The Copernicus Climate Change Service

A European Response to Climate Change

Jean-Noël Thépaut, ECMWF

Climate Change

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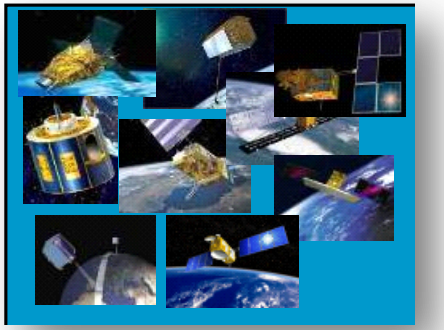
Copernicus Architecture

6 services use Earth Observation data to deliver …



Sentinels

Contributing missions

…added-value products

in-situ

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Copernicus Space Component: Dedicated Missions

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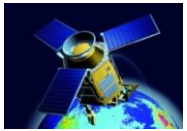
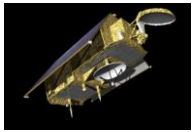

	**S1:** Radar Mission	✔ ✔ ? ?
	**S2:** High Resolution Optical Mission	✔ ✔ ? ?
	**S3:** Medium Resolution Imaging and Altimetry Mission	✔ ✔ ? ?
	**S4:** Geostationary Atmospheric Chemistry Mission	*2022?*
	**S5P:** Low Earth Orbit Atmospheric Chemistry Precursor Mission	✔ ?
	**S5:** Low Earth Orbit Atmospheric Chemistry Mission	*2021?*
	**S6 (Jason-CS):** Altimetry Mission	*2020?*

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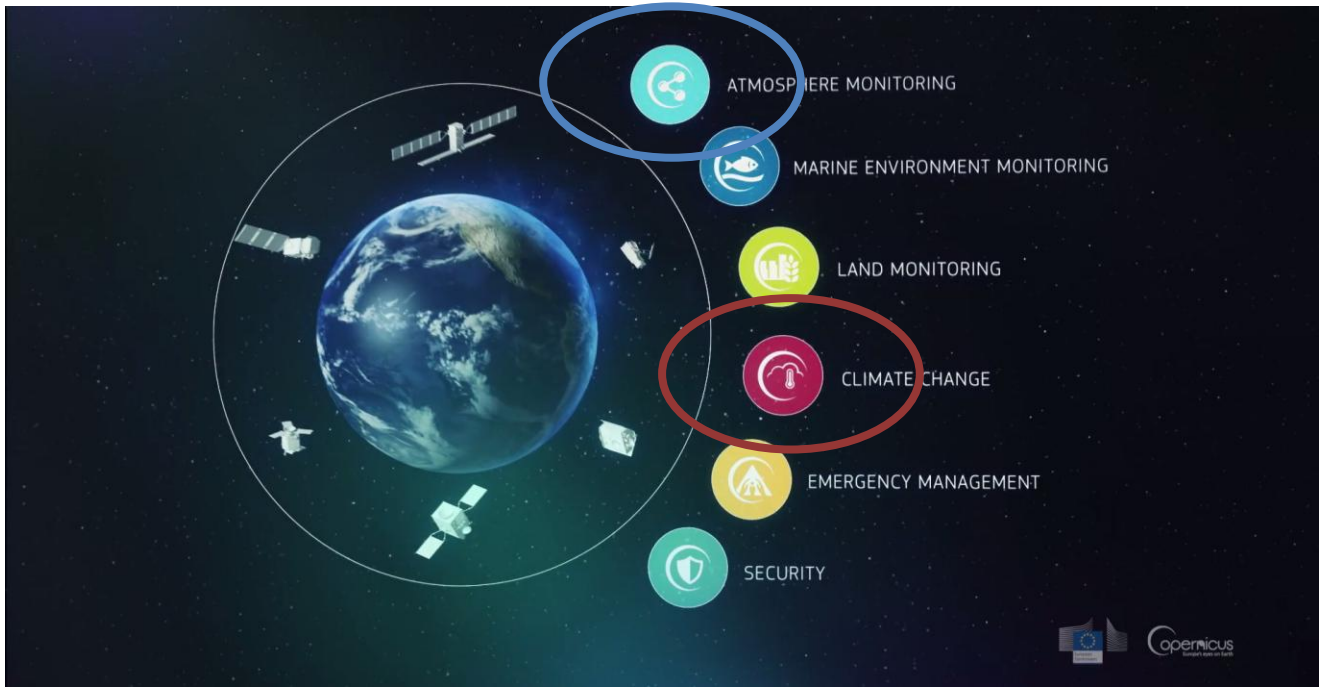
Copernicus: Earth observations and information services



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The C3S mission

To support European adaptation and mitigation policies by:

- Providing consistent and authoritative information about climate (past, present, future)
- Building on existing capabilities and infrastructures (nationally, in Europe and worldwide)
- Stimulating the market for climate services in Europe

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Achievements since the signature of the Delegation Agreement

Celebrating C3S transitioning from a concept to an operational Service*

[Video 1]

*: C3S second General Assembly, Berlin, 24-28 September 2018

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Climate Change

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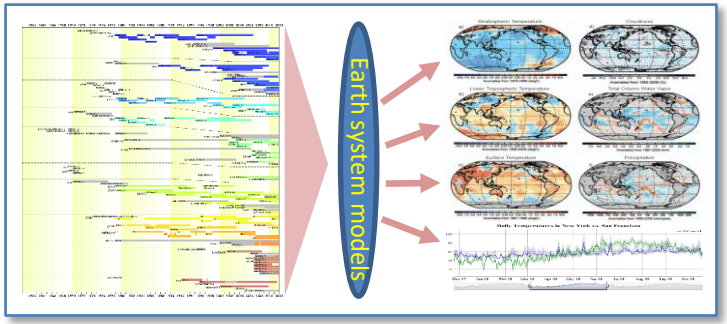
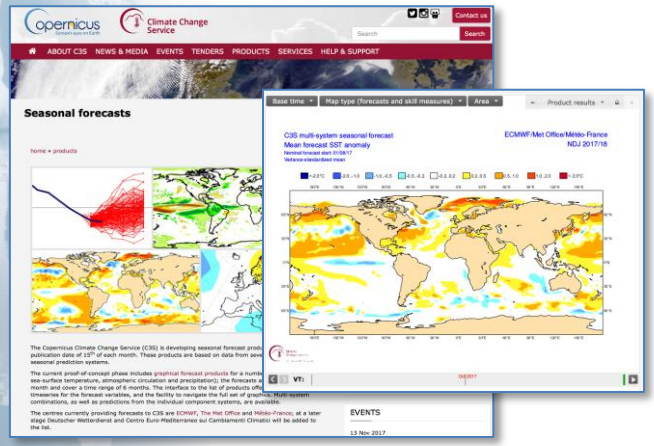
Access to past, present and future climate information



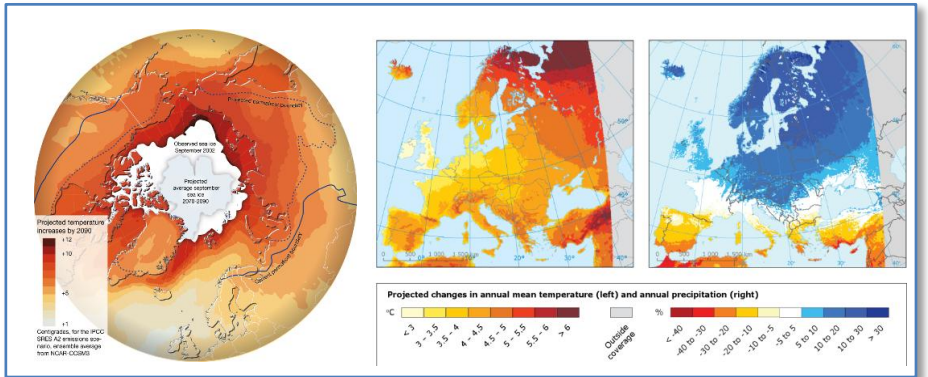
Observations and climate reanalyses

Seasonal forecast data and products

Climate model simulations



Sectoral climate impact indicators



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Climate Data Store content (November 2018)

Scientific basis:

- Essential Climate Variables as defined by GCOS
- GCOS Status Report and Implementation Plan
- IPCC, CMIP

Action engaged

In progress

Not started

Observations	Global estimates of ECVs from satellite and in-situ observations	Reprocessed CDRs, reference observations	Support for data rescue, climate data collections	Climate Indicators
Climate reanalysis	Global atmosphere, ocean, land	Regional reanalysis for Europe	Coupled climate reanalysis for 100 years (*)	
Model output	Multi-model seasonal forecast products	Access to CMIP data and products (global and regional)	Reference set of climate projections for Europe	

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(*): To be produced 2021-2022 based on FP7 ERA-CLIM2 outcomes (CERA-20C)

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Entities contributing to C3S

dd.29/10/2018

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C3S:
a truly European effort

249 different entities from

29 EU and ECMWF Member Sta

International Organisations and third countries

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C3S and the ecosystem

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etc…

Drias les futurs du climat

National Climate Services
- Value chain at local level, governments, etc.
- Provision of pan-European dimension for national businesses

EEA (Climate Adapt):
- State of Climate for Europe
- Climate Indicators
- CDS toolbox
- CC IV report

DG-Clima

GFCS:
- Global products (ECVs, reanalyses, seasonal forecasts and projections)
- WIS compliance
- Training and outreach
- Global SIS
- Liaison with RCCs

H2020/ERA4CS/JPI/KIC/etc.:
- CDS as a data resource
- Liaison with RD projects
- Underpinning science

Coordination with DG-DEvCO

GEO & UNFCCC:
- C3S discoverable through GEOSS portal
- Contribution to many SDGs

GCOS

WMO & GCOS:
- C3S ECVs and global indicators
- WMO State of the Climate

NOAA

NOAA:
- Coordination on observations and CDR issues with NCEI
- In-kind contribution of NCEP seasonal forecasts

