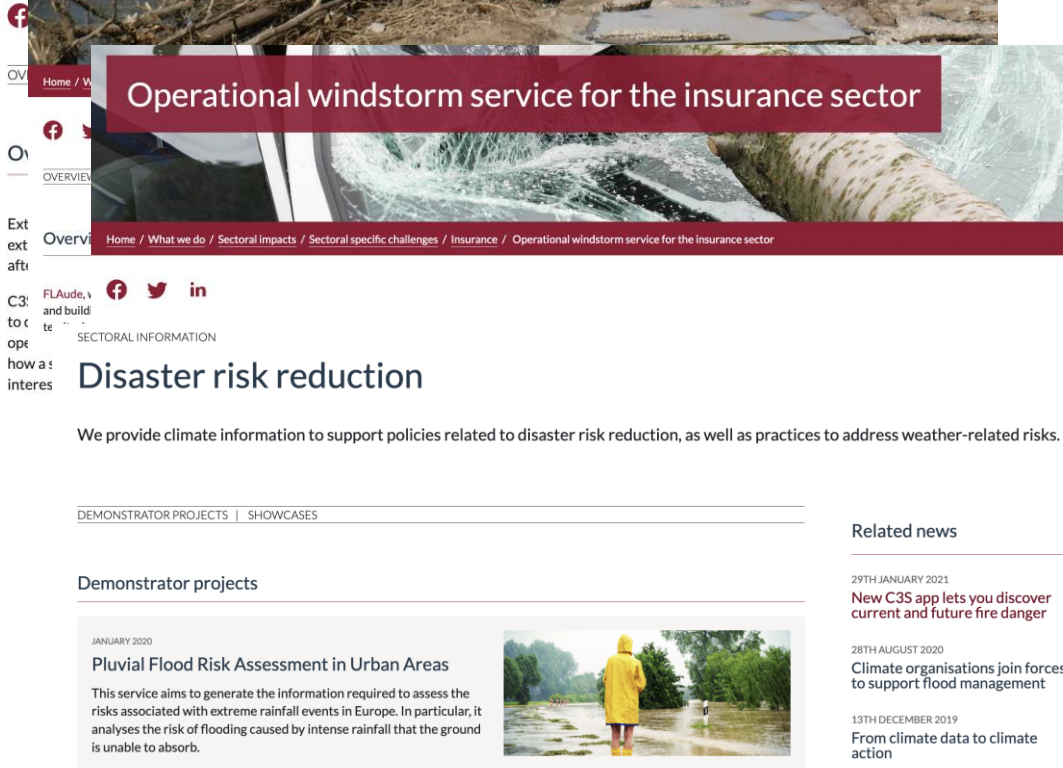




Prototype extreme events and attribution service

SCO FLAude: Understanding extreme hydrometeorological events in Aude and Occitanie in the context of climate change

Operational windstorm service for the insurance sector



Operational access to extreme event information:

- Long term observed changes in extremes and their attribution
- Extended information on types of events in a changing climate (e.g. factsheets or similar)
- Extend number of tools for extreme event analysis on trends, consistent with climate projections
- NRT daily suite similar to the (extended/evolved) C3S monthly bulletin suite
- Triggering mechanism via the Extreme Forecast Index (or similar)
- Fitness-for-purpose of data sets for extreme analysis
- Enhanced adoption of AI-based tools

ITT to be launched in the upcoming weeks!

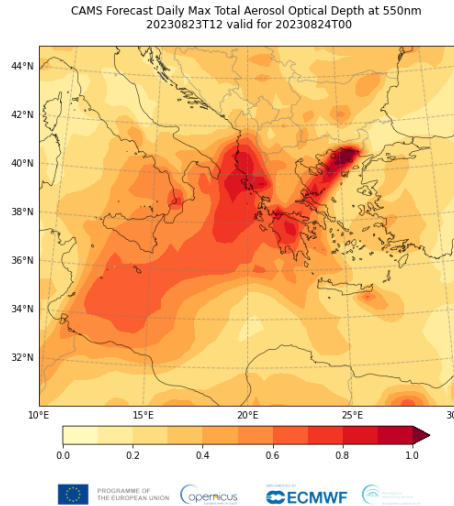
Copernicus Atmosphere Monitoring Service (CAMS)

Helps policy makers at national, EU and global level by providing air monitoring analysis and forecasts, policy tools and assessment reports



