



Climate Change

## Water quantity data within C3S

### *An introduction to the Copernicus Climate Change Service*

**Fredrik Wetterhall**  
Senior Scientist  
ECMWF  
[Fredrik.Wetterhall@ecmwf.int](mailto:Fredrik.Wetterhall@ecmwf.int)





Climate  
Change

# Copernicus programme: EU funded but with GLOBAL scope



observations  
feeding into  
value-added  
Services



Atmosphere



Climate



Land



Marine



Emergency



Security

**Sentinels and in-situ observations**

*Copernicus is the European Union's operational Earth Observation and Monitoring programme, looking at our planet and its environment for the ultimate benefit of all citizens.*

**User-driven with free and unrestricted data access**



Climate  
Change

# C3S as a user oriented service

Our service includes:

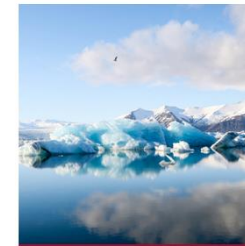
- Open and free access to climate data, accessible via a **one-stop Climate Data Store**
- **Tools** to use and analyze the data
- Specific climate indicators on **sectoral impacts**
- Climate change **assessments**
- **Quality assurance** on data, products and infrastructure as well as providing a dashboard to monitor **service performance**
- **User requirements** database and analysis as input for **service evolution**