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Climate Data Store Content

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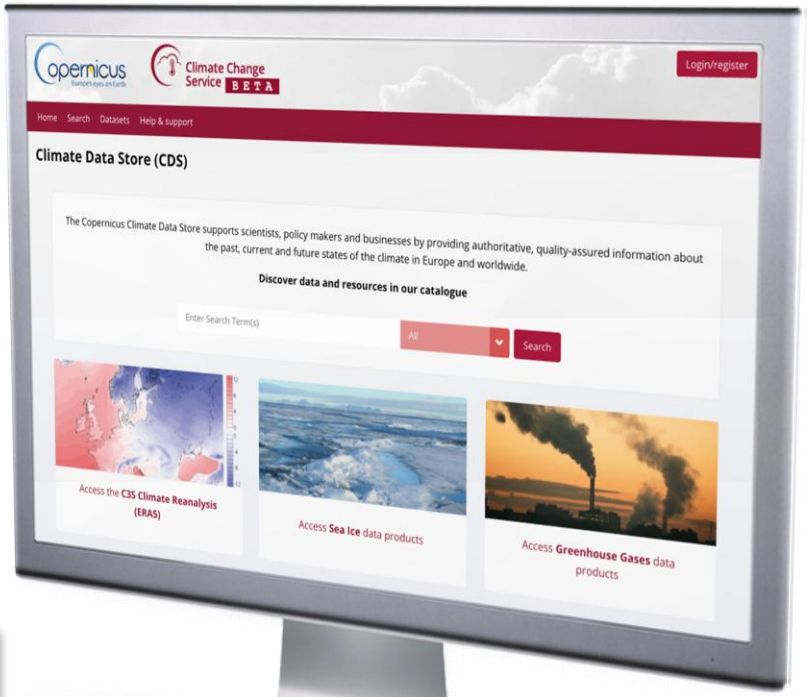
What C3S offers to its users

- Access to climate data
- Tools needed to use the data
- Information on sectoral impacts
- Quality assurance
- User support and training
- Climate change assessments
- Outreach and communication

A one-stop Climate Data Store



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CDS toolbox, workflows and applications

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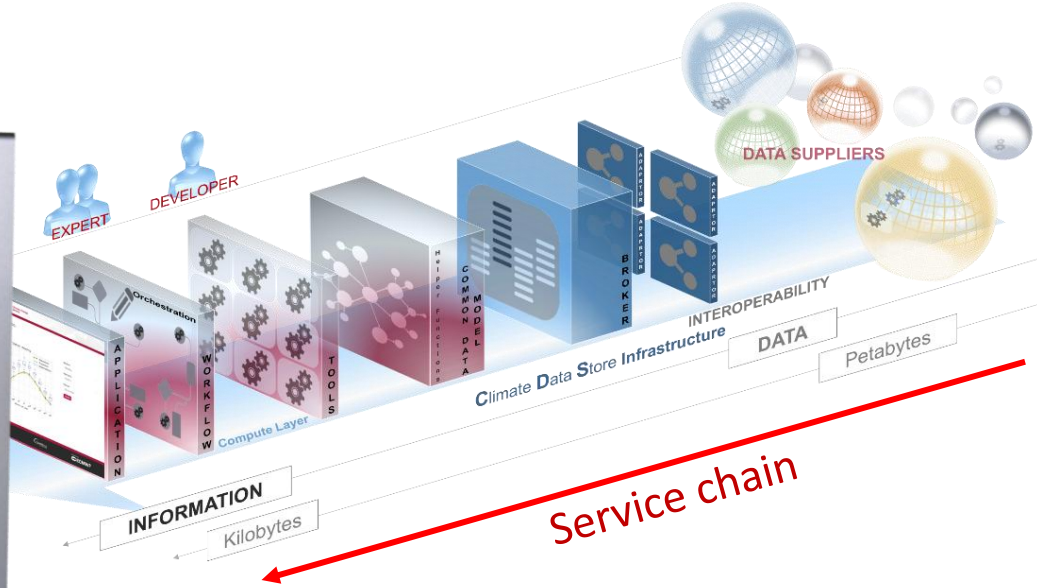

Quality assured information and tools for users: scientists, consultants, decision makers.

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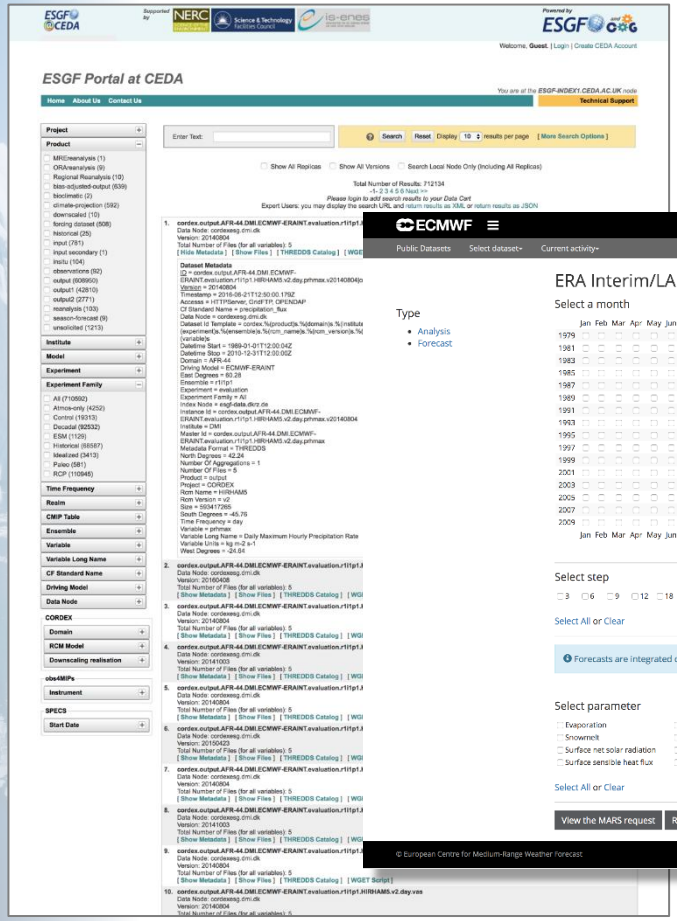
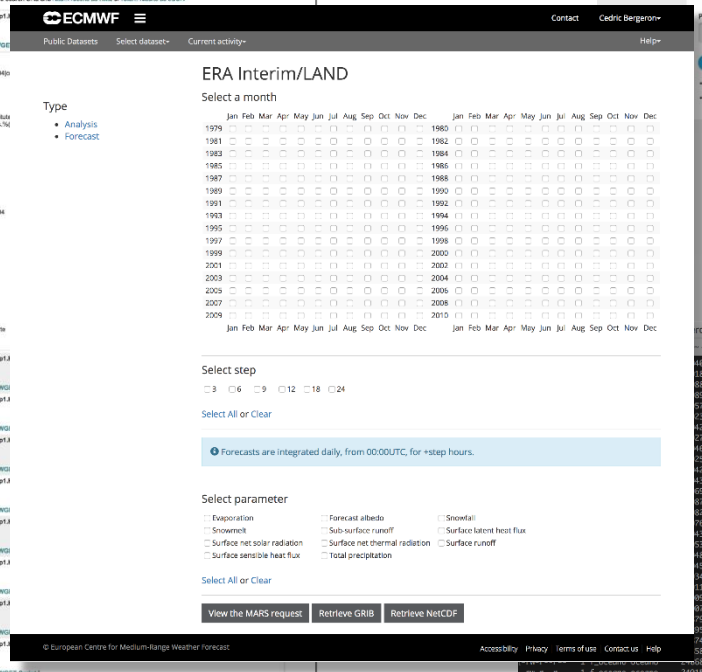
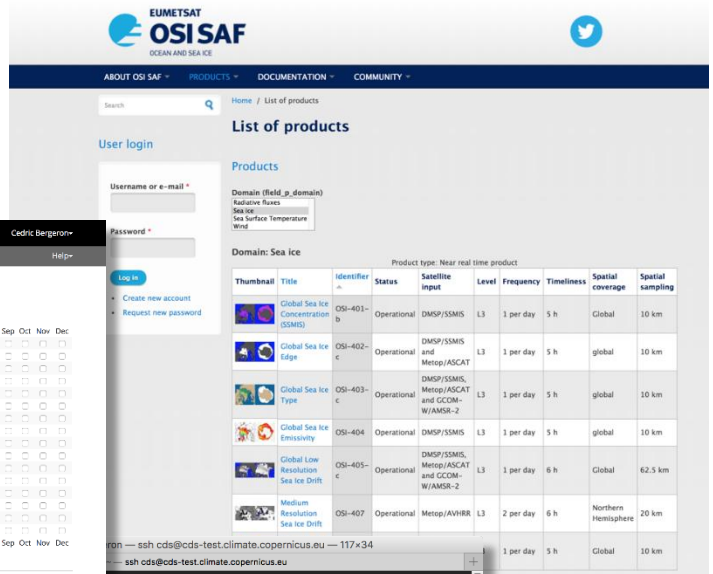
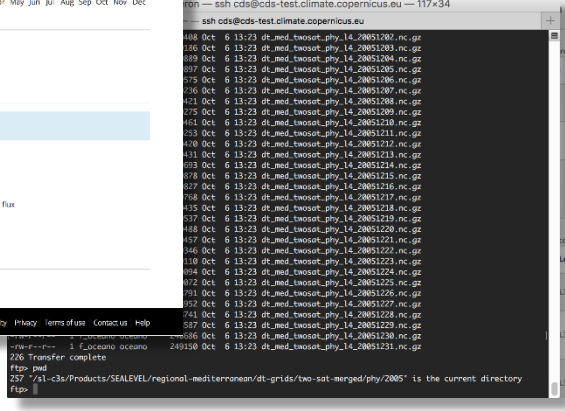
Access to climate datasets before the CDS…



