



Climate Change

Climate Change Service

Jean-Noël Thépaut & the C3S team

Email: jean-noel.thepaut@ecmwf.int

Twitter: [@JeanNoelThepaut](https://twitter.com/JeanNoelThepaut)



European
Commission





Climate
Change

The C3S mission

To support European adaptation and mitigation policies by:

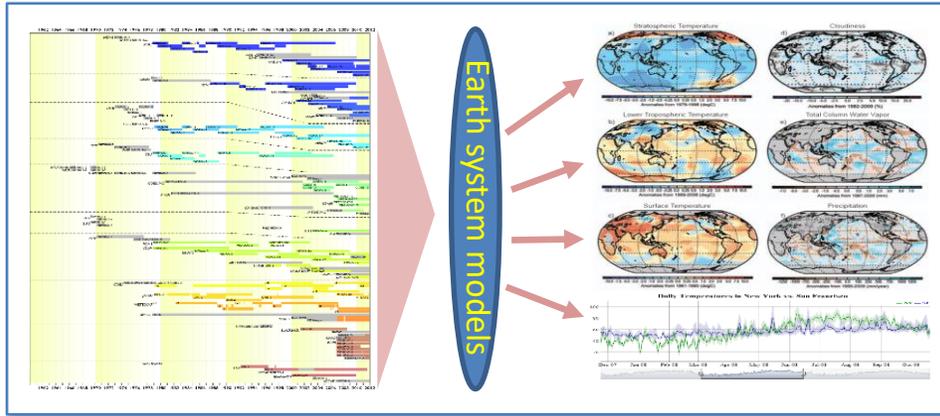
- Providing consistent and authoritative information about climate
- Building on existing capabilities and infrastructures (nationally, in Europe and worldwide)
- Stimulating the market for climate services in Europe





Climate Change

Access to past, present and future climate information



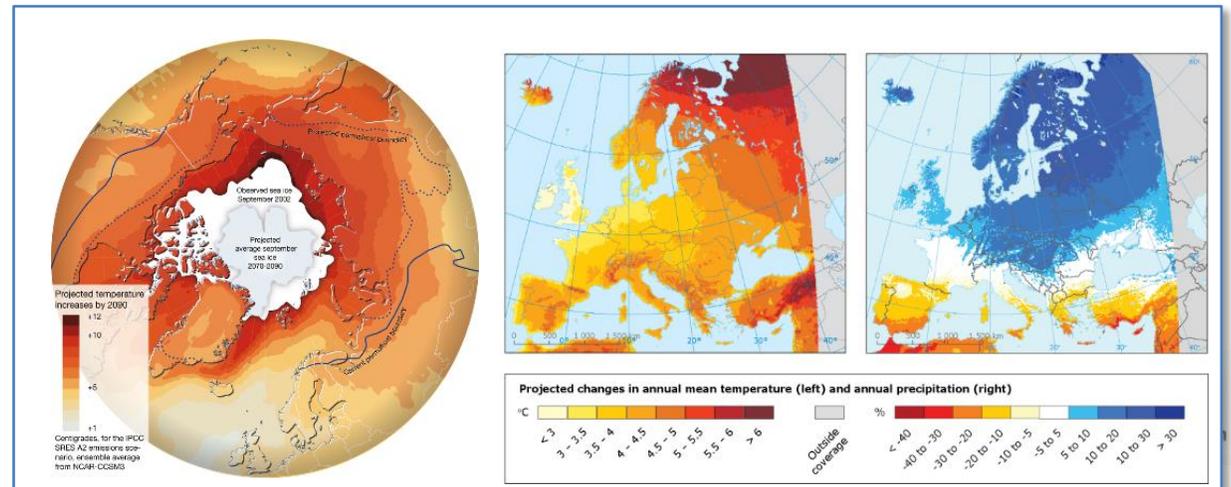
Observations and climate reanalyses

Seasonal forecast data and products

Climate model simulations

Sectoral climate impact indicators

The screenshot shows the Copernicus Climate Change Service website interface. The main content area displays "Seasonal forecasts" with a world map showing temperature anomalies. A legend indicates temperature ranges from -2.0°C to 2.0°C. Below the map, there is a section for "EVENTS" dated 13 Nov 2017.