## Climate Change

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

### Key products and services



Climate bulletins



Climate Data Store



Data in action



In focus

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

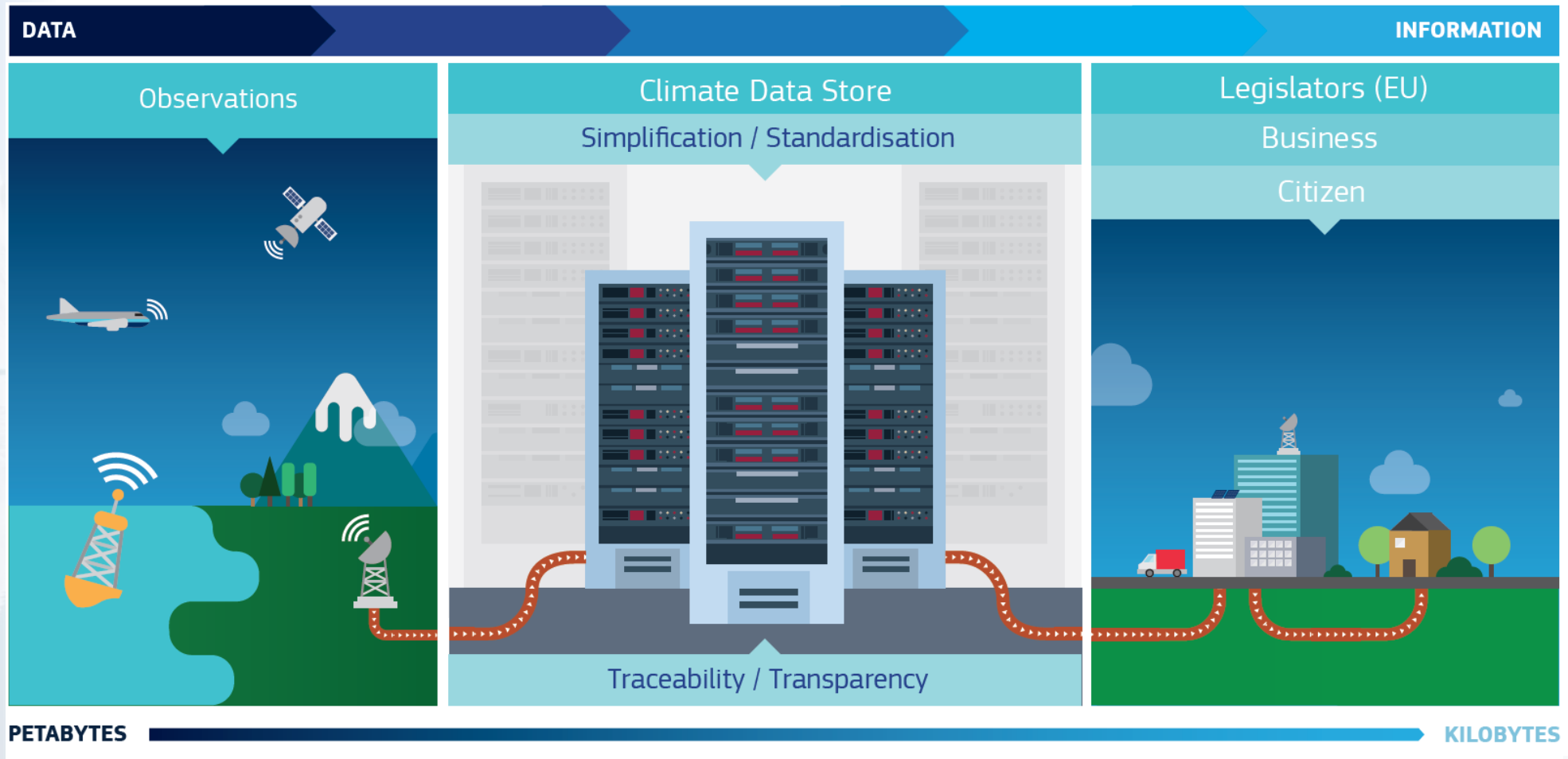




Climate  
Change

# Operational climate data for service

Providing consistent and authoritative information  
about climate (past, present, future)

