Climate Change

The Copernicus Climate Change Service

Climate
Change

To support European adaptation and mitigation policies by:

- Providing consistent and authoritative information about climate

- Building on existing capabilities and infrastructures (nationally, in Europe and worldwide)

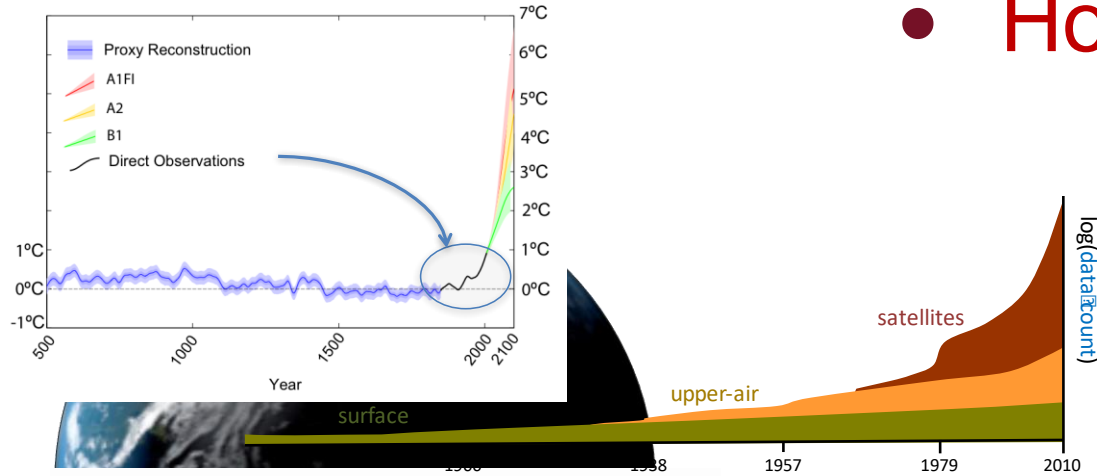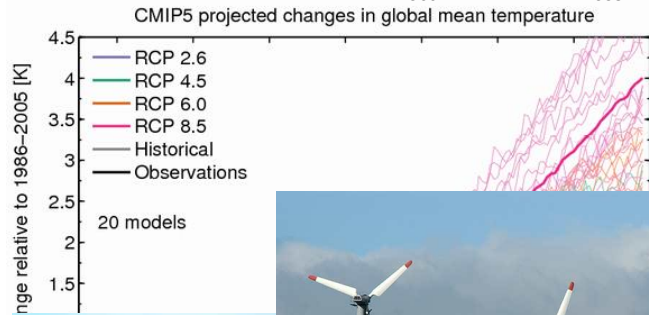- Stimulating the market for climate services in Europe

Climate Change

Global Temperature Relative to 1800-1900 (°C)

- **How is the climate changing?**
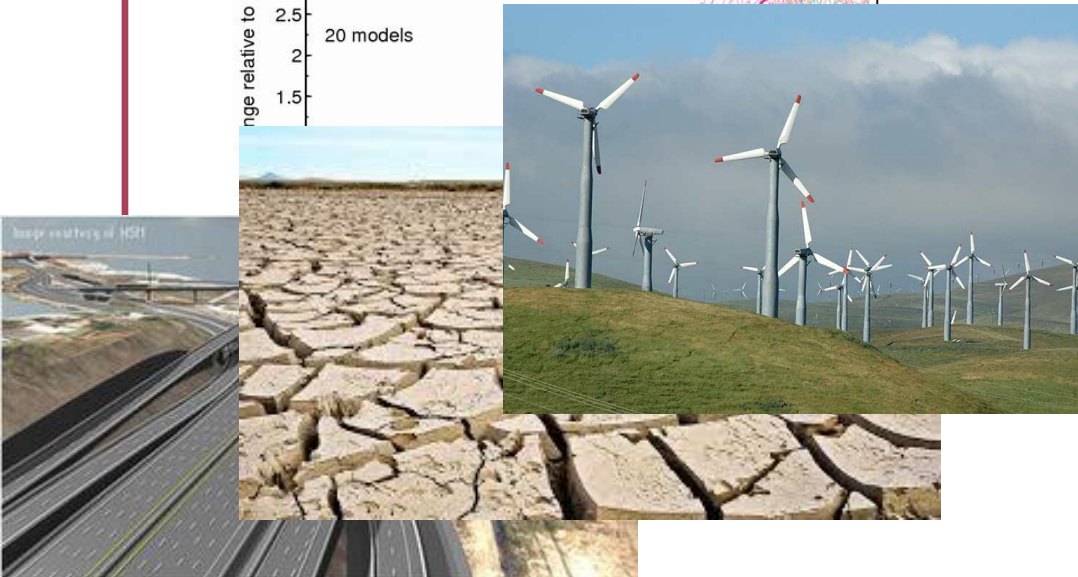
- **How will it change in future?**