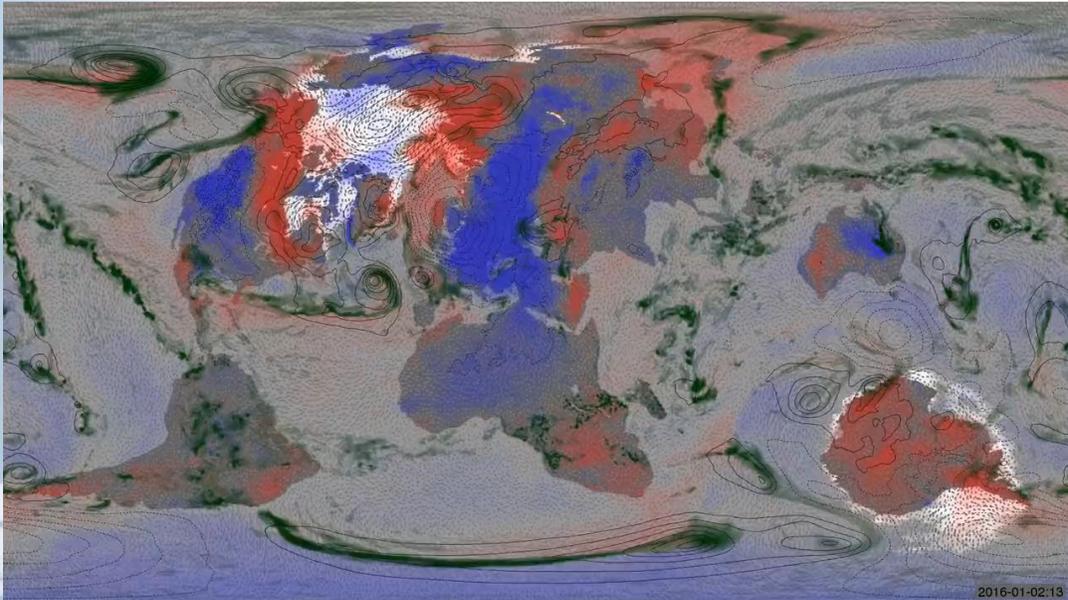




Climate Change

C3S: Reanalysis based Essential Climate Variables (30km global ERA5)

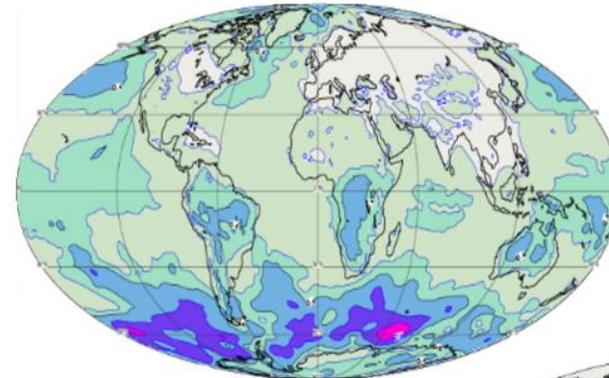
Hourly data and increased number of parameters