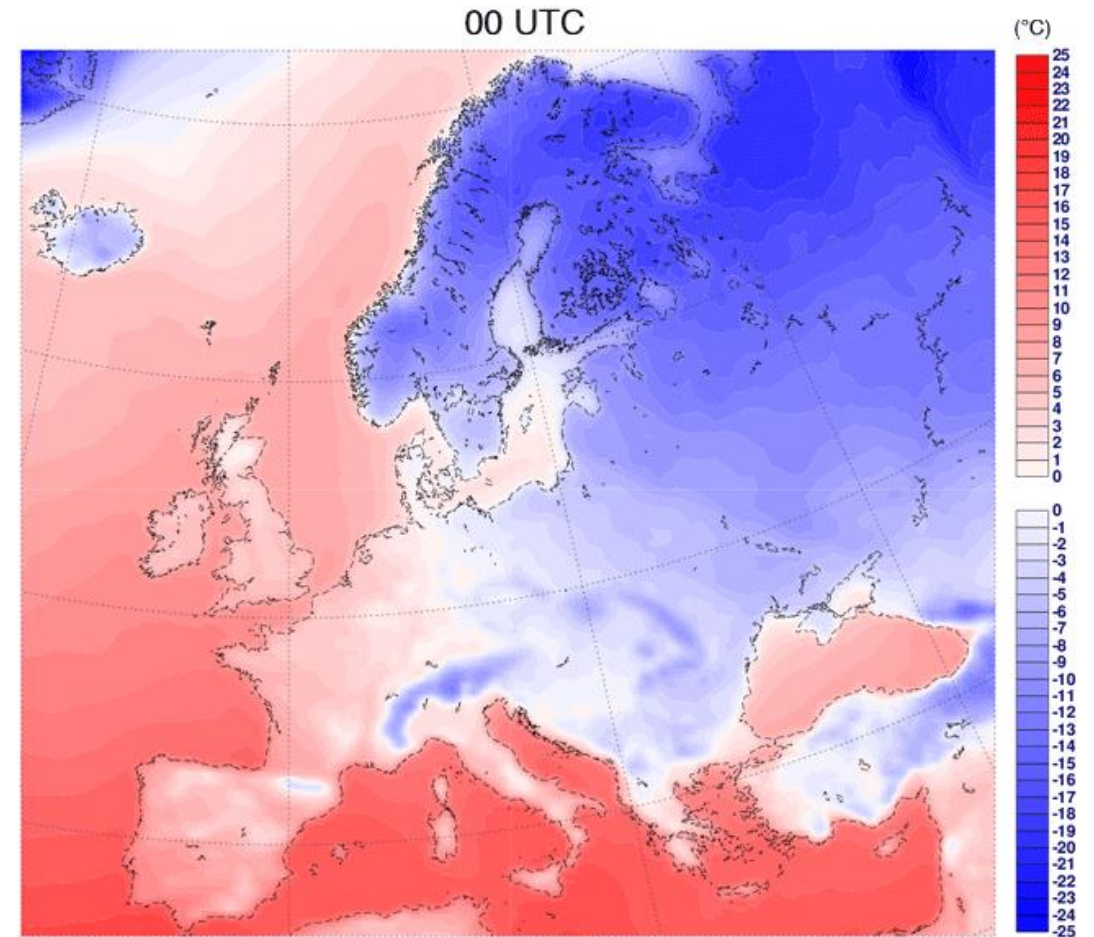




Climate  
Change

## Global reanalysis: ERA5

- Atmosphere/land/wave parameters
- 31 km global resolution, 137 levels
- Hourly output from 1979 onward
- Using 2016 ECMWF forecast system
- Using improved input observations
- Ensemble data assimilation method
- Uncertainty estimates for all ECVs





Climate  
Change

# Seasonal Forecasts



**Operational service: 6-month forecasts issued monthly**

C3S support to member state activities:

- generation of graphical and digital (data) products
- support to Member State development and operational activities in seasonal forecasting;