Atmosphere
Monitoring Service

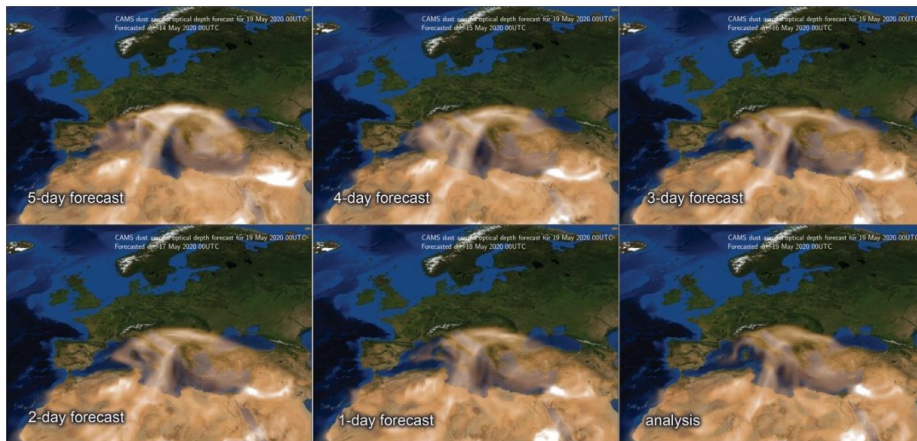
atmosphere.copernicus.eu



Fire emissions (AOD)

CAMS provides consistent and quality-controlled information related to **air pollution and health, solar energy, greenhouse gases and climate forcing, everywhere in the world.**

- Services to European countries, EU and UN on **air quality, dust, (wildfire) emissions, pollen and UV radiation** in support of environmental, energy and health policies
- Preparations for service on **CO₂ and CH₄ emissions** and their trends in support of **Paris Agreement.**



Dust monitoring and forecasting

Air pollution at target cities
4-day forecast (EMEP model)

PM10

Max. concentration
($\mu\text{g}\cdot\text{m}^{-3}$)



Air quality forecasts European cities



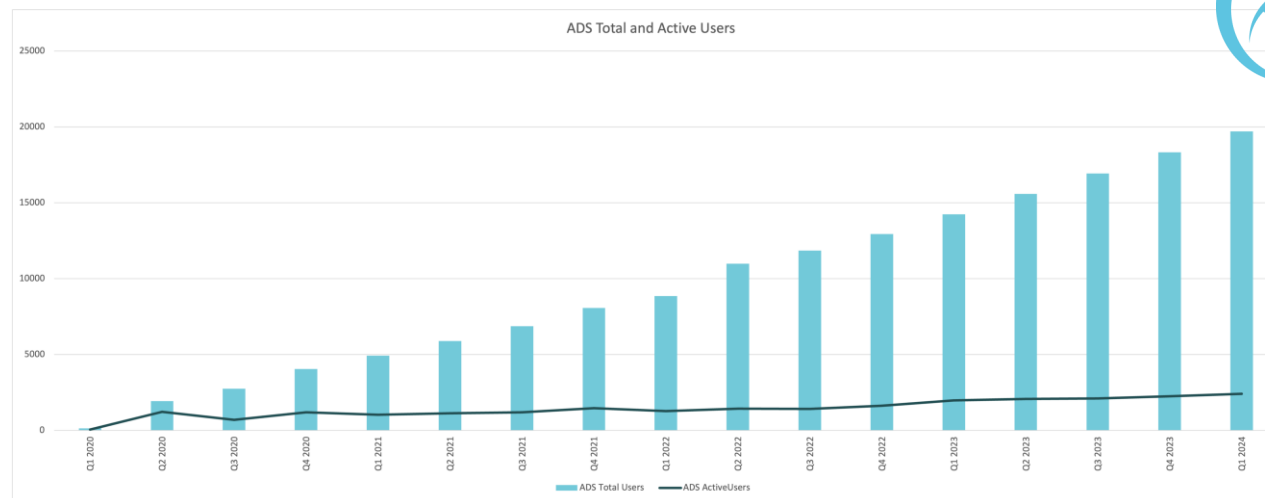


CAMS Headline Statistics

33,489 total registered users by Q1 2024

3,171 active users in Q1 2024

269 TB data delivered in Q1 2024



CAMS Top 5 Datasets - by downloaded volume

CAMS Regional Air Quality
(cams-europe-air-quality-forecasts)