Courtesy: Philip Brohan

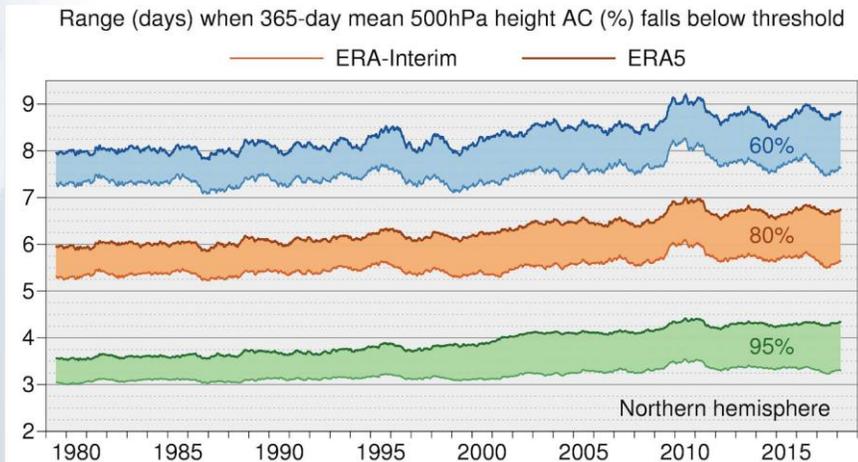
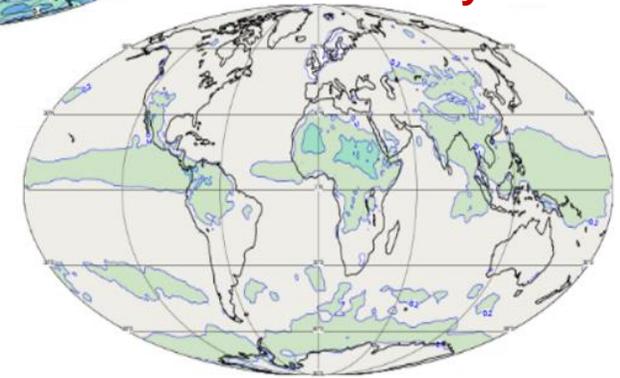
Uncertainty estimate

Spread in Surface Pressure (hPa)



January 1979

July 2014



Reflects variations in:

- ingested observing system
- flow-dependent sensitivity

Credit: H. Hersbach, ECMWF



ERA5 complete!

(1979-2017)