- access to data from other providers

**International prominence:**

- **NCEP** - joined the service in November 2019
- **ECCC and JMA** – planned to be integrated
- **BoM** - expression of interest

**Graphical products:** [https://climate.copernicus.eu/charts/c3s\\_seasonal/](https://climate.copernicus.eu/charts/c3s_seasonal/)

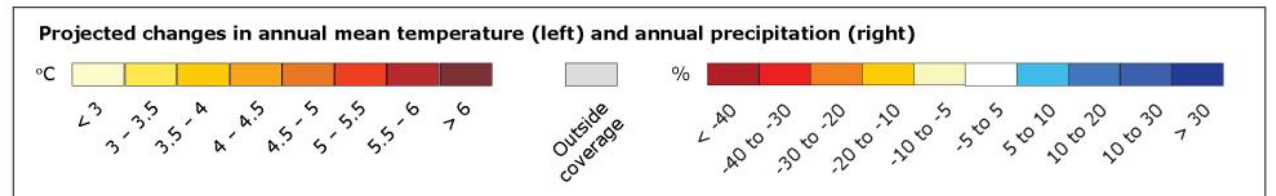
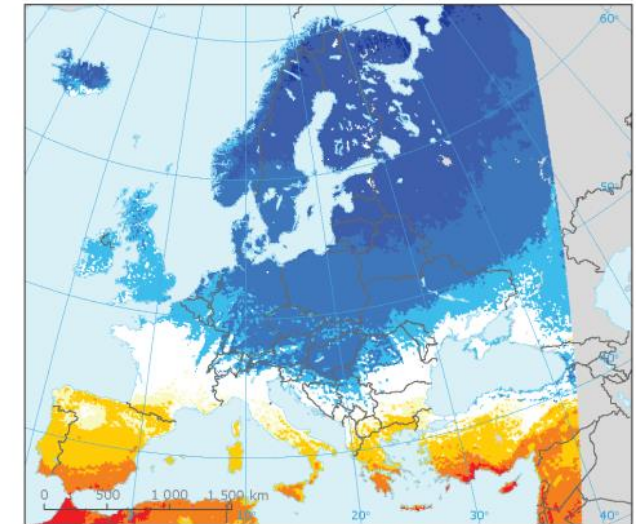
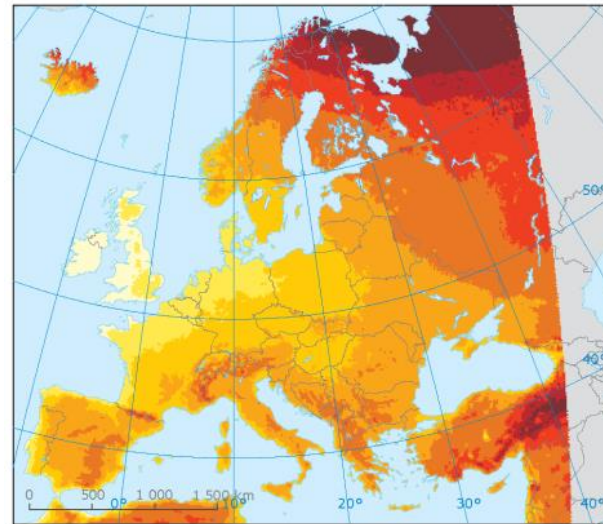
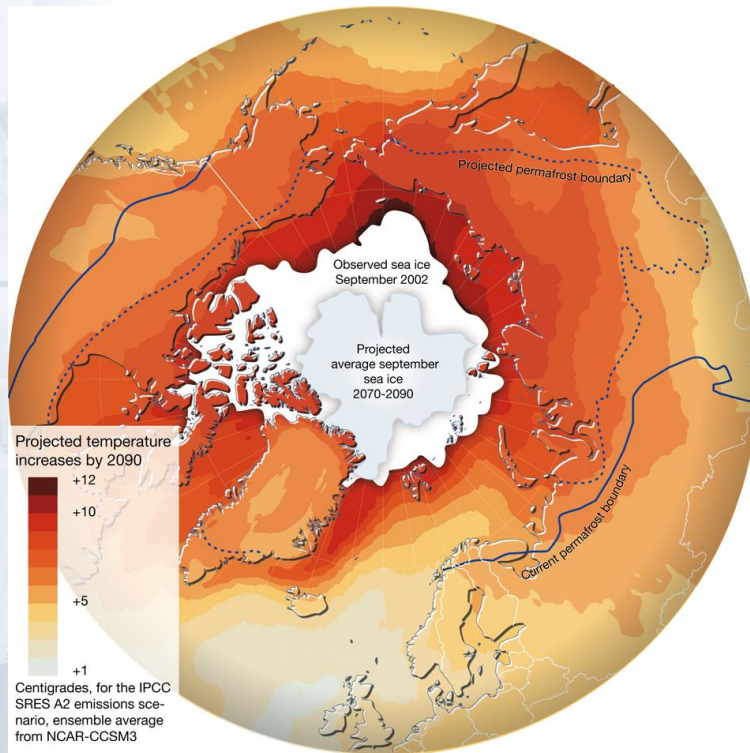
**Data service:** <https://cds.climate.copernicus.eu/cdsapp#!/search?type=dataset>