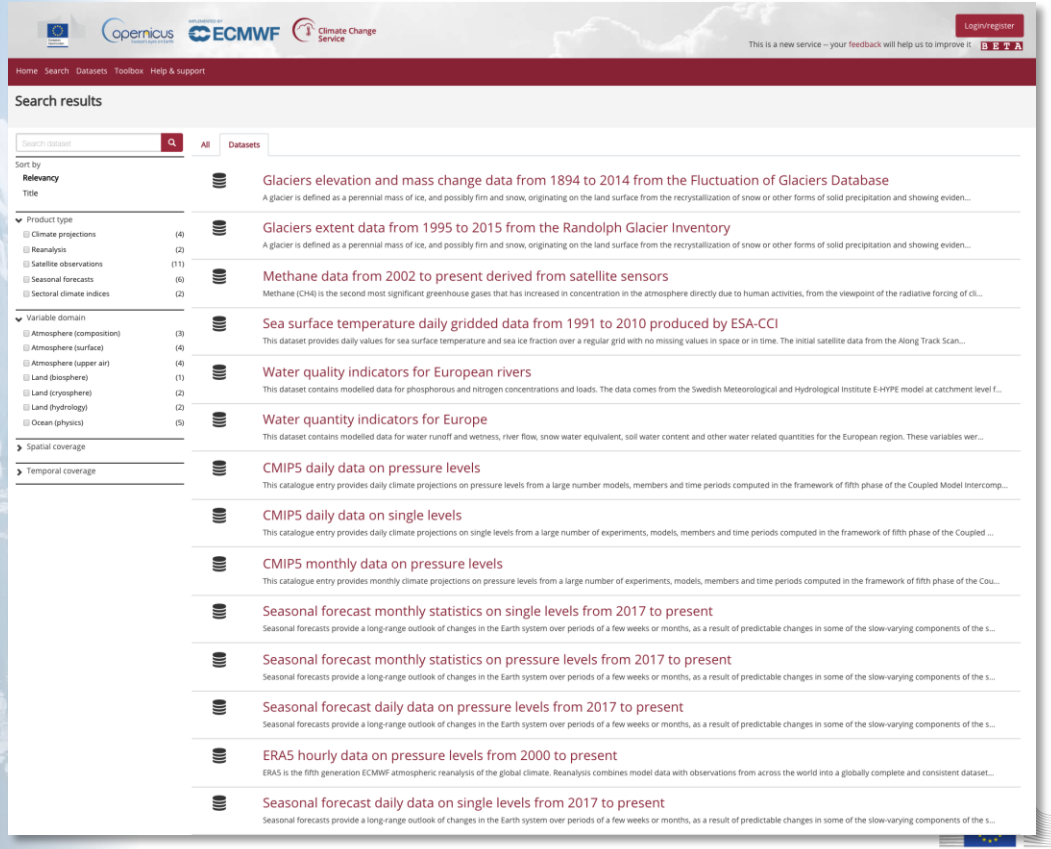


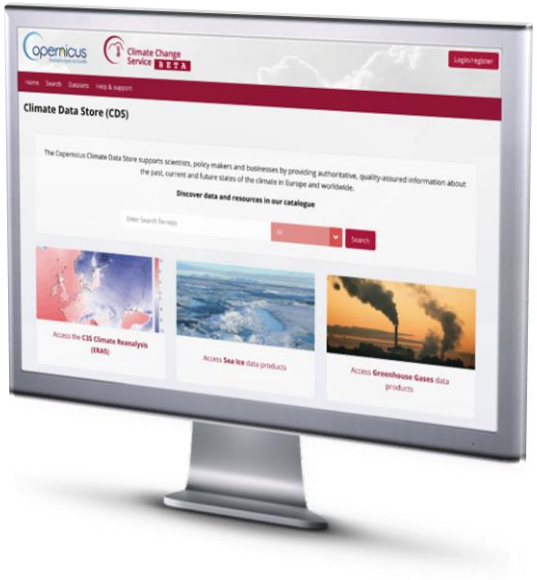




Catalogue of climate datasets

Climate Change





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ECV products from Earth observations

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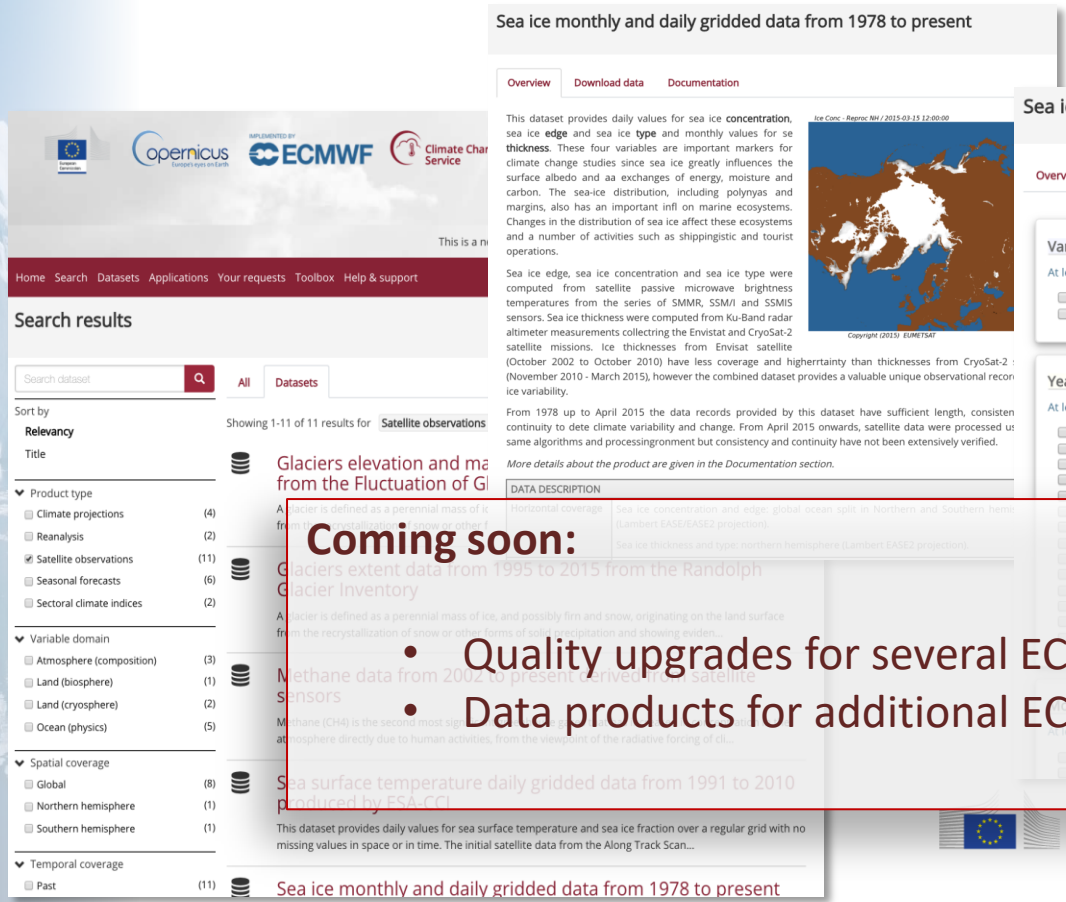

Coming soon:

- Quality upgrades for several ECV datasets
- Data products for additional ECVs (22 ECVs)

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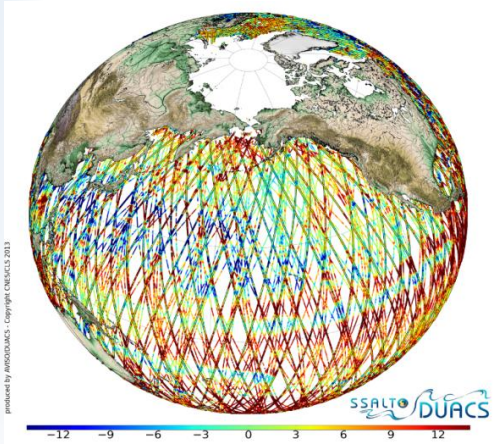
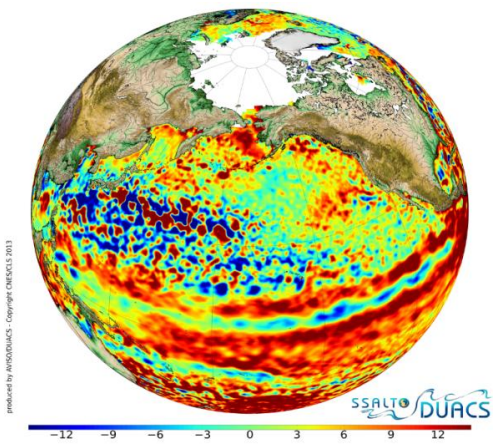
From satellite tracks to long-term global coverage

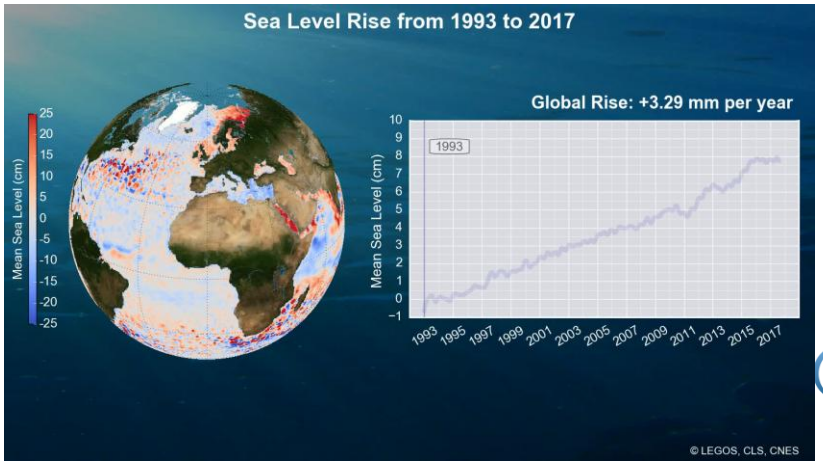


From satellite **along-track** measurements…

… to **sea level gridded maps**…



… to derive Ocean Monitoring Indicators



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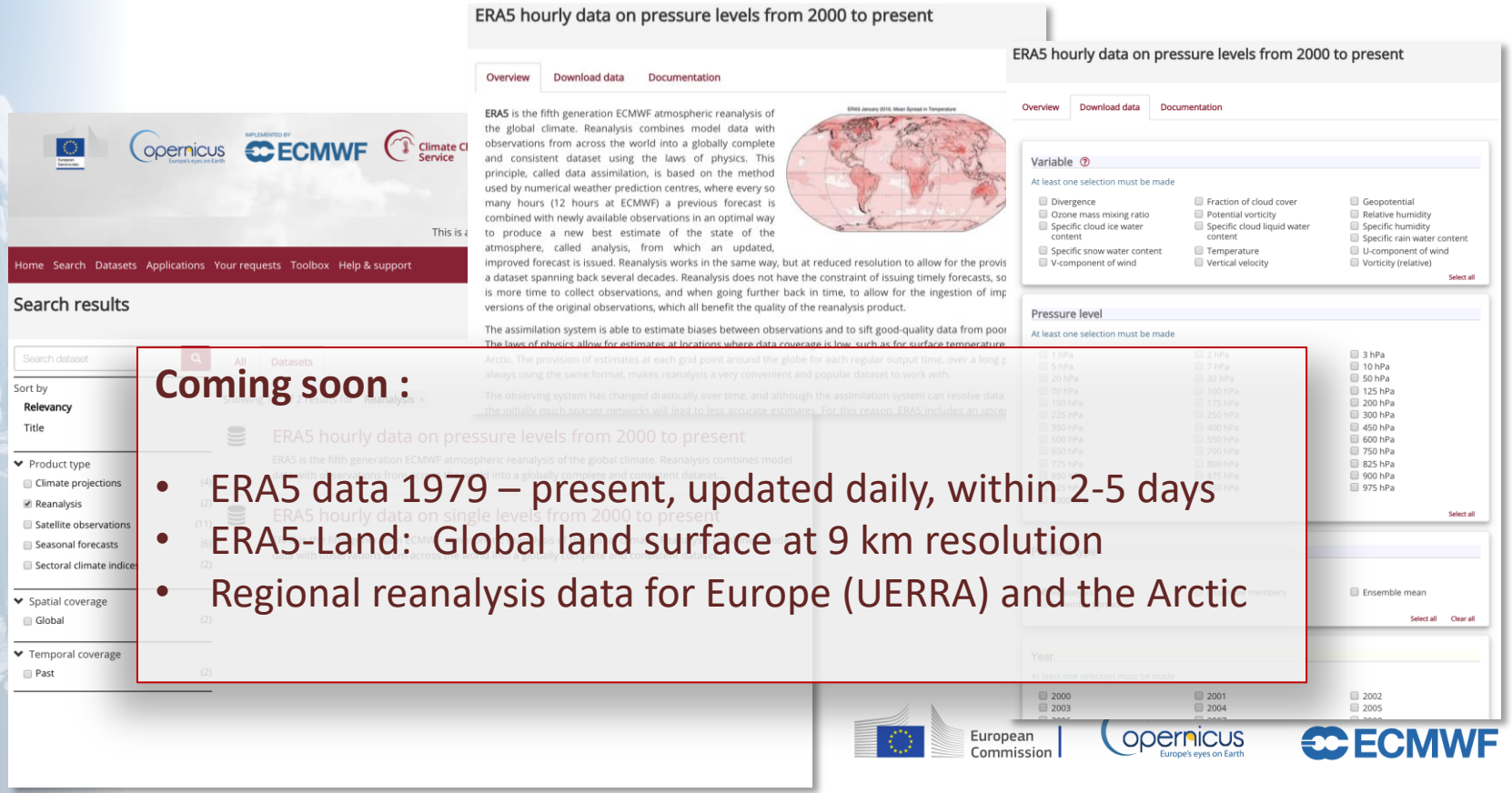
Climate reanalysis