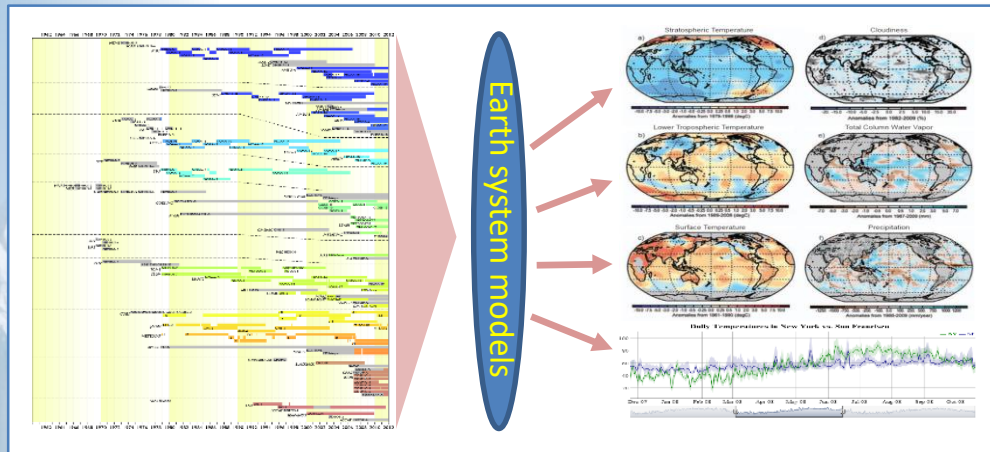CMIP5 projected changes in global mean temperature
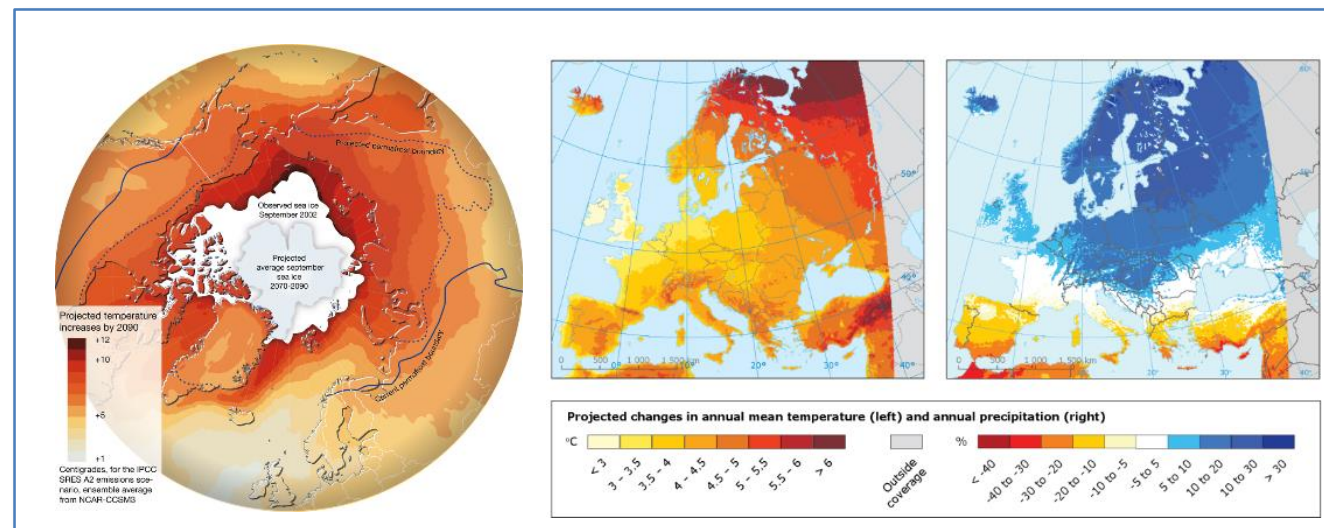
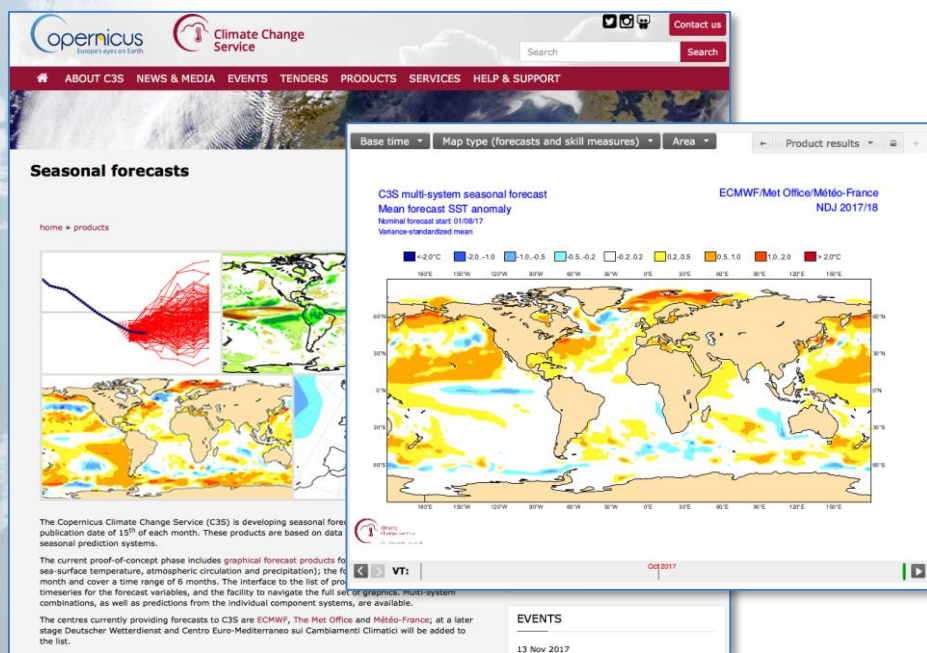- **How will it impact society?**