Climate  
Change

# Climate projections

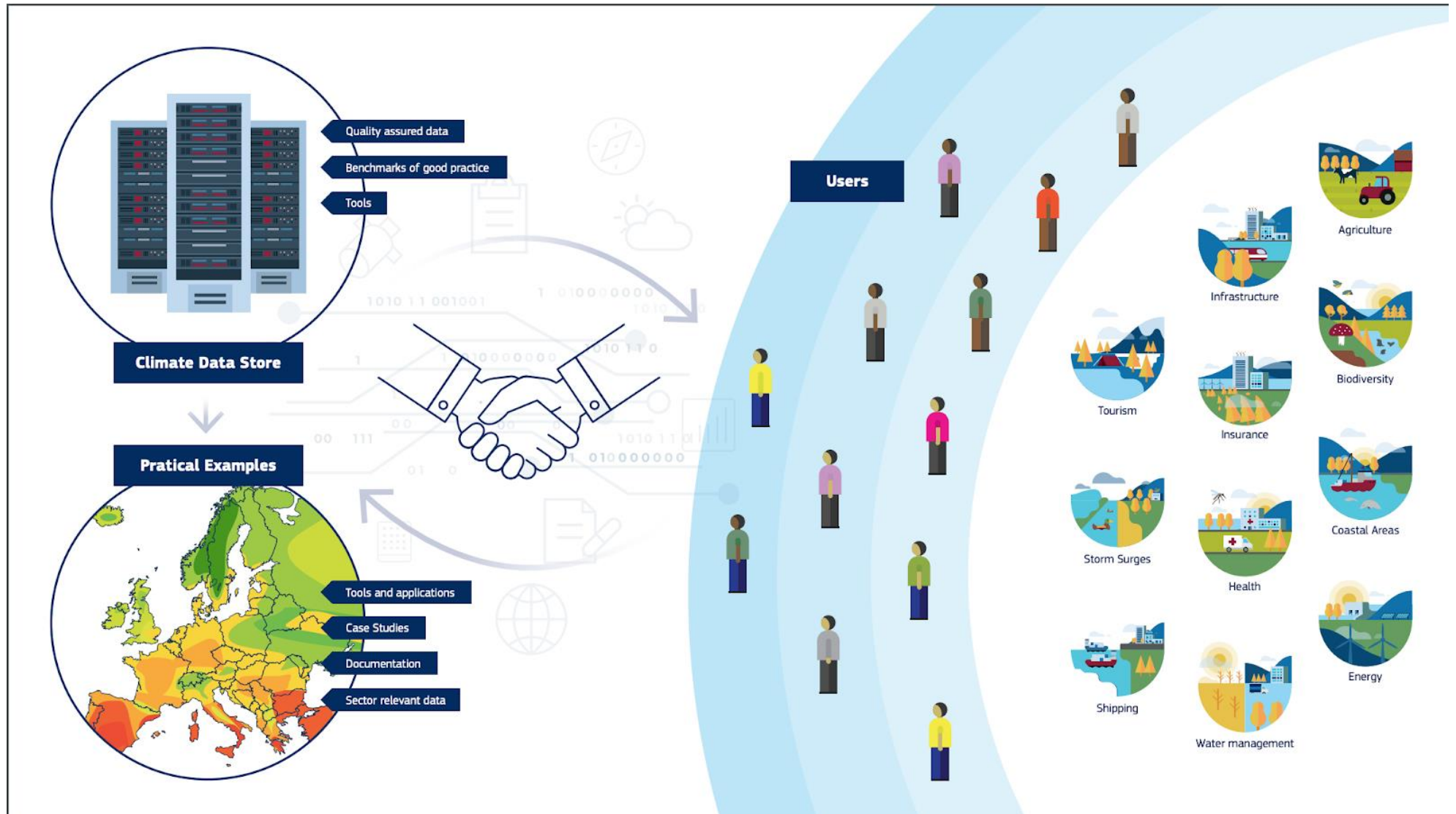
*Service: Providing users with timely access to climate change scenarios produced with state-of-the-art climate models (CMIP, CORDEX)*