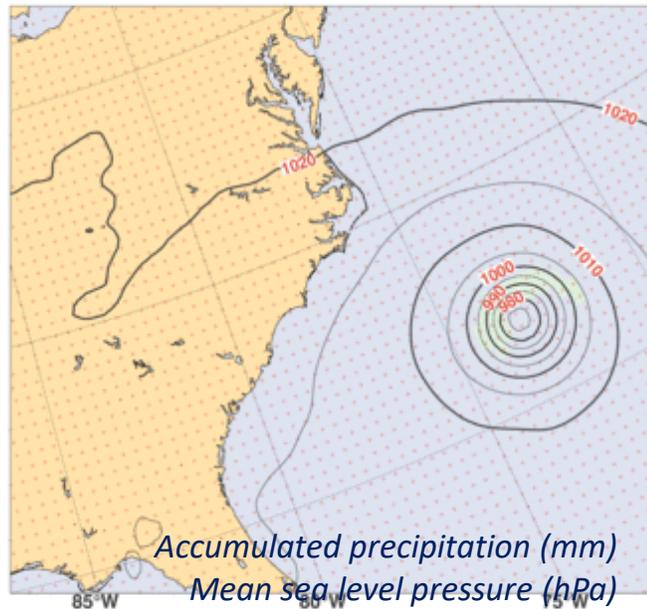


Climate
Change

C3S production highlights: ERA5 versus ERA-interim

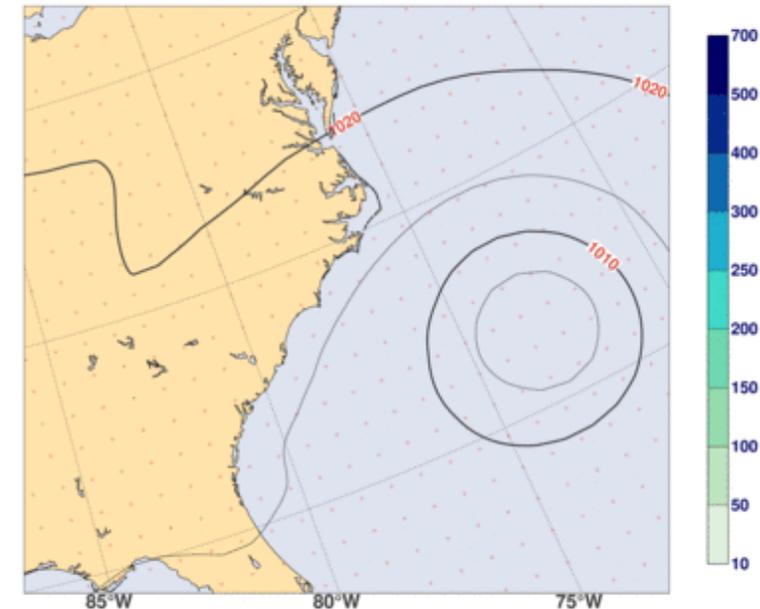
Better model, better and more observations, higher resolution, hourly output

Florence Thu 13 Sep 2018, 01 UTC for ERA5



ERA5 (preliminary)

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



ERA-Interim (preliminary)

ERA5 production (1979-2018..) completed.

- Will go in the CDS before the end of 2018

ERA5-land (surface global 9km) production ongoing



Reanalysis data portfolio

Global reanalyses

- ERA5 data for 1950 – present, updated monthly, 2-3 month delay
- ERA5T data, updated daily, 2-5 day delay
- ERA5-land, ERA5-land-T (?)

	ERA-Int	Era-Int/Land	ERA5	ERA5-Land
Period covered	Jan 1979 – NRT(*)	Jan 1979 – Dec 2010	Jan 1950 - NRT	Jan 1950 - NRT
Spatial resolution	~79km / 60 levels	79 km	~32 km / 137 levels	~9 km
Uncertainty estimate	-	-	yes	yes
Output frequency	6-hourly Analysis fields	6-hourly Analysis fields	Hourly (three-hourly for the ensemble)	Hourly (three-hourly for the ensemble)

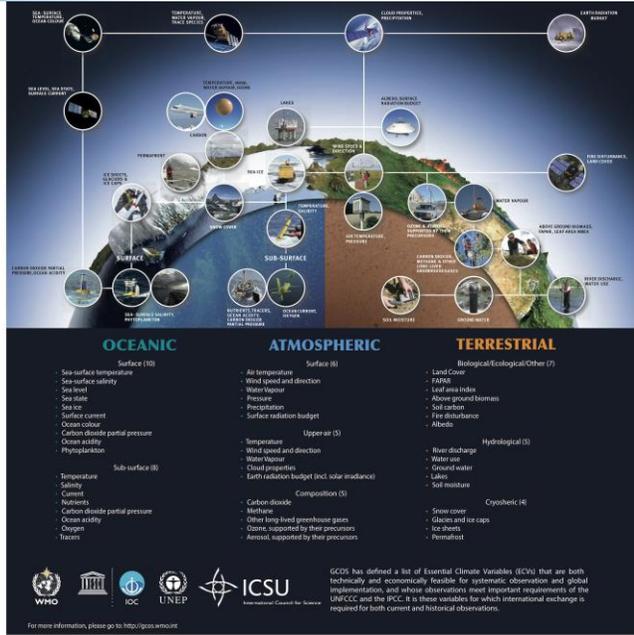
Regional reanalyses

- Regional reanalysis for Europe
- Arctic prototype reanalyses (two domains)



Climate Change

C3S ECVs: Transfer from Research to Operations



Heritage/coordination:

- ESA CCI
- EUMETSAT SAFs
- Other Copernicus Services
- etc..