Coming soon :

- ERA5 data 1979 – present, updated daily, within 2-5 days
- ERA5-Land: Global land surface at 9 km resolution
- Regional reanalysis data for Europe (UERRA) and the Arctic

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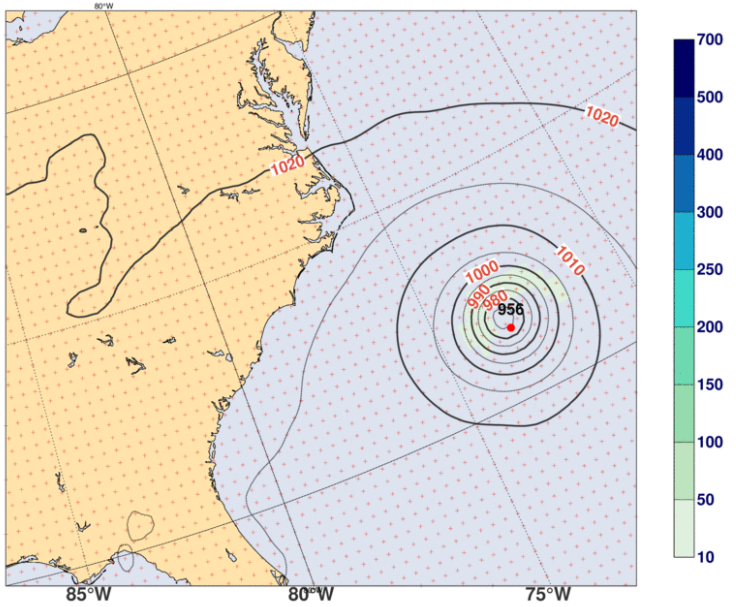
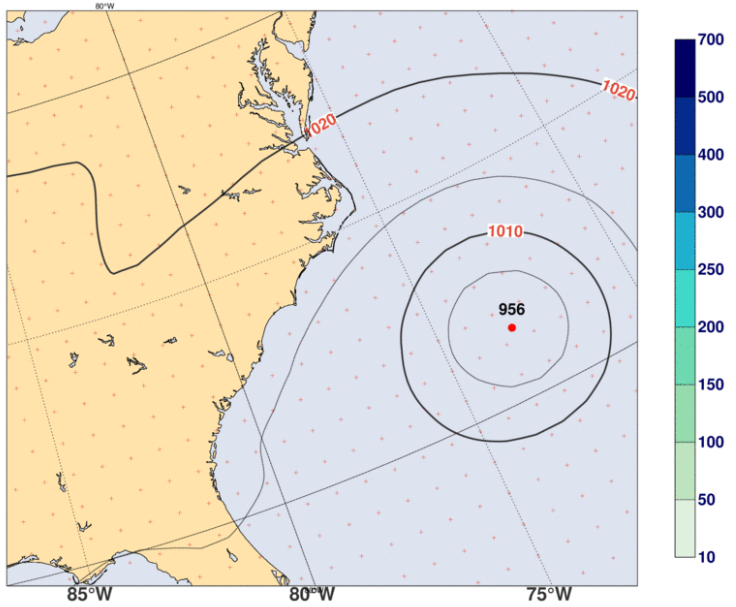
Going from ERA-Interim to ERA5

Florence Thu 13 Sep 2018, 01 UTC for ERA5



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



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Multi-system seasonal forecasts

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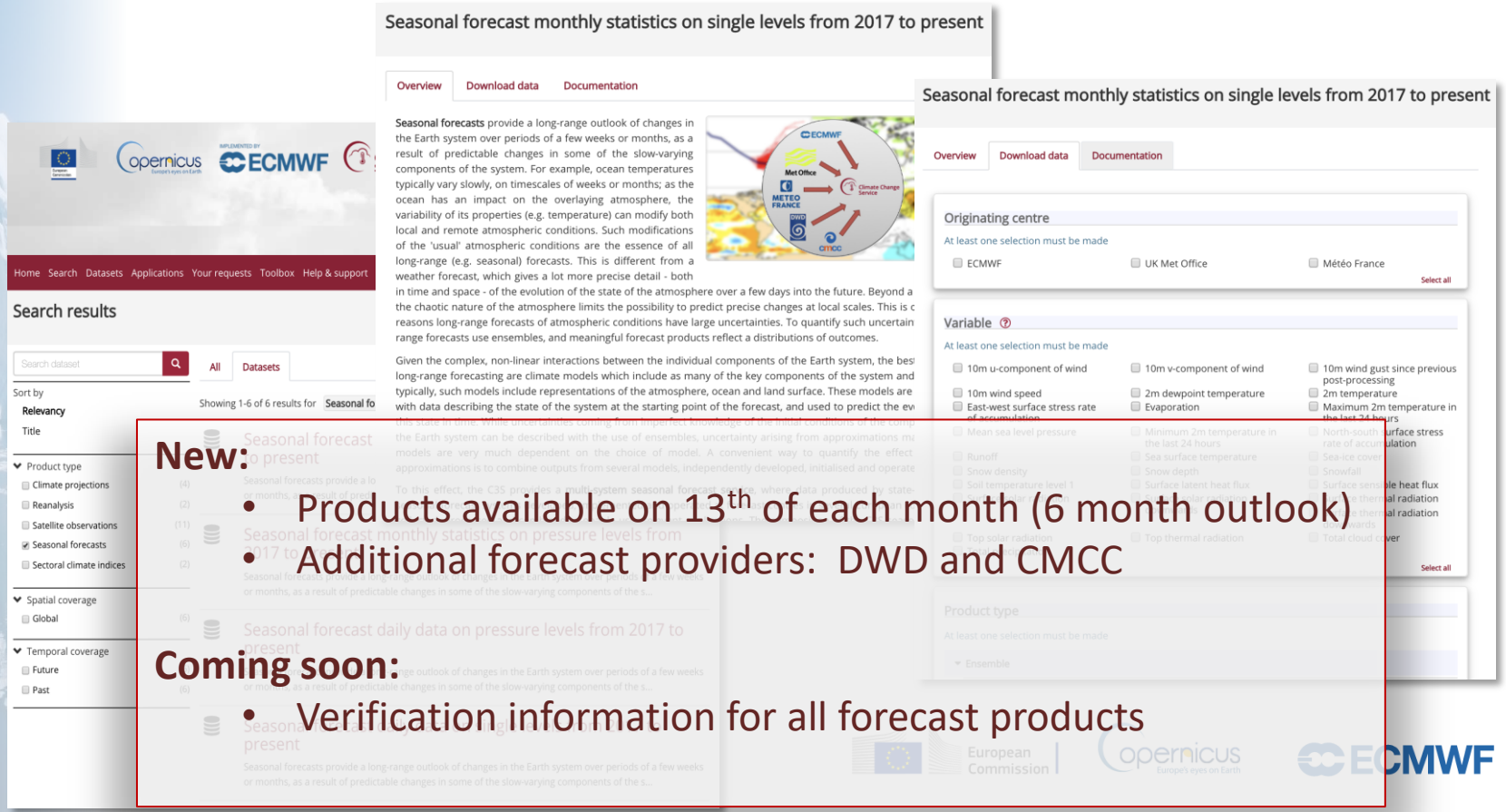

New:

- Products available on 13th of each month (6 month outlook)
- Additional forecast providers: DWD and CMCC

Coming soon:

- Verification information for all forecast products

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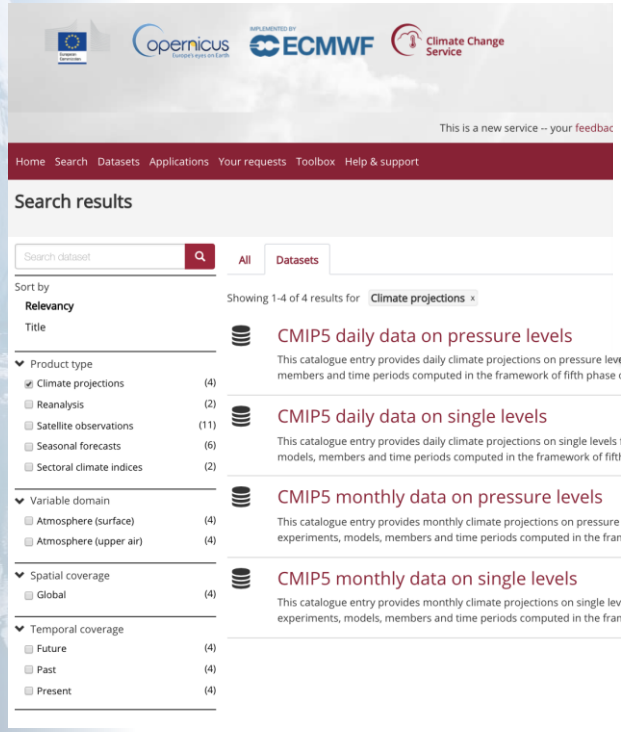
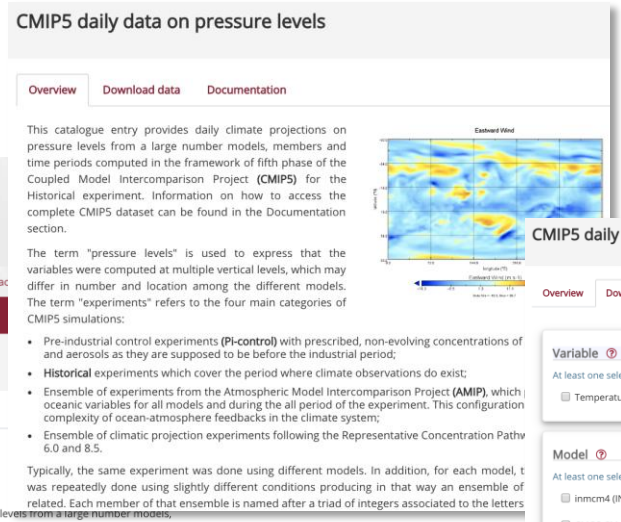
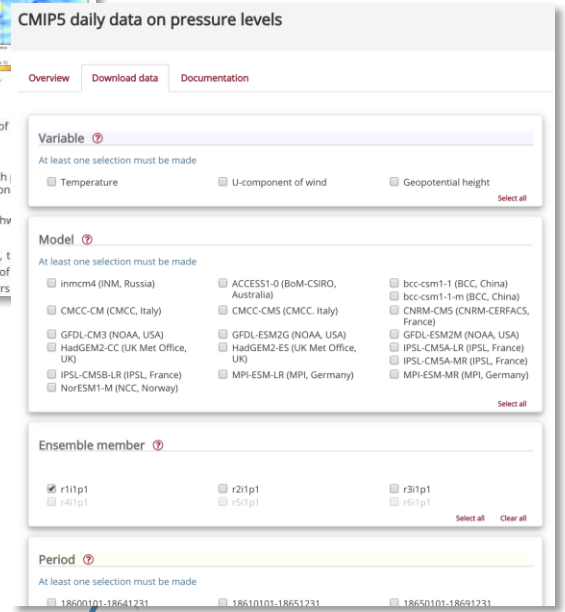
Climate projections from CMIP5







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Evaluation and Quality Control (EQC)

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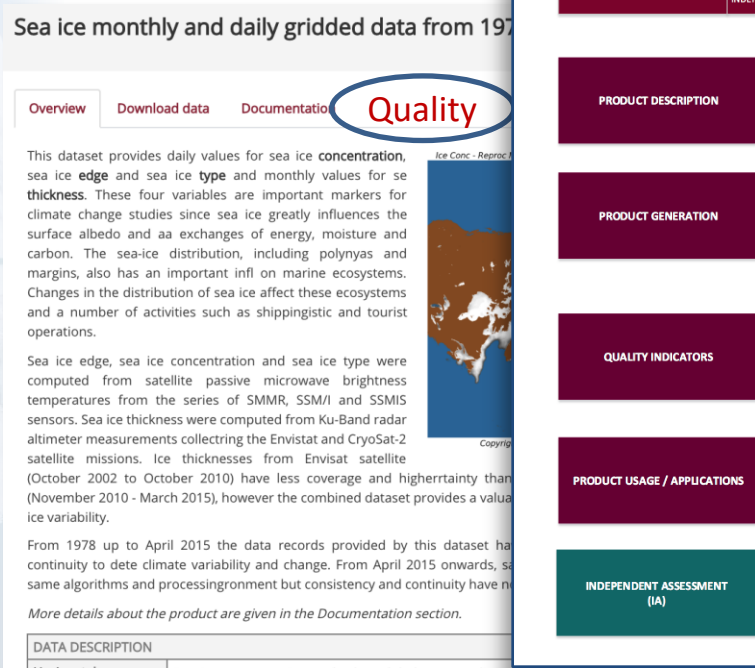
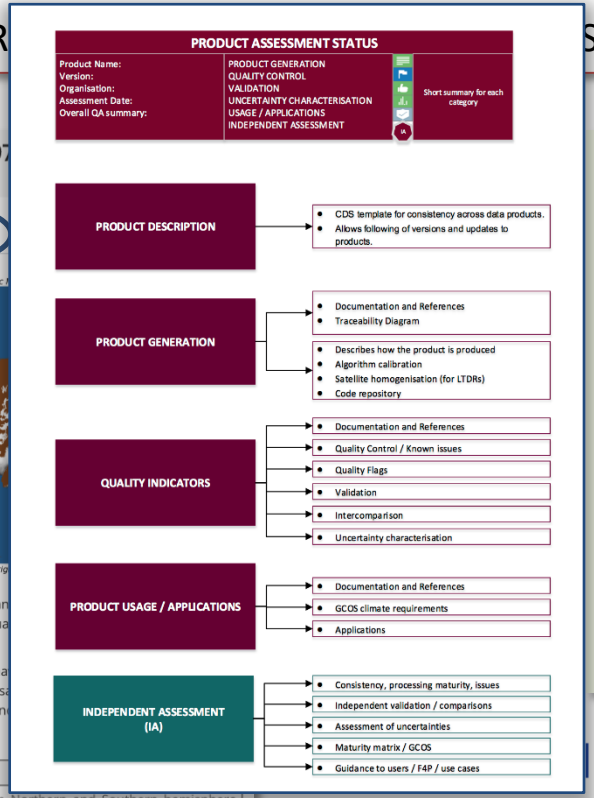
A suitable EQC framework has been developed for quality assurance of CDS datasets

Key feature: Quality Assurance R… S





Quality of data:
- assessments
- user guidance
- gaps and limitations

Quality of tools:
- fitness for purpose
- best practices

Quality of service:
- speed, responsiveness
- system availability, …

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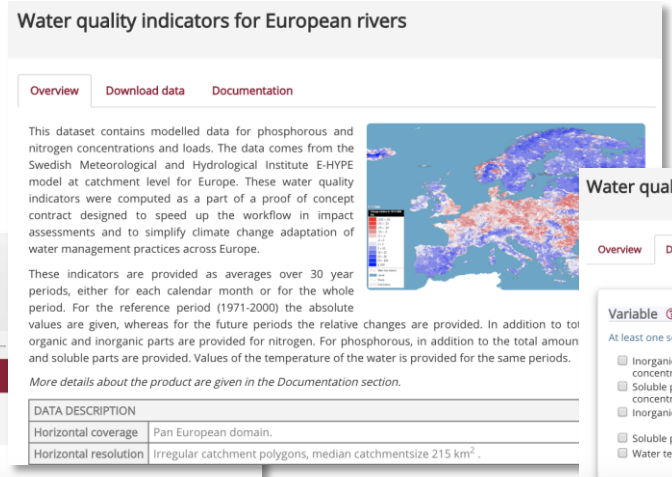
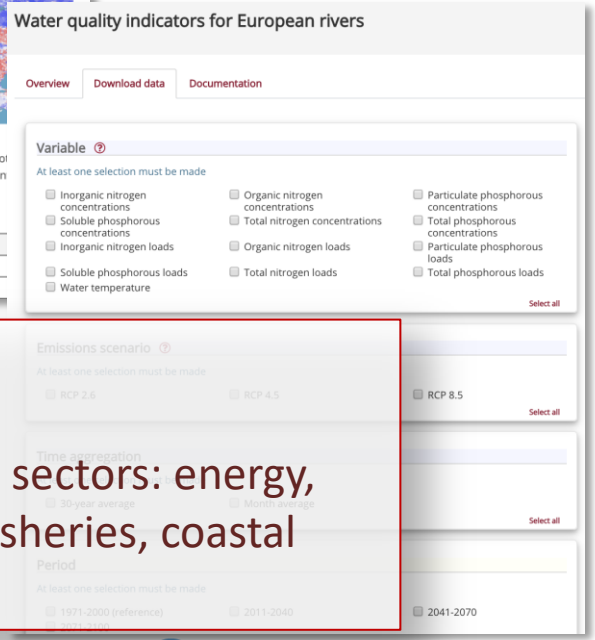
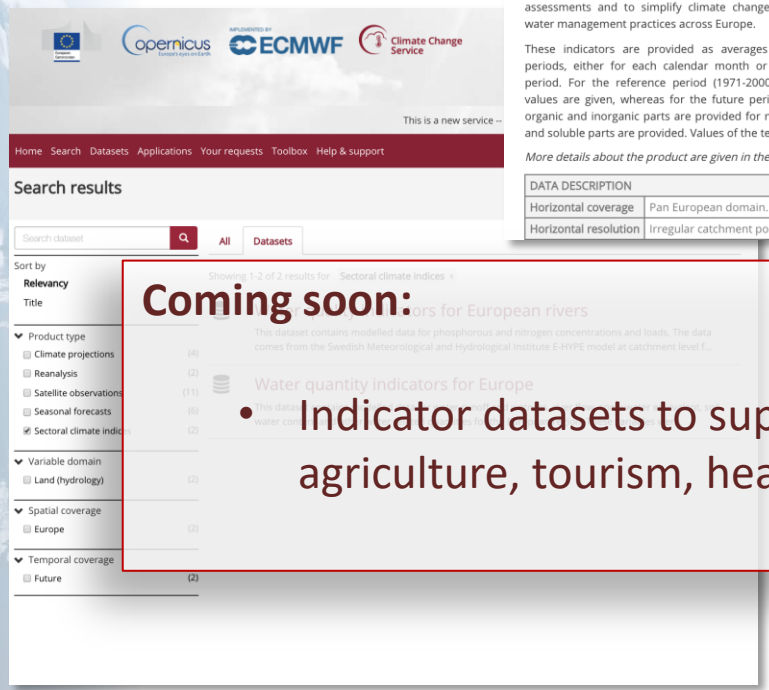
Data on sectoral impacts







Coming soon:

- Indicator datasets to support additional sectors: energy, agriculture, tourism, health, shipping, fisheries, coastal

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C3S reanalysis data: A use case

C3S reanalysis data as a business model for an SME in the renewable energy sector