Climate  
Change

# Develop user driven and sectorial workflows & applications







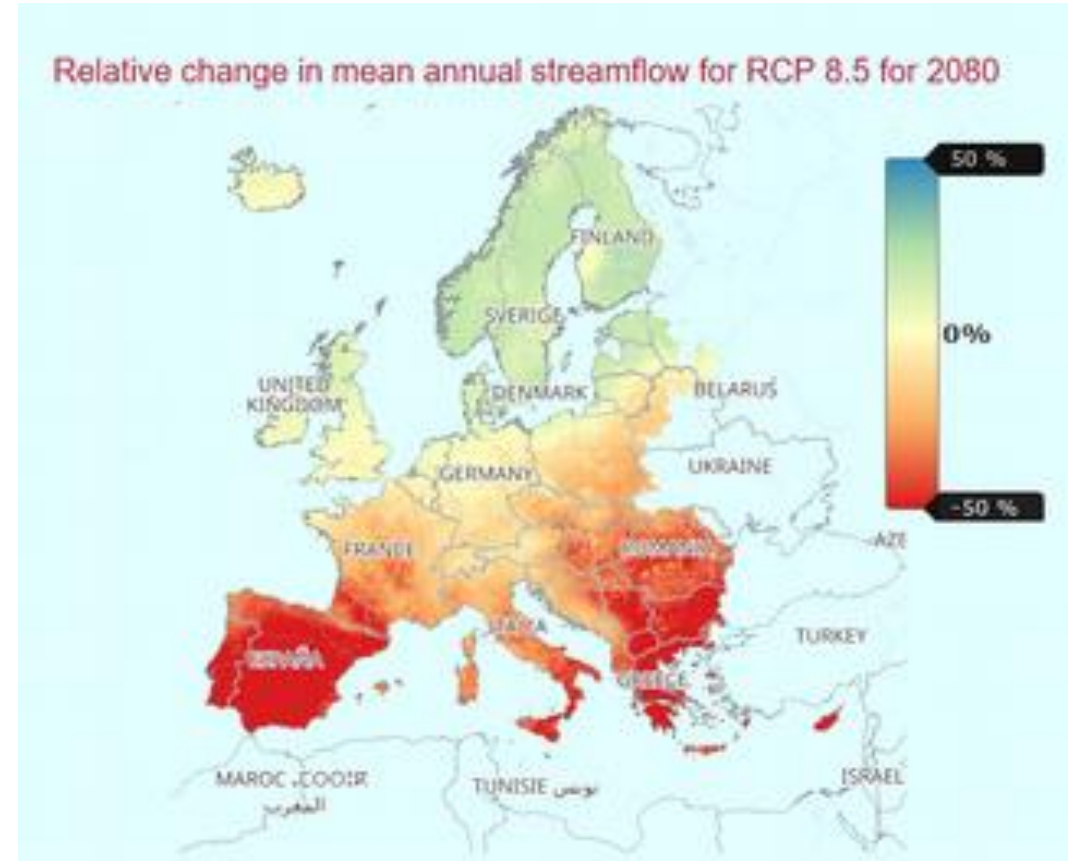
Climate  
Change

# Water sector indicators of hydrological change across Europe from 2011 to 2095 derived from climate simulations

## Transforming data from climate projections into usable information for the European water sector

- The indicators cover hydrological variables of **river discharge, soil moisture, snow water equivalent and groundwater recharge**.
- Based on **stakeholder consultations** in different areas of the water sector (hydropower, irrigation, water supply)
- A range of global climate models and standard projection scenarios were used along a multi-hydrological model approach to produce these indicators. This **ensemble approach** to the climate and hydrological modelling captures the **uncertainty and variability of the hydrological regime**.

*Produced on behalf of C3S, by UKCEH, UFZ, Cetaqua, CPL, EA, MENBO and NVE*



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



Climate  
Change

## Inland navigation - Rhine river

### Case study to monitor and project river flow changes and effects on costs of inland waterway transport on the Rhine river by using C3S climate data

- Improved information on **observed and future river flow, stream velocities and water levels** can help to guide users and managers of inland waterway traffic in optimising their system and processes, thus **improving the competitiveness of the inland navigation sector** in the overall transport market.
- For the next decades (until 2050), no clear changes of user relevant indicators are obvious. Consequently, needs for adaptation measures are limited for that period.
- **After 2050**, a **growing importance of low water periods** is seen. Various measures can be envisioned for limiting the negative effects of this change on navigation on the River Rhine. The conditions for implementing these measures still need to be worked out in more detail.

Implemented by SMHI on behalf of C3S



Climate  
Change

# CEMS-Flood data in CDS

## 10 CEMS-Floods datasets now available on CDS for EFAS and GloFAS:

- The dataset contains:
  - Forecasts
  - Historical runs
  - Reforecasts
  - Seasonal forecasts
  - Seasonal reforecasts
- Available variables are river discharge, soil moisture and snow water equivalent. Updated in near real-time
- Applications in development to select area and point data
- Data supporting seasonal hydrological multi-model

*This dataset is being produced and quality assured by CEMS-COMP*

Home Search Datasets Applications Your requests Toolbox FAQ Live

### River discharge and related historical data from the European Flood Awareness System

Home Search Datasets Applications Your requests Toolbox FAQ Live

### River discharge and related historical data from the European Flood Awareness System

Home Search Datasets Applications Your requests Toolbox FAQ Live

### Reforecasts of river discharge and related data by the European Flood Awareness System

WARNING: Use with caution. Some areas may show extremely low soil moisture values. This does not affect the discharge reforecasts.

**Overview** Download data Documentation

This dataset provides gridded modelled hydrological time series forced with medium- to sub-seasonal range meteorological reforecasts. The data is a consistent representation of the most important hydrological variables across the European Flood Awareness System (EFAS) domain. The temporal resolution is 20 years of sub-daily reforecasts run twice weekly (Mondays and Thursdays) of:

- River discharge
- Soil moisture for three soil layers
- Snow water equivalent

It also provides static data on soil depth for the three soil layers. Soil moisture and river discharge data are accompanied by ancillary files for interpretation (see related variables and links in the documentation).