Access to past, present and future climate information

Observations and climate reanalyses

Seasonal forecast data and products
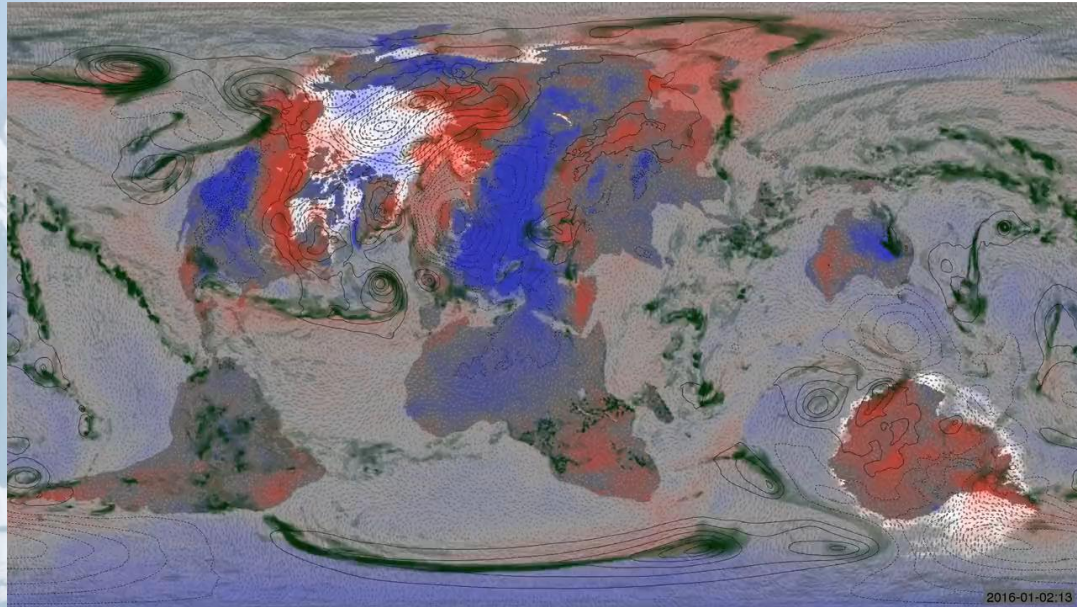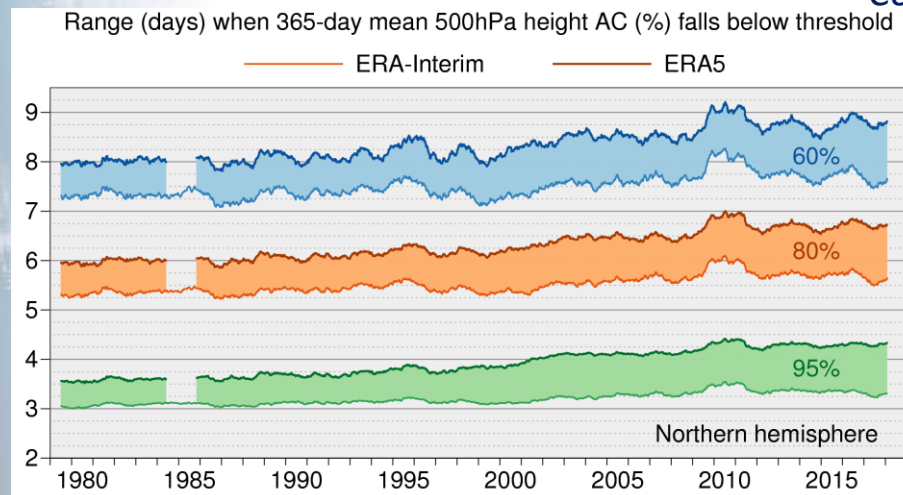
Climate model simulations

Climate Change

Hourly data and increased number of parameters
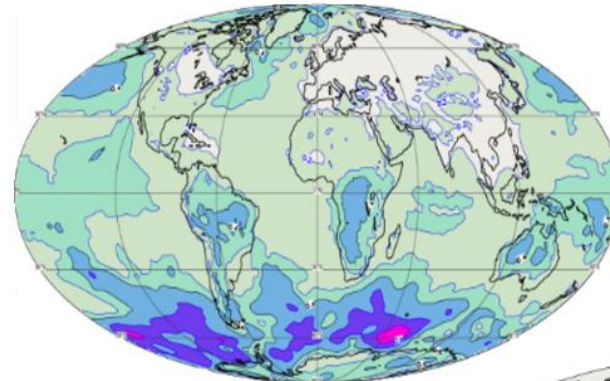

2016-01-02:13

Courtesy: Philip Brohan

Uncertainty estimate

Spread in Surface Pressure (hPa)

0-0.1 | 0.1-0.2 | 0.2-0.3 | 0.3-0.4 | 0.4-0.6 | 0.6-0.8 | 0.8-1

January 1979

July 2014

Range (days) when 365-day mean 500hPa height AC (%) falls below threshold

— ERA-Interim   — ERA5

60%

80%

95%

Northern hemisphere

Reflects variations in:
- **ingested observing system**
- **flow-dependent sensitivity**

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

Credit: H. Hersbach, ECMWF

Climate Change

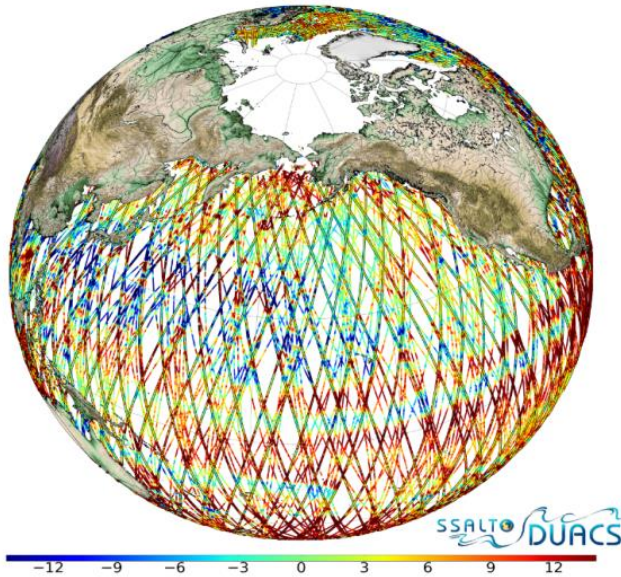|		GCOS	C3S_312a 2017	C3S_312b 2018	2019	2020	2021
Atmospheric physics							
	Precipitation	4.3.5					
	Surface Radiation Budget	4.3.6				Lot 1	
	Water Vapour	4.5.3					
	Cloud Properties	4.5.4					
	Earth Radiation Budget	4.5.5					
Atmospheric composition							
	Carbon Dioxide	4.7.1	Lot 6				
	Methane	4.7.2	Lot 6			Lot 2	
	Ozone	4.7.4	Lot 4				
	Aerosol	4.7.5	Lot 5				
Ocean							
	Sea Surface Temperature	5.3.1	Lot 3				
	Sea Level	5.3.3	Lot 2			Lot 3	
	Sea ice	5.3.5	Lot 1				
	Ocean Colour	5.3.7					
Land hydrology & cryosphere							
	Lakes	6.3.4					
	Glaciers	6.3.6	Lot 8			Lot 4	
	Ice sheets and ice shelves	6.3.7					
	Soil moisture	6.3.16	Lot 7				
Land biosphere							
	Albedo	6.3.9	Lot 9				
	Land Cover	6.3.10					
	Fraction of Absorbed Photosyntheti	6.3.11	Lot 9			Lot 5	
	Leaf Area Index	6.3.12	Lot 9				
	Fire	6.3.15					
			2017	2018	2019	2020	2021

Climate Change

- The **Sea Level ECV** produced within the C3S (312a_Lot2) is derived from **satellite altimetry**.
- The service is ensured by **CLS and LEGOS** (France)
- **Gridded daily maps** of **sea level anomalies** and **velocities** are provided in delayed-time in the **global ocean**, **Mediterranean** and **Black seas** during 1993-2017.
- **Users** are interested in **sea level changes**, **ocean dynamics**, **data assimilation for climate projections**, **model validation**, …

- Strong **interaction and complementarity** with the **Copernicus Marine Service (CMEMS):**
  - **C3S**: retrieval of **long-term variability** and
        focus on the **Mean Sea Level stability**
    with a stable altimeter constellation in time.
  - **CMEMS**: focus on the **mesoscale estimation** with
        all satellites missions available to provide the best sampling.