Video 2

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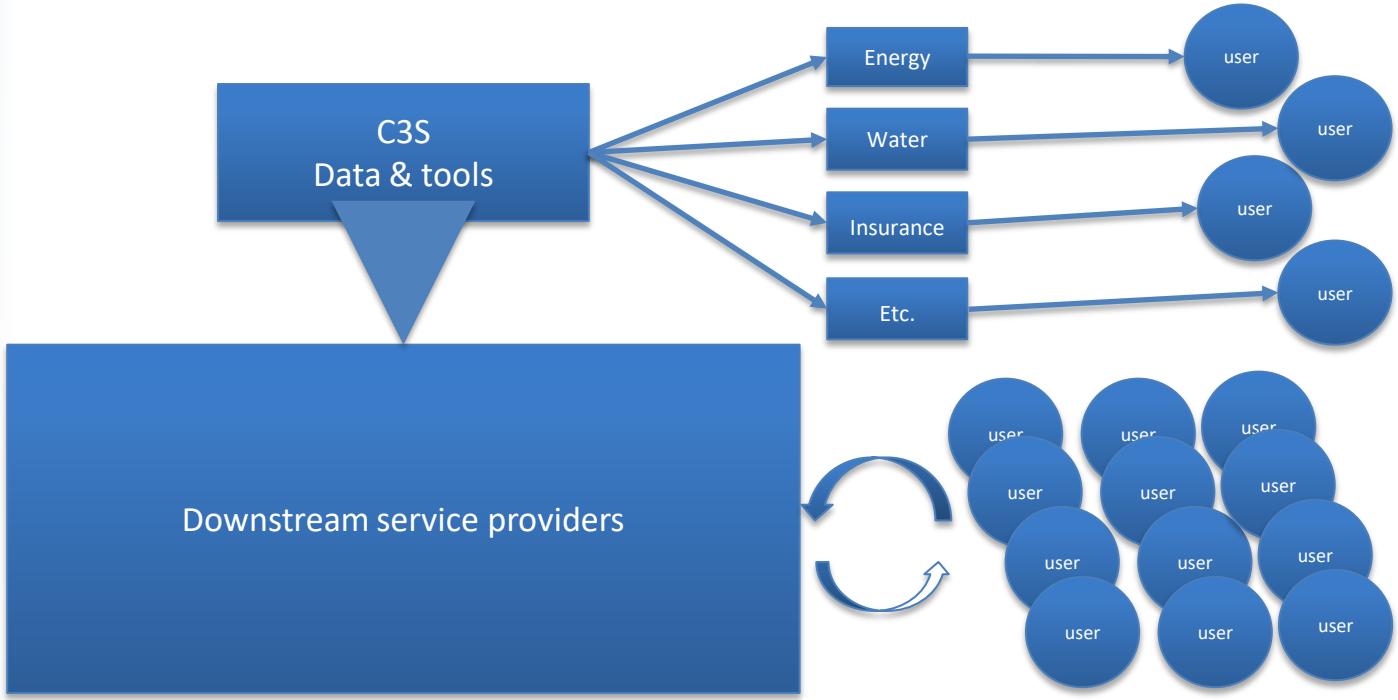
Enabler for downstream exploitation



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Sectoral Information System

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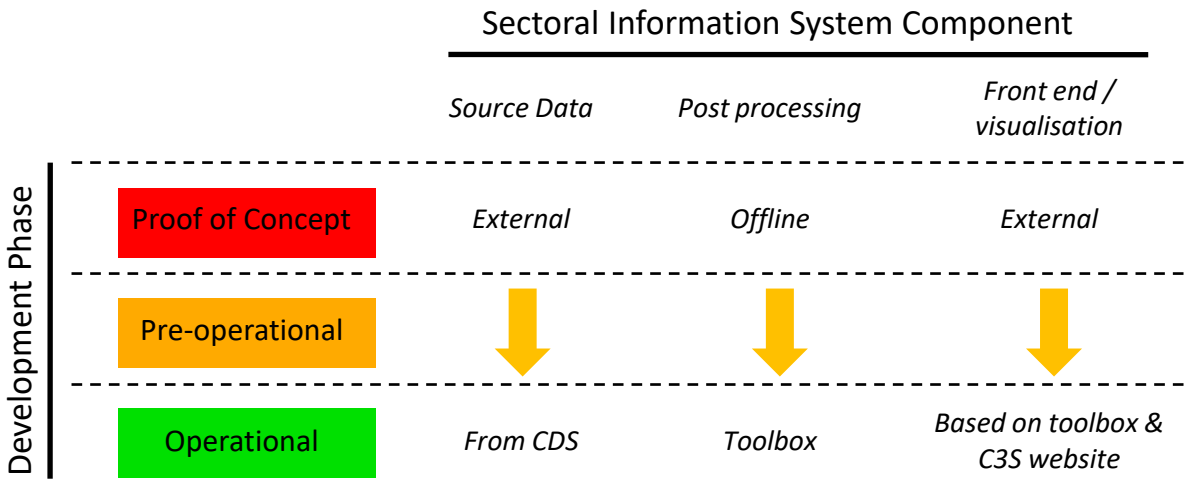

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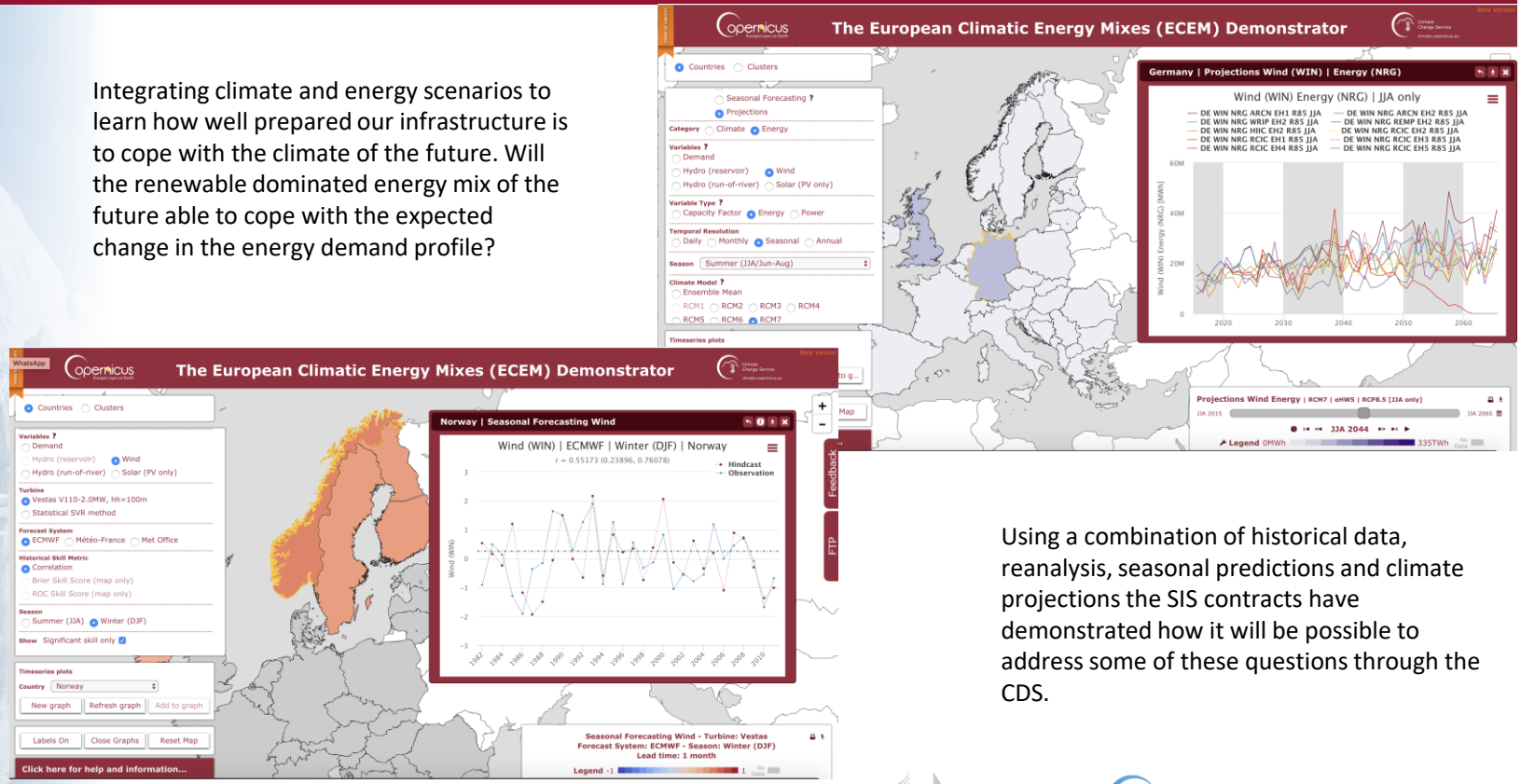
Energy

Integrating climate and energy scenarios to learn how well prepared our infrastructure is to cope with the climate of the future. Will the renewable dominated energy mix of the future able to cope with the expected change in the energy demand profile?



Using a combination of historical data, reanalysis, seasonal predictions and climate projections the SIS contracts have demonstrated how it will be possible to address some of these questions through the CDS.

Contract led by UEA

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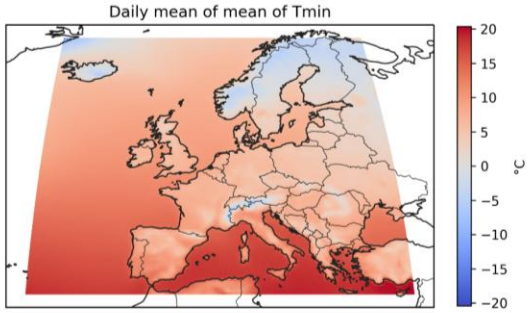
Health exposure demonstrator

Secure | https://cds.climate.copernicus.eu/apps/355/heat_exposure?sdk_version=2.8.1

Heat_exposure



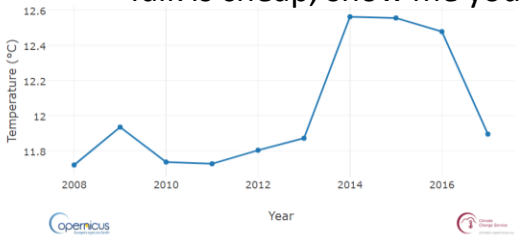
Variable: Tmin

City: Rome

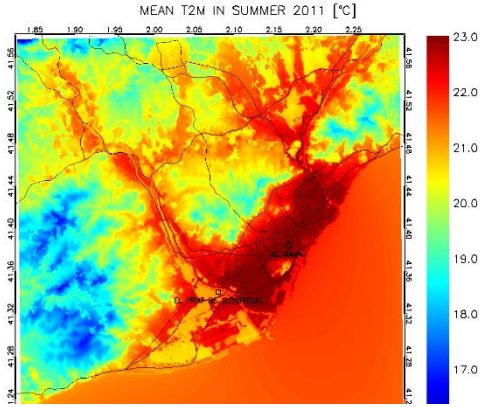
Statistic: Mean

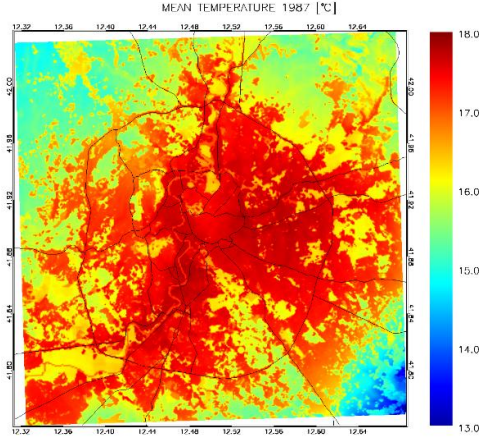
Period: Annual

Timeseries of mean of Tmin for Rome



"Talk is cheap, show me your code" *Linus Torvalds 2000-05-02*





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Our strength

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EUMETSAT

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Indicators, global agriculture contract