This dataset was produced by forcing the LISFLOOD hydrological model at a 5x5km resolution with ensemble meteorological reforecasts from the European Centre of Medium-range Weather Forecasts (ECMWF). Reforecasts are forecasts run over past dates and are typically used to assess the skill of a forecast system or to develop tools for statistical error correction of the forecasts. The reforecasts are initialized twice weekly with lead times up to 46 days, at 6-hourly time steps for 20 years in the recent history. For more specific information on the how the reforecast dataset is produced we refer to the documentation.

Companion datasets, also available through the Climate Data Store (CDS), are the operational forecasts, historical simulations which can be used to derive the hydrological climatology, and seasonal forecasts and reforecasts for users looking for long term forecasts. For users looking for global hydrological data, we refer to the Global Flood Awareness System (GloFAS) forecasts and historical simulations. All these datasets are part of the operational flood forecasting within the Copernicus Emergency Management Service (CEMS).

EFAS v4.6 hourly forecast skill at 5 day lead time



Climate  
Change

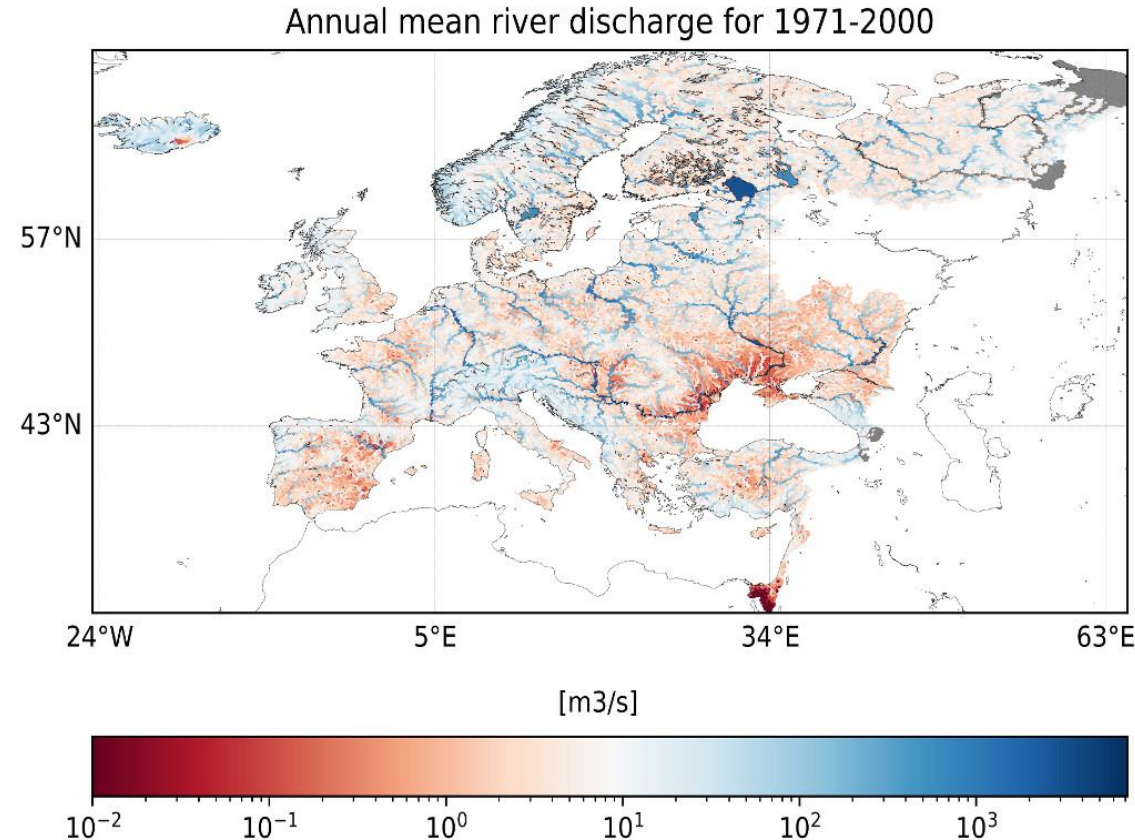
# Operational C3S Water Sector dataset and applications

## Hydrology related climate impact indicators from 1970 to 2100 derived from bias adjusted European climate projections

Dataset and  
applications ready  
for publication in  
May 2021

- The dataset contains **essential climate variables** in the form of daily mean River discharge and **a set of 18 climate impact indicators (CIIs)** for both water quantity and quality indicators at a **catchment scale**.
- The data represent the **current state-of-the-art in Europe** for regional climate and hydrological modelling and indicator production.
- The temporal resolution of the indicators is 30 year annual and monthly means with absolute values for the climatological period (1971-2000) and relative or absolute change, depending on the indicator, for three future periods for three Representative Concentration Pathways (2.6, 4.5 and 8.5). The water discharge is provided also at a daily time step for the period 1970-2100.