- Strong **interaction** is required with **Copernicus space component** and **space agencies:**
  - To **manage satellite databases** and
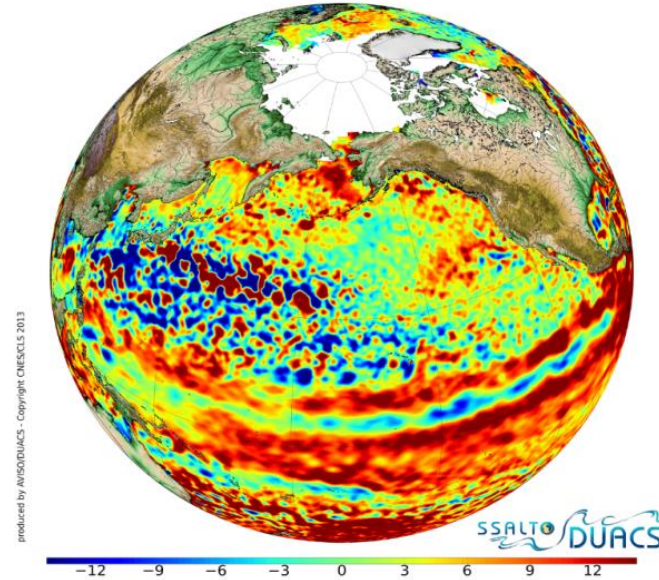 - To phase the production with R&D activities (ESA CCI+…)

Climate Change

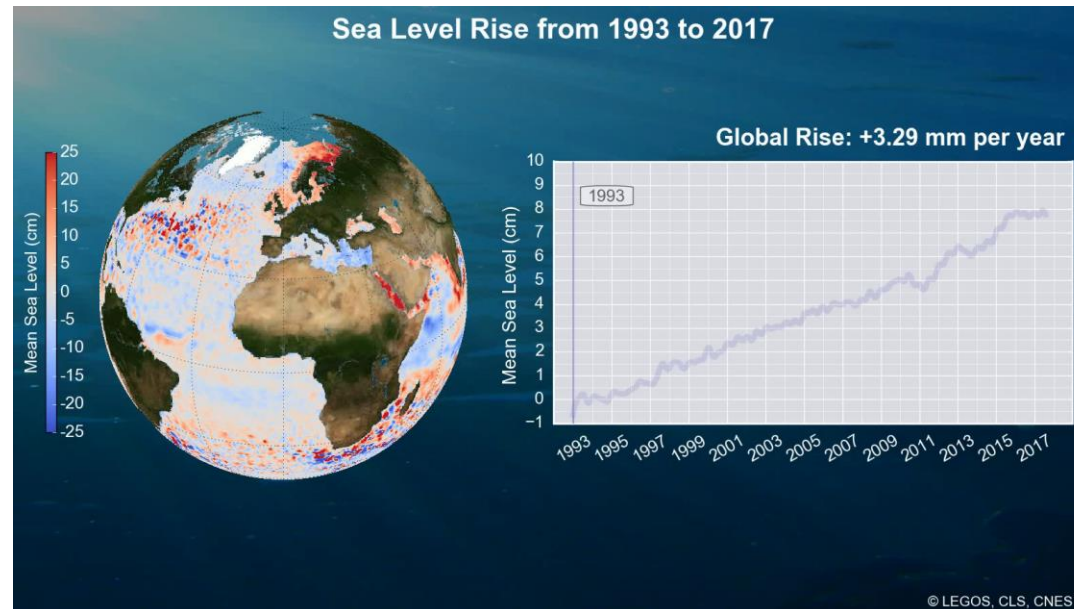From satellite **along-track** measurements...

... to **sea level gridded maps**...

... to derive Ocean Monitoring Indicators
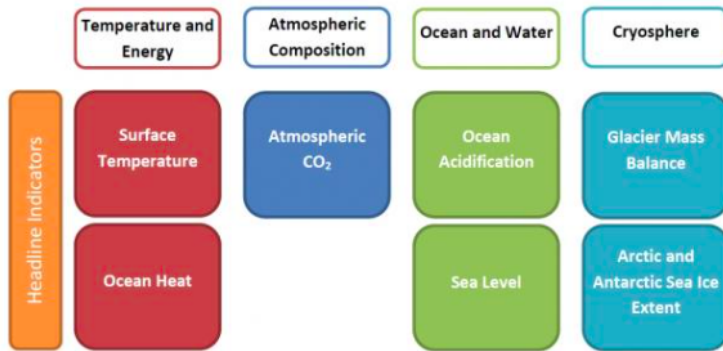
C3S is an operational response to GCOS and takes an increasing role in contributing to the WMO State of the Climate
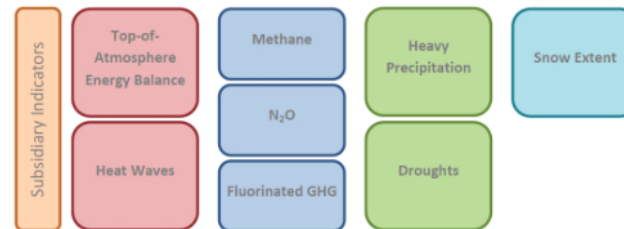

Global Climate Indicators

Contact: gcos@wmo.int

The Global Climate Indicators are a set of seven parameters that describe the changing climate without reducing climate change to only temperature. They comprise key information for the most relevant domains of climate change: temperature and energy, atmospheric composition, ocean and water as well as the cryosphere.

These Global Climate Indicators have been identified by scientists and communication specialists in a discursive process led by GCOS during workshops and scientific panel meetings and have been finally endorsed by WMO. They form the basis of the annual WMO Statement of the State of the Global Climate, which is submitted to the Conference of Parties of the United Nations Framework Convention on Climate Change (UNFCCC).