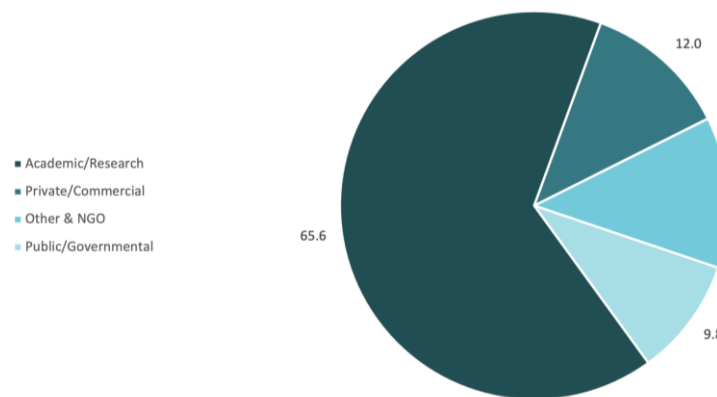
CAMS Global Reanalysis
(cams-global-reanalysis-eac4)

CAMS Global Atmospheric Composition
(cams-global-atmospheric-composition)

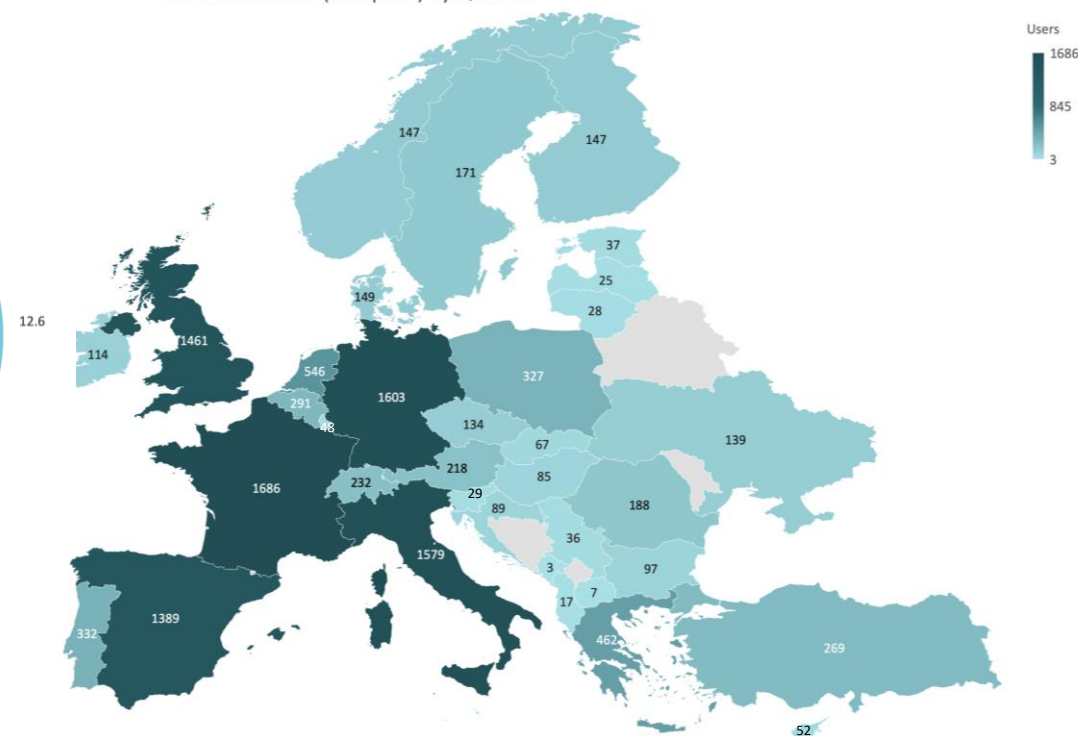
CAMS Europe Air Quality Reanalysis
(cams-europe-air-quality-reanalyses)

CAMS Global Fire Emissions
(cams-global-fire-emissions-gfas)