- Biologically Effective Degree Days, Growing Season Length, Maximum number of consecutive dry days, Maximum number of consecutive frost days (Cold spell), Cold Spell Duration Index , Maximum number of consecutive summer days (Hot spell), Maximum number of consecutive wet days (Wet spell), Mean of diurnal temperature range, Frost Days, Ice Days, Heavy precipitation days, Very heavy precipitation days, Precipitation sum, Wet Days, Simple Daily Intensity Index (Mean precipitation per wet day), Sumer Days, Mean of daily mean temperature, Mean of daily minimum temperature, Minimum value of the daily minimum temperature, Maximum value of the daily minimum temperature, Tropical nights, Mean of daily maximum temperature, Minimum value of daily maximum temperature, Maximum value of daily maximum temperature, Warm Spell Duration Index, Warm and wet days, AgERA5 wind speed, AgERA5 dewpoint temperature, AgERA5 air temperature, AgERA5 precipitation type, AgERA5 relative humidity, AgERA5 snow, AgERA5 solar radiation, AgERA5 cloud cover, AgERA5 precipitation, AgERA5 vapour pressure, Soybean development stage, Soybean Total above-ground production, Soybean Total weight storage organs (yield), Wheat development stage, Wheat Total above-ground production, Wheat Total weight storage organs (yield), Rice development stage, Rice Total above-ground production, Rice Total weight storage organs, (yield), Maize development stage, Maize Total above-ground production, Maize Total weight storage organs (yield), evapotranspiration

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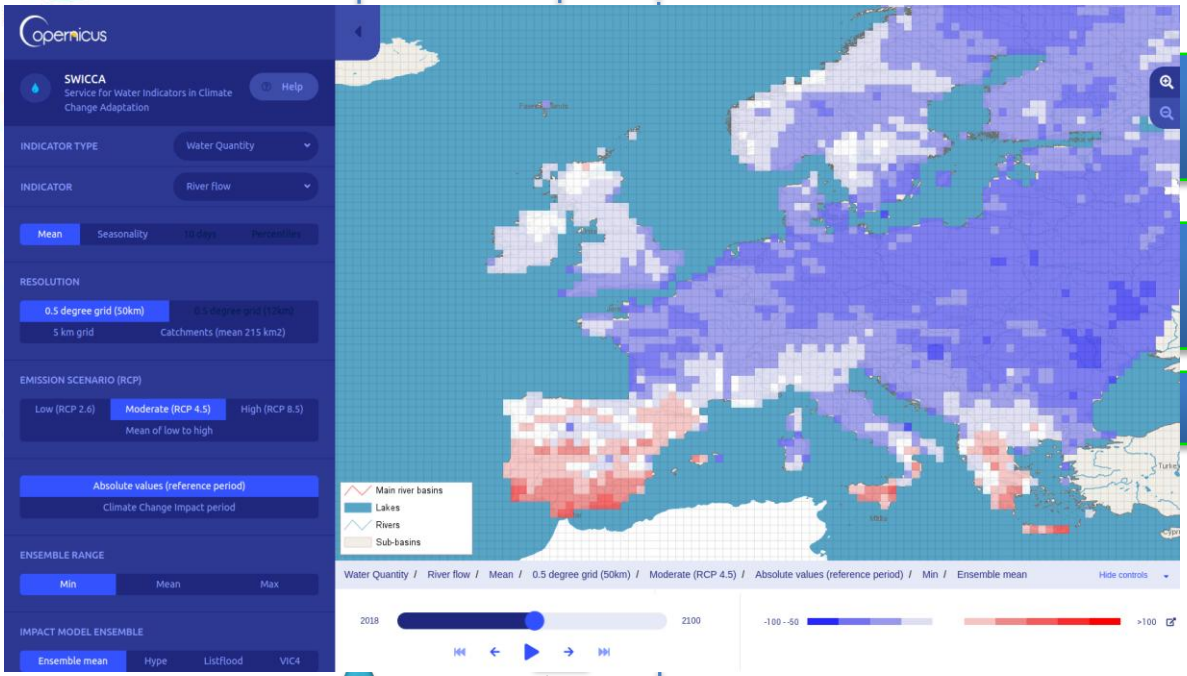
2016 2017 2018 2019 2020 2021

Proof of concept → Operational Phase

Agriclass

POC to Operations



Previous C3S GA March 2017

CDS / Toolbox launched

Present

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Global Services

European Services

AGRICULTURE & FORESTRY

WATER MANAGEMENT

TRANSPORT

FISHERIES

TOURISM

HEALTH

COASTAL AREAS

2016 2017 2018 2019 2020 2021

Proof of concept

Operational Phase

Agriclass

Global Agriculture (WenR)

Global Impacts (SMHI)

Global Shipping (OSM)

European Fisheries (PML)

European Tourism (TEC)

European Health (VITO)

European Storm Surges (Deltares)

Previous C3S GA March 2017

CDS / Toolbox launched

Present

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Climate Change

2016 2017 2018 2019 2020 2021

Proof of concept → Operational Phase

DISASTER RISK REDUCTION

BIODIVERSITY

INFRASTRUCTURE

DRR

Biodiversity

Standards & Infrastructure

Application development (TBC)

Evaluation & Quality Control SIS

User Cases

Demo Cases

Demo Cases

Demo Cases

Toolbox launched

Present

Have a look at:
https://climate.copernicus.eu/complete-list-tenders-issued-c3s

And develop a Use/Demo Case!

European Commission

opernicus Europe's eyes on Earth

ECMWF

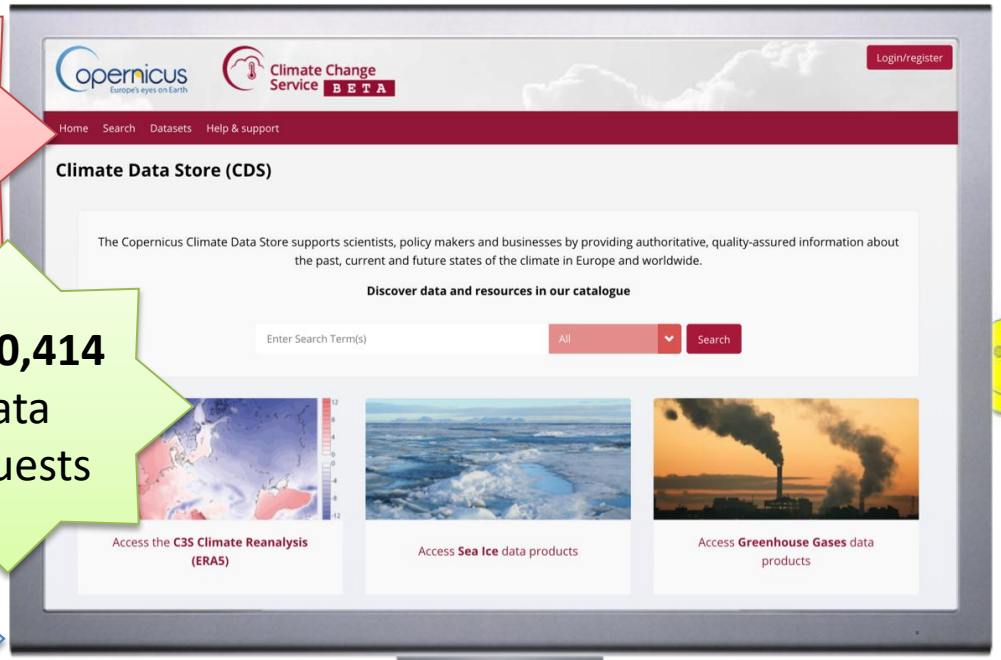
CDS out of the starting blocks… (21 November 2018)

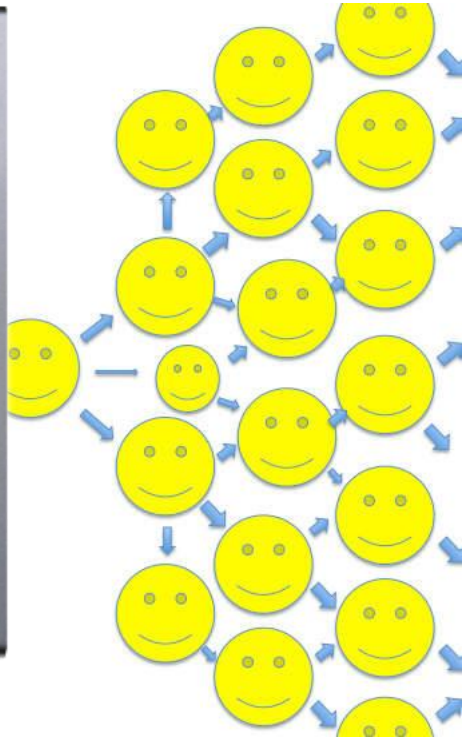
Climate Change

4,431 registered users

1,710,414 data requests

873 Tb data volume delivered





European Commission | Copernicus Europe's eyes on Earth | ECMWF

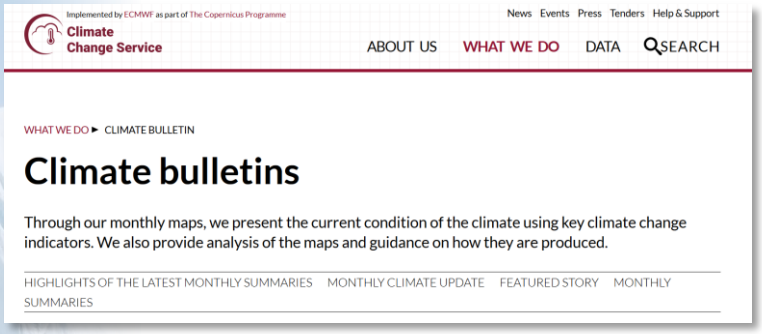
Climate Change

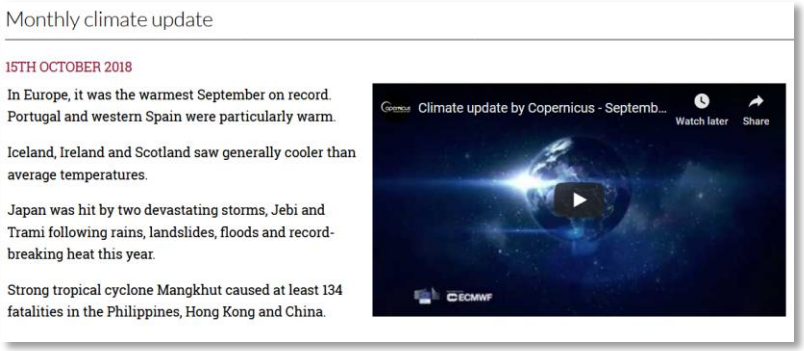
C3S for climate monitoring

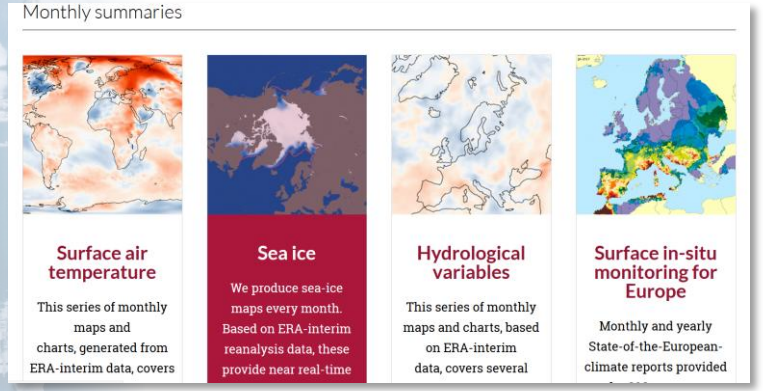
European Commission | Copernicus Europe's eyes on Earth | ECMWF