These seven headline indicators are complemented by a set of subsidiary indicators that provide additional information and allow a more detailed picture of the changes in the respective domain.

The Global Climate Indicators are a concept that is meant be used to tell stories about climate change in a way that can be understood by non-experts. It is important to note, that the Global Climate Indicators are not limited to specific datasets or certain storylines. A multitude of narratives, told in different ways and forms and fitted to the respective auditorium, will catch more peoples interest and finally form a more comprehensive picture of climate change.
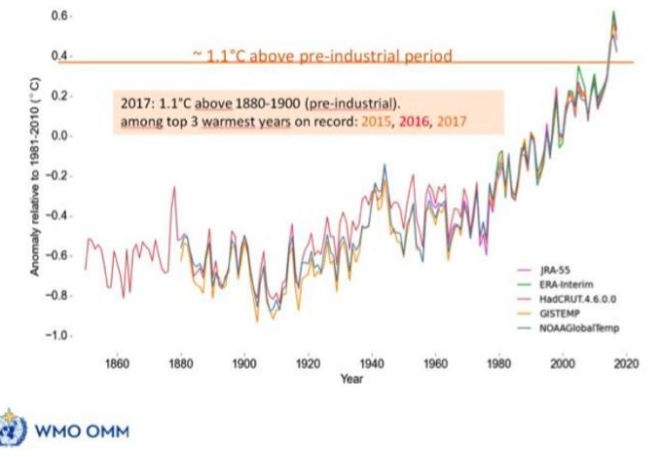
The current state of global temperature and additional content is provided by the Copernicus Climate Change Service (C3S) under: https://climate.copernicus.eu/indicators-2017-temperature

From the GCOS Website

From the WMO and UNFCCC Websites

C3S and UNFCCC Sustainable Development Goals

Climate

C3S contribution to SDGs

SDG	C3S contribution to SDGs
2 ZERO HUNGER	C3S SIS addresses agriculture, and some of the global services will focus on food security
3 GOOD HEALTH AND WELL-BEING	C3S SIS addresses health, providing relevant climate change indicators
6 CLEAN WATER AND SANITATION	Two Proof-of-concept SIS projects in C3S dedicated to water management. A urban PoC SIS is also addressing this SDG at city level. Operationalisation underway
7 AFFORDABLE AND CLEAN ENERGY	Two proof-of-concept SIS projects in C3S dedicated to the Energy Sector. Reanalyses (produced by C3S) are also highly relevant.
8 DECENT WORK AND ECONOMIC GROWTH	C3S activities contribute indirectly to this SDG insofar that the energy climate impact indicators (see goal 7) are relevant.
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE	C3S is working closely with the standardisation community (via DG-CLIMA) on developing climate change information required for the writing of standards in infrastructure and transport.

C3S contribution to SDGs

SDG	C3S contribution to SDGs
11 SUSTAINABLE CITIES AND COMMUNITIES	C3S SIS related to urban aspects of climate change, as well as health and infrastructure aspects, contribute indirectly to this SDG. Reanalysis products too.
12 RESPONSIBLE CONSUMPTION AND PRODUCTION	C3S SIS products and indicators on water management are directly relevant for this goal.
13 CLIMATE ACTION	ECV products, including from reanalysis, CDRs, seasonal forecasts and climate scenarios, directly relevant for adaptation. The SIS also delivers relevant indicators in support of adaptation. Cooperation: EEA Climate ADAPT
14 LIFE BELOW WATER	Some of the ECV products generated by C3S (including reanalysis ORAS5) are ocean relevant. This is done in coordination with CMEMS.
15 LIFE ON LAND	Biodiversity is a future sectoral application of C3S. Relevant products will contribute to this goal. ECV products on soil moisture, forestry, lakes, also contribute to this goal.

We have built a store.

The door opened to customers in June 2018

We continuously put products on the shelves.

Open and free data
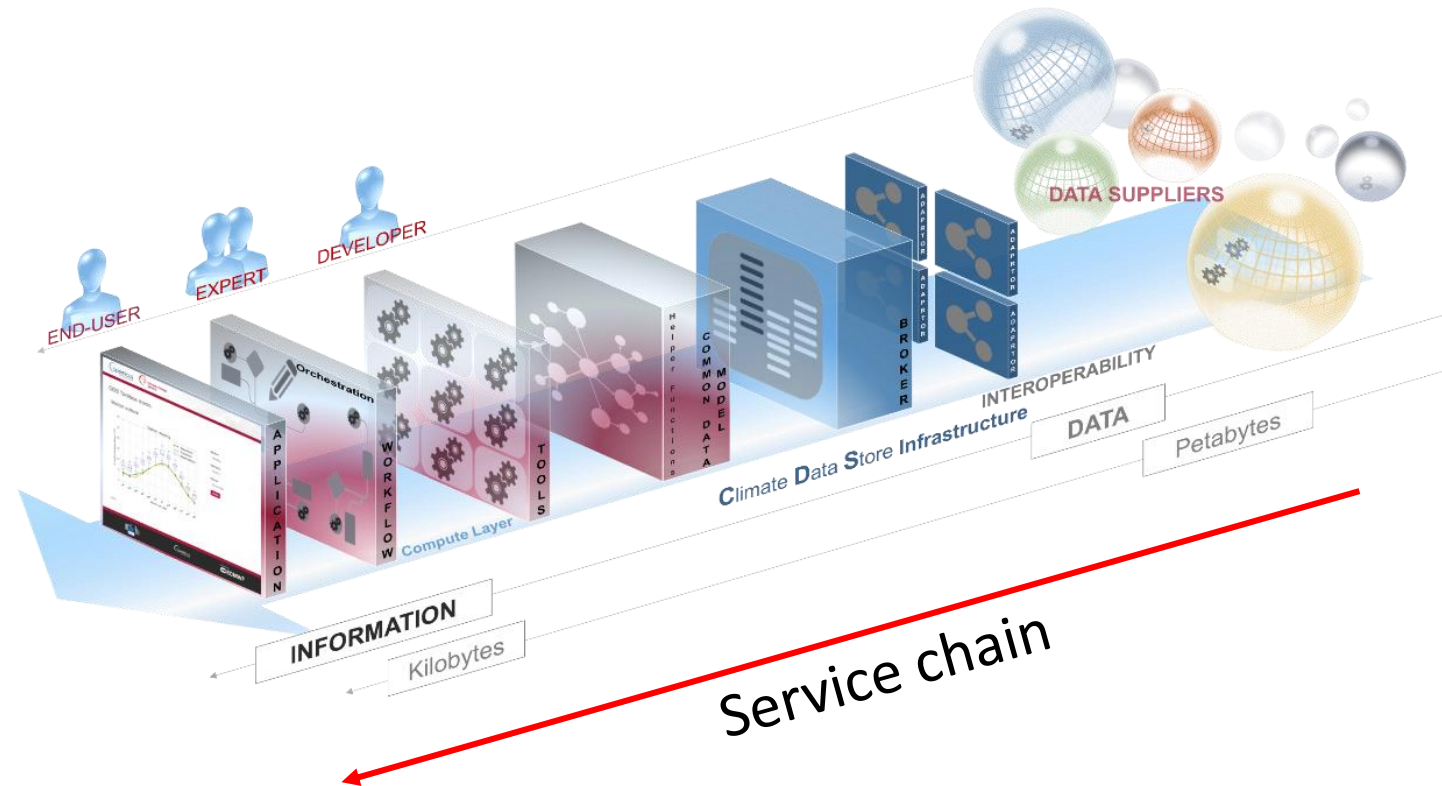
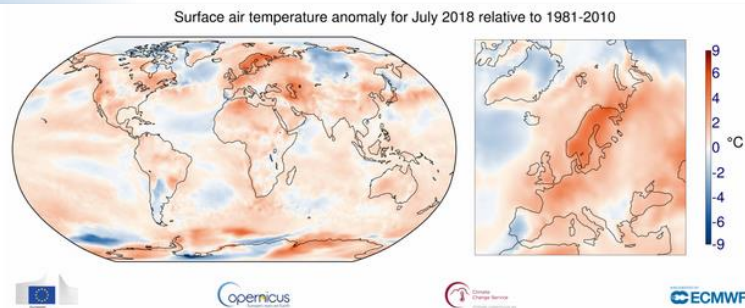**Climate data records**