*This dataset is being produced and quality assured by SMHI on behalf of C3S.*





Climate  
Change

# User driven climate data service –outlook for next phase



We support activities that turn our data and information into **knowledge and insights for decision makers**

- Serve EU and UN policies
- **Co-creation** of applications and solutions together with domain specialists at the service of national or regional authorities
- **Support** uptake via downstream market to create added-value products
- **Training and capacity building**



Climate Change



Copernicus EU



Copernicus ECMWF



@CopernicusEU  
@CopernicusECMWF



@copernicusecmwf



Copernicus EU  
Copernicus ECMWF



[www.copernicus.eu](http://www.copernicus.eu)  
[climate.copernicus.eu](http://climate.copernicus.eu)

For questions and support, please contact us at  
[copernicus-support@ecmwf.int](mailto:copernicus-support@ecmwf.int)



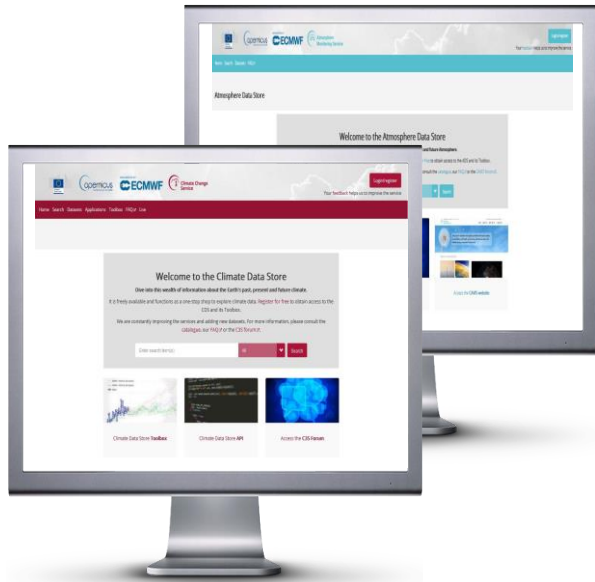
# CAMS & C3S User Support Journey – self-support is key!

CKB: <http://copernicus-support.ecmwf.int/knowledgebase>

Forum: <http://copernicus-support.ecmwf.int/forum>

Enquiry Portal: <http://copernicus-support.ecmwf.int>

<https://ads.atmosphere.copernicus.eu>



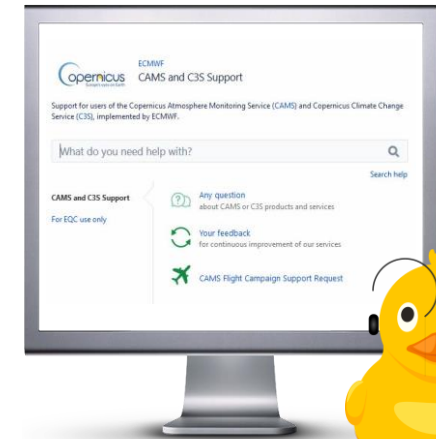
<https://cds.climate.copernicus.eu>



**Copernicus Knowledge Base (CKB)**, a collection of **quality-controlled documentation** and “how to” guides, reviewed and checked by experts, updated regularly.



**User Forum**, a platform for CAMS and C3S users to share and learn from the experience of other users and experts. Also the place to watch for **latest CAMS & C3S announcements**.



**Enquiry Portal**, a secure web interface for users to **communicate with the Copernicus Helpdesk** by submitting enquiries, providing feedback & new requirements, to track progress and to monitor status of submitted requests.



[copernicus-support@ecmwf.int](mailto:copernicus-support@ecmwf.int)