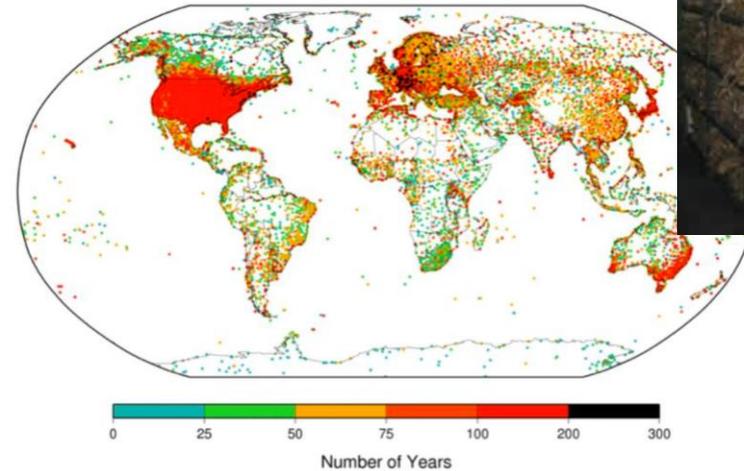
GCOS-195	CCI	CCI+	uptake	C3S
Atmospheric surface				
4.3.1	Air temperature			
4.3.2	Wind speed and direction			
4.3.5	Precipitation			
4.3.6	Surface radiation budget			
Atmospheric upper air				
4.5.1	Air temperature			
4.5.2	Wind speed and direction			
4.5.3	Water vapour			
4.5.4	Cloud properties			
4.5.5	Earth radiation budget			
Atmospheric composition				
4.7.1	Carbon dioxide			
4.7.2	Methane			
4.7.3	Other long-lived greenhouse gases			
4.7.4	Ozone			
4.7.5	Aerosol			
Ocean surface				
5.3.1	Sea-surface temperature			
5.3.2	Sea-surface salinity			
5.3.3	Sea level			
5.3.4	Sea state			
5.3.5	Sea ice			
Ocean biogeochemistry				
5.3.7	Ocean colour			
5.3.8	Carbon dioxide partial pressure			
5.3.9	Ocean surface acidity			
Ocean sub-surface				
5.4.1	Temperature			
5.4.2	Salinity			
5.4.3	Current			
Land hydrology & cryosphere				
6.3.4	Lakes			
6.3.5	Snow cover			
6.3.6	Glaciers and ice caps			
6.3.7	Ice sheets			
6.3.8	Permafrost			
6.3.16	Soil moisture			
Land biosphere				
6.3.9	Albedo			
6.3.10	Land cover (including vegetation type)			
6.3.11	Fraction of absorbed photosynthetically active radiation			
6.3.12	Leaf area index			
6.3.13	Above-ground biomass			
6.3.15	Fire			
6.3.17.1	Land-surface temperature			



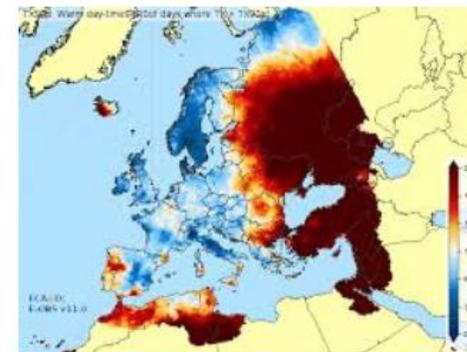
Climate
Change

C3S and in-situ observations

- EO - Lot 1: C3S data rescue
- EO - Lot 2: Observations from global climate data archives
- EO - Lot 3: Observations from Baseline and Reference Networks
- EO - Lot 4: High-resolution ECV products for Europe



E-OBS



Update: 1- and 6-months

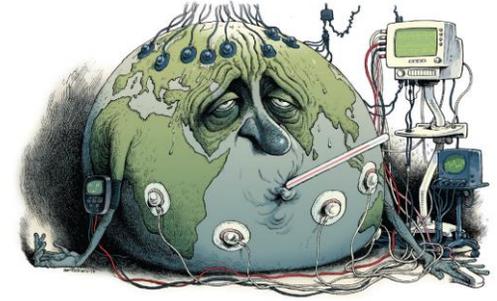
European
Commission



C3S: Operational production of climate indicators



Surface temperature	↑
Greenhouse gases	↑
Rain	—
Sea Ice	↓
Glaciers	↓
Sea Level	↑
Soil Moisture	↓