cds.climate.copernicus.eu

Climate
Change

Quality Assured information and tools for users ranging from scientists to practitioners and policy makers.

Climate Change

Surface air temperature anomaly for July 2018 relative to 1981-2010

Surface air temperature anomaly for July 2018 relative to the July average for the period 1981-2010.
Source: ERA-Interim. (Credit: Copernicus Climate Change Service / ECMWF)
DOWNLOAD THE ORIGINAL IMAGE

July 2018 was warmer than the 1981-2010 average over much of Europe. Temperatures were substantially higher than normal over most of Norway, Sweden and Finland, but were also relatively high over parts of France, Germany, the United Kingdom and the Benelux countries. Records for maximum temperature were broken in places, and many more places saw records for the monthly average temperature broken. Temperatures were below average over Portugal and parts of Spain, and to a lesser degree over most of the Balkan Peninsula.

Heatwaves were also experienced in several other regions of the summer hemisphere. Monthly average temperatures were much higher than normal over California, eastern Canada, Algeria, countries bordering the Caspian Sea, northern China, Korea and Japan. Media articles have reported some of the local temperature records that have been broken and impacts of the extreme heat.

Regions of the northern hemisphere that were colder than average include central Russia, where temperatures were much higher than average in June, and northern Greenland and the far north-east of Canada.

Parts of the Antarctic were less cold than normal for July, although other parts had temperatures that were below average for the month. Most of Australia had a relatively warm month. Temperatures were above average over much of South America, most so over the Brazilian state of São Paulo, but it was colder than average in the south of the Continent.

Marine air temperatures were above normal on average, and particularly warm over the North Pacific and Atlantic Oceans to the east of Japan and the USA respectively. There were nevertheless numerous oceanic regions with below-average temperatures.
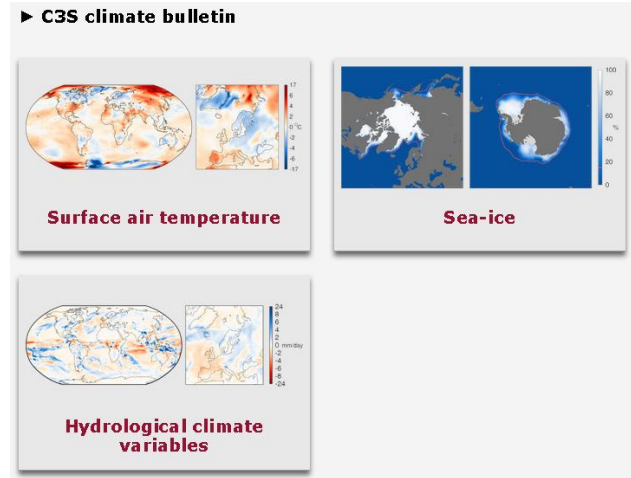
Quality Assured information and tools for users ranging from scientists to practitioners and policy makers.
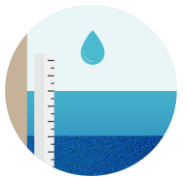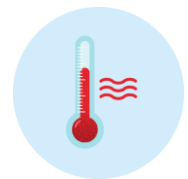
Climate
Change

4th-6th

15th

Monthly

March / April

Yearly

Surface temperature	⬆
Greenhouse gases	⬆
Rain	—
Sea Ice	⬇
Glaciers	⬇
Sea Level	⬆
Soil Moisture	⬇

Credit: Victor & Kennel, Nature Climate Change, 2014.