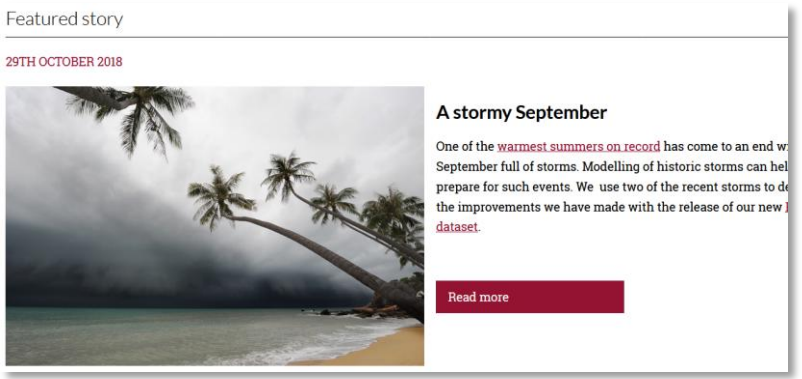
Monthly climate bulletins

Climate Change









European Commission | Copernicus Europe's eyes on Earth | ECMWF

➢ climate.copernicus.eu/climate-bulletins

European State of the Climate

Climate Change

2 main sections

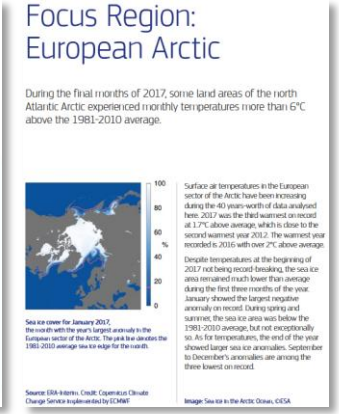
- Climate in 2017
- Headline climate indicators

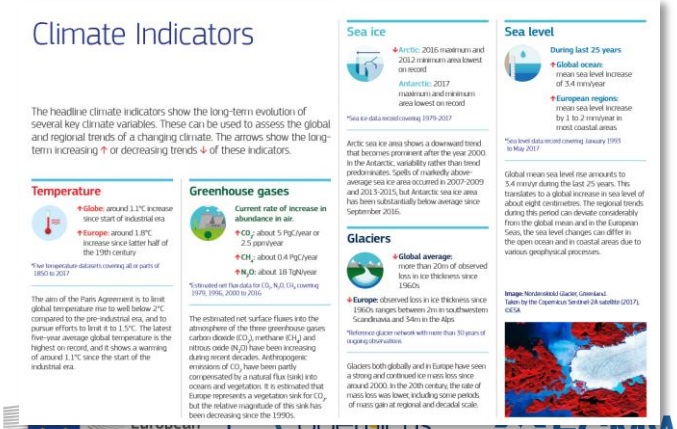
Based on

- Reanalysis, in-situ, satellite data

With contributions from

- CAMS, CMEMS, EEA and GCOS
- 13 further European research institutions





➢ climate.copernicus.eu/copernicusESC

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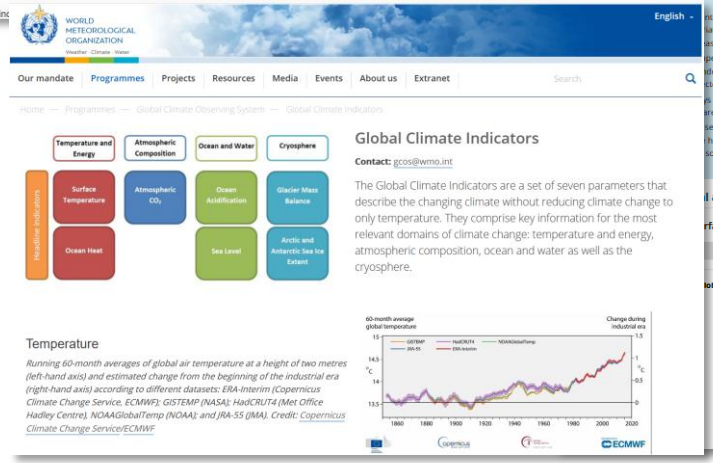
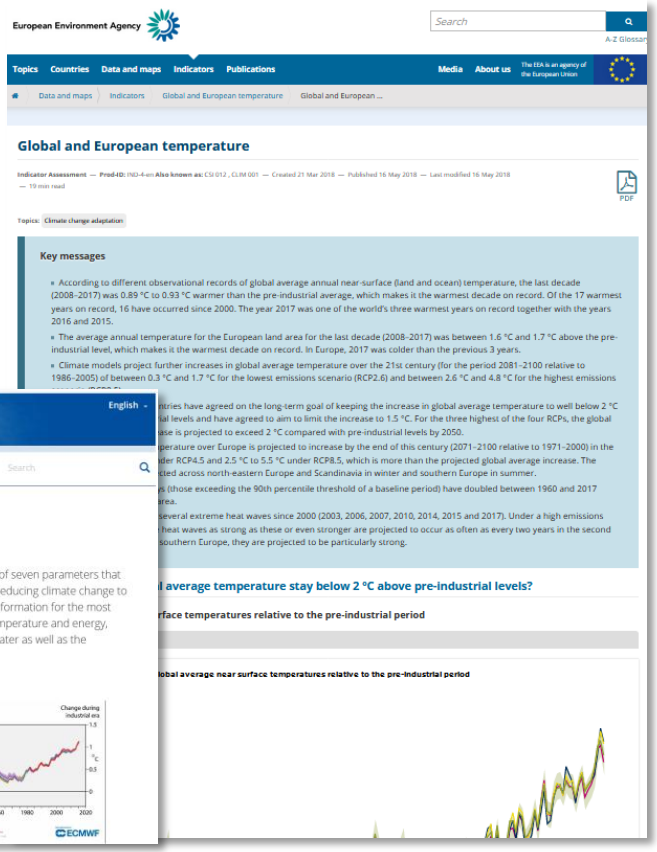
Contributing to EEA, GCOS and the WMO





C3S latest press coverage highlights

Climate Change

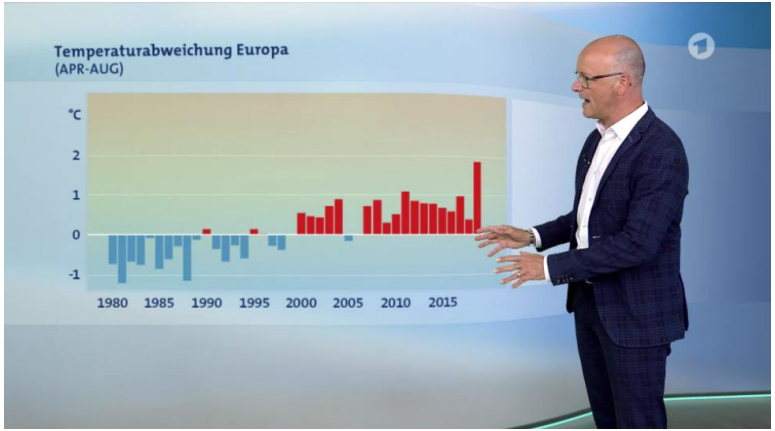
TV presenters around Europe continue to use C3S monthly maps – latest example was from German national TV broadcaster

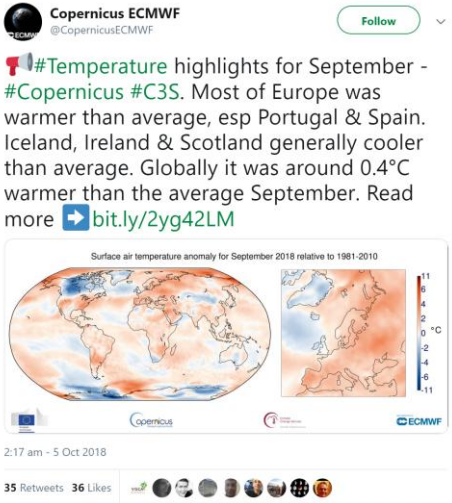
ARD where C3S data and maps were shown at **prime time** evening news.

Reach: 8m

https://www.daserste.de/information/nachrichten-wetter/wetter/videos/rueckblick-sommer-2018-100.html

- C3S Monthly maps are also regularly featured via social media channels such as Twitter





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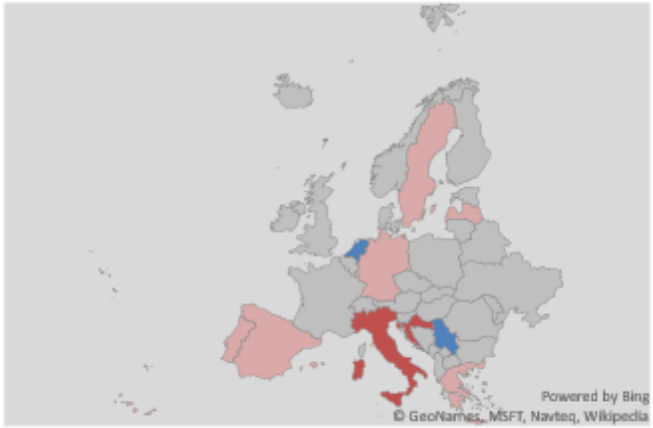
C3S outreach activities

- Presence at conferences, meetings and fairs
- Press tour
- Hackathon
- User workshops
- C3S user learning services
- “Ad-hoc“ training



➢ uls.climate.copernicus.eu

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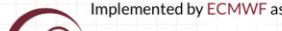

Get involved with the Copernicus Climate Change Service

Questions?