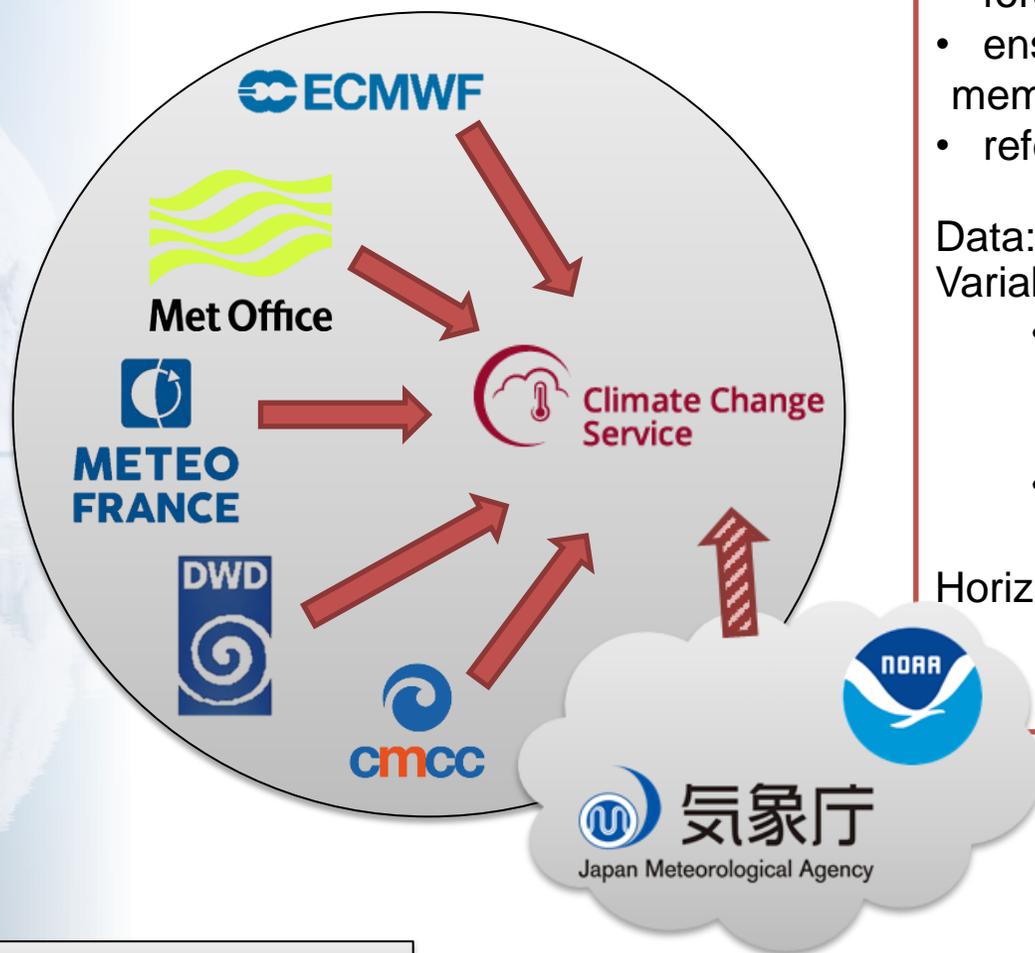
Credit: Victor & Kennel, Nature Climate Change, 2014.





Climate
Change

C3S seasonal forecast service



Also likely: ECCO and BoM

Protocol:

- time of submission of data; time of publication of forecasts (13th of each month)
- ensemble size (forecasts: ~50 members; hindcasts: ~25 members)
- reference period: 1993-2016 (24 years)

Data:

Variables

- Surface
 - 9 vars every 6h
 - +20 vars every 24h
- Pressure (11 levels, from 925 hPa to 10 hPa)
 - 5 vars every 12 h

Horizontal grid: global 1deg x 1deg

Agreed netCDF specification C3S-0.1 (based on CF)

IMPLEMENTED BY