European State of the Climate 2017 Summary

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

Climate
Change

▶ C3S climate bulletin

Surface air temperature   Sea-ice

European State of
the Climate 2017

Key message

Bullet-points for media
send-out / feature article

Executive summary

Detailed analysis

Standardised format,
repeated every month

Combination of standard
format and specific events

**Background
information**

About the data and the analysis, incl.
reliability/representativeness of the product used

➢ **climate.copernicus.eu/monthly-maps-and-charts**
➢ **climate.copernicus.eu/ESC**

ECMWF   Copernicus
            Europe's eyes on Earth

European
Commission

Climate
Change

May 2018 –
warmest May on record in Europe

April 2018 –
Finally, above average rainfall in southern Africa

September 2017 –
Lowest Antarctic sea ice maximum on record

2017 – warmest non-El Niño year on record

Climate Change

2017

2015

2016

Average surface air temperature compared to 1981-2010

Climate Change

Precipitation (mm/day)

Soil moisture (%)

Annual SW Europe precipitation anomaly (mm/day)

ERA-Interim annual SW Europe soil moisture (%) relative to 1981-2010

Wildfires

CAMS GFASv1.2 annual wildfire CO_2 emissions for SW Europe

Climate Change

Credit: ZDF, Özden Terli, C3S

BBC, July 2018
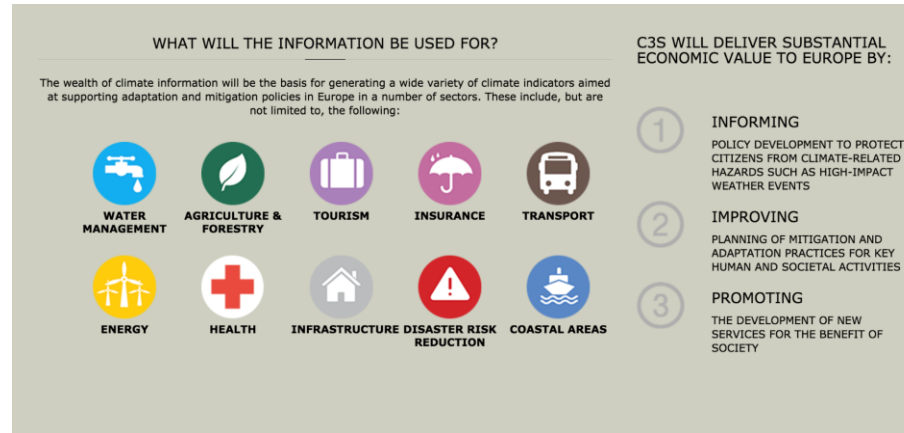
- ➢ **Standard C3S monthly products**
- ➢ **"Bespoke" C3S products**

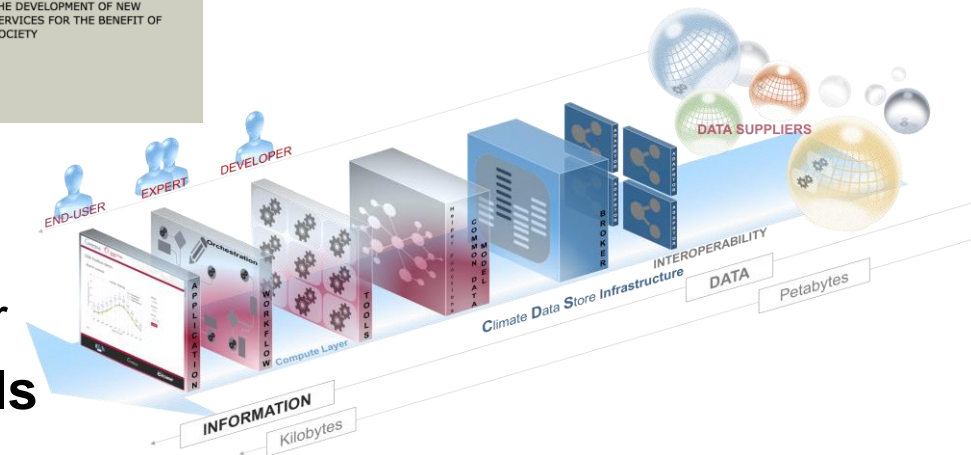**Climate Change**

<u>Proof-of-concepts of climate services</u>: Demonstration of the **value chain** with several end-to-end **demonstrators**

As an operational Service, **C3S** ambitions to become an **enabler** of **downstream climate services**, by providing or brokering **high quality** and sector relevant climate **data** and **indicators**, **good practices**, **tools** and by supporting compelling **use cases**.

Further down the line, Copernicus **DIAS** will provide free access to **all Copernicus data and information** in the cloud, plus a development environment for users to develop and market their own **cloud-based applications**/front offices (under cloud computing commercial terms). Other EO missions data are also expected to be available.
5 DIASs under development (4 by ESA, 1 by ECMWF/EUM/MO)

Climate Change

- Story mapping
- T
- A

Climate Change

C3S_422_Lot1_WEnR

Agri-research

Agri-policy

Agri-business

4 data product groups:

1. Climate forcing data for crop models
   - all time scales, downscaled, bias corrected
2. Water based indicators
   - Soil moisture, groundwater recharge, reservoir inflow, ~~filtration~~ ET, SPI, …
3. Agroclimatic indicators
   - Growing degree days, huglin index, cold/heat stress days, insect flight index, …
4. Climate enhanced EarthObservation based indicators
   - Dry Matter Productivity, ET_{actual}, …