% of CAMS users by Sector



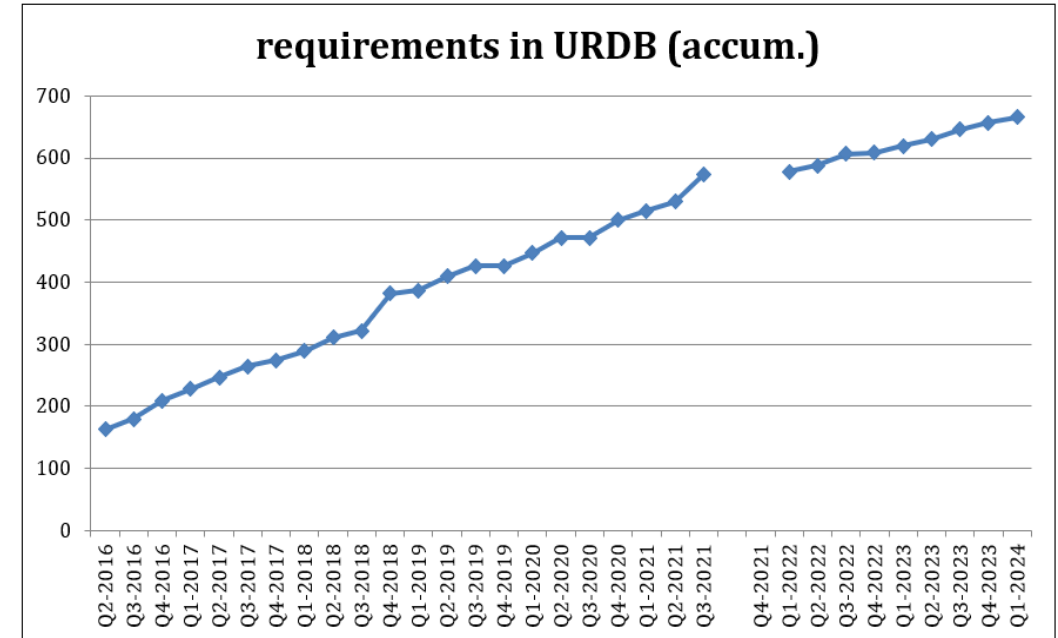
CAMS Total users (European) by Q1 2024





Requirements analysis: few insights

- **General requirements**
 - Improvement of information and data access (website, ADS)
 - Spatial coverage of the European domain
 - High spatial resolution
 - CO2MVS co-development
- **Policy**
 - More chemical compounds monitored to support source apportionment
 - Services on natural sources
 - Observation-based emissions
- **Downstream AQ**
 - High resolution datasets
 - More maps available on the website
 - Improved ADS functionalities
- **Solar energy**
 - Increase of daily maximum requests
 - Extension of the spatial coverage
 - NRT capacities



- Key importance of user intelligence
- Will shape CAMS 3.0
- Co-creation of value will be a key point in the future strategy

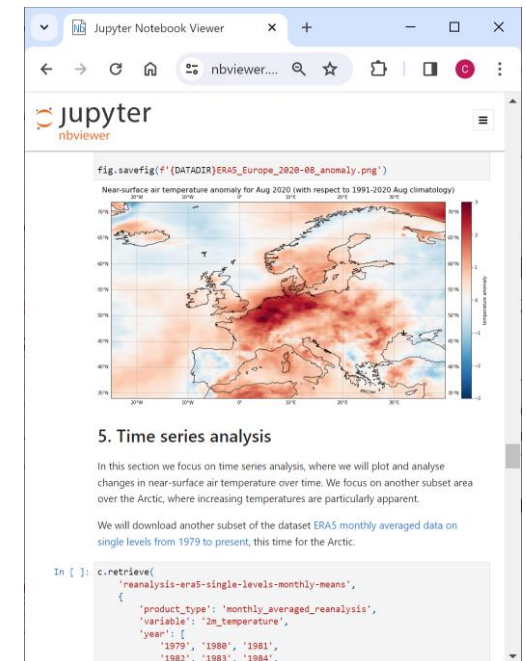
CAMS and C3S training and knowledge transfer

- 6th joint ECMWF, ESA, EUMETSAT Training in Atmospheric Composition (Oslo, 16-20.09.24)
- **Co-designing training events & development of new training resources:**
 - Training events in context of partnerships, NCPs, core & other users
 - Curation & development of learning resources (Jupyter, e-learning)
- **Open Call for training experts** to support with specific domain expertise
 - Trainers
 - Content Creators
 - Instructional Designers

Interested? Apply [here](#)
- **C3S mini-MOOCs**
 - Series of short online courses on C3S user topics to be launched in 2025, 2026 and 2027
 - Targeted to a wider audience



Copernicus training Experts Application Form



e-learning material:

<https://atmosphere.copernicus.eu/training>
<https://climate.copernicus.eu/user-learning-services>

Copernicus Thematic Hubs

Two new pilot initiatives launched in November 2023

We are eager to hear your voice.

Share your story on how you combine Copernicus, health and energy information, weather forecast data, etc.

We look forward to receive your user testimonies.

Send your testimony to Dr. Julie Letertre, Copernicus Hubs Coordinator
julie.letertre@ecmwf.int

HEALTH HUB

Copernicus Health Hub: environmental data and Earth Observation at the service of public health

More information



ENERGY HUB

Copernicus Energy Hub: Connecting environmental data and Earth Observations to the green energy transition

More information



Thank you
for your attention

Stijn Vermoote

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