All aggregated to crop specific
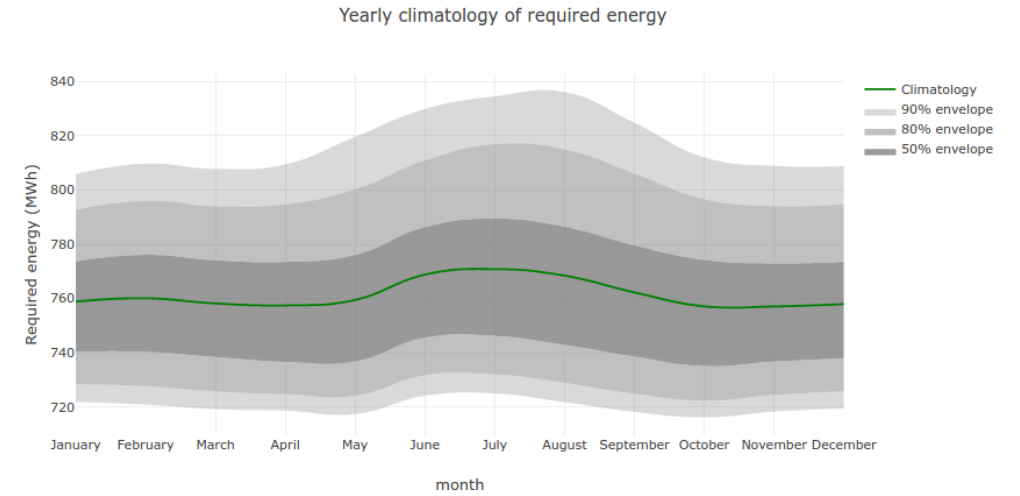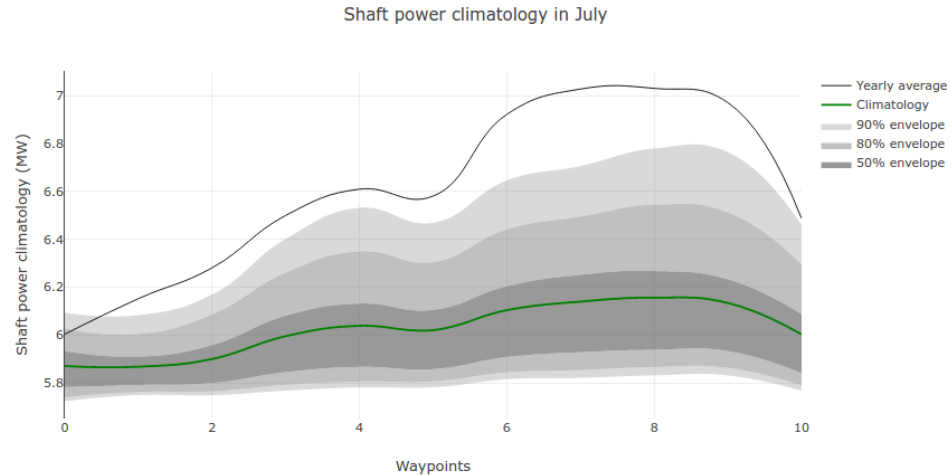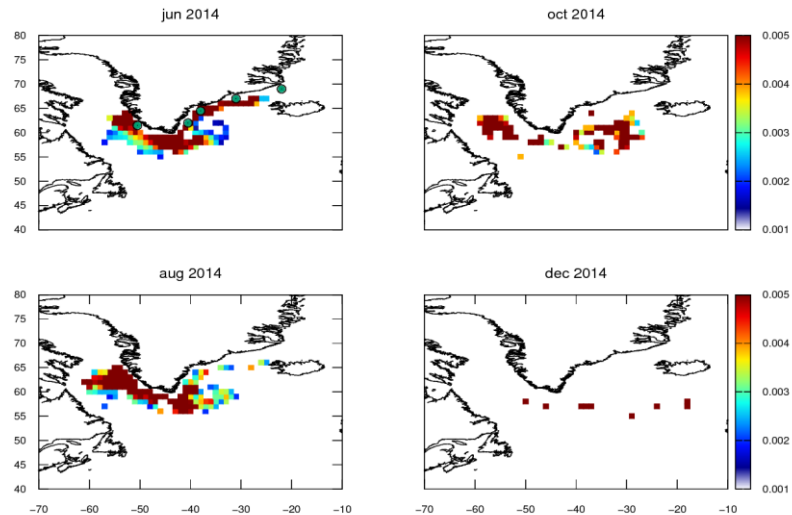- phenological calendars
- growing areas

Which part of the route/season is most likely to lead to overconsumption ?

Shaft power climatology in July

Yearly climatology of required energy

Where/when will I find icebergs ?

When will the Arctic route become commercially viable?

Evaluation and Quality Control (EQC) for the CDS

Climate Change

Quality of data
- Assessments
- User guidance
- Gaps and limitations

Quality of tools
- Fitness for purpose
- Best practices

Quality of service
- Speed, responsiveness
- System availability, …

Climate Change

- C3S has developed a state-of-the-art cloud infrastructure that makes it simple for users to freely access an unprecedented range of quality-controlled climate data and information.

- C3S serves a wide range of European and worldwide users and bodies: EU DGs, WMO, GCOS, GFCS, EEA, etc.

- The Climate Data Store provides a compute layer allowing users to create and run their own applications/workflows on the cloud without downloading huge volumes of data.

- The system comes with a series of exemplar applications to show how the infrastructure can be used to address specific user needs:
  - SISs (Europe, Global), Use Cases, Demonstrators
  - Downstream Services

- The Quality Assurance process within C3S is unique and absolutely critical

Climate Change

etc...

Climate Change

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

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

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

Latest News

C3S helps to safeguard health, food and water security in South Africa

As part of a global initiative targeting various sectors, the Copernicus Climate Change Service (C3S) is working with researchers in South Africa to address the environmental threat to water security and to mitigate the associated food-supply and health risks.

A c...

To provide access to vast amounts of climate data, the Copernicus Climate Change Service (C3S) has recently created the Climate Data Store (CDS). This free and open service provides users with information about the past, present and future climate.

A Toolbox for Climate Data Processing

For experts and developers of applications there is an extra level to the CDS, a software toolbox, within which data can be processed in order to analyse, monitor and help to predict the effects of climate change.
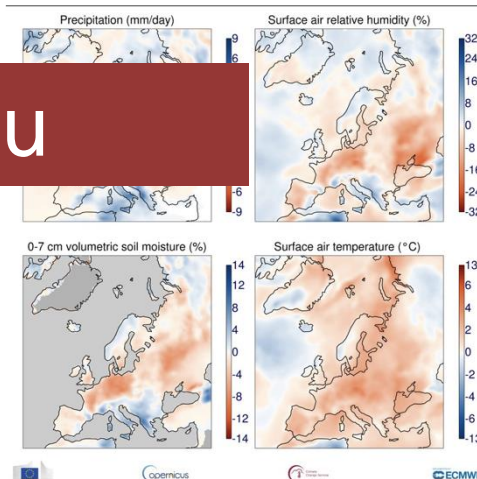
More News ▶

EVENT

International Conferences on Subseasonal to Decadal Prediction

📍 Boulder, USA

📅 17 - 21 Sep 2018

The Copernicus Climate Change Service (C3S) will be represented at the International Conferences on Subseasonal to Decadal Prediction which will take place on 17–21 September.

Read More ▶

Tweets by @CopernicusECMWF ⓘ

Copernicus ECMWF
@CopernicusECMWF

Have you checked the latest #Copernicus #C3S #hydrological summary? Very dry conditions continued in much of northern Europe in August. Again much wetter than average in Alpine region & northern Mediterranean. Very dry in Australia & SAfrica. Read more ➡ bit.ly/2O0MDNP

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climate.copernicus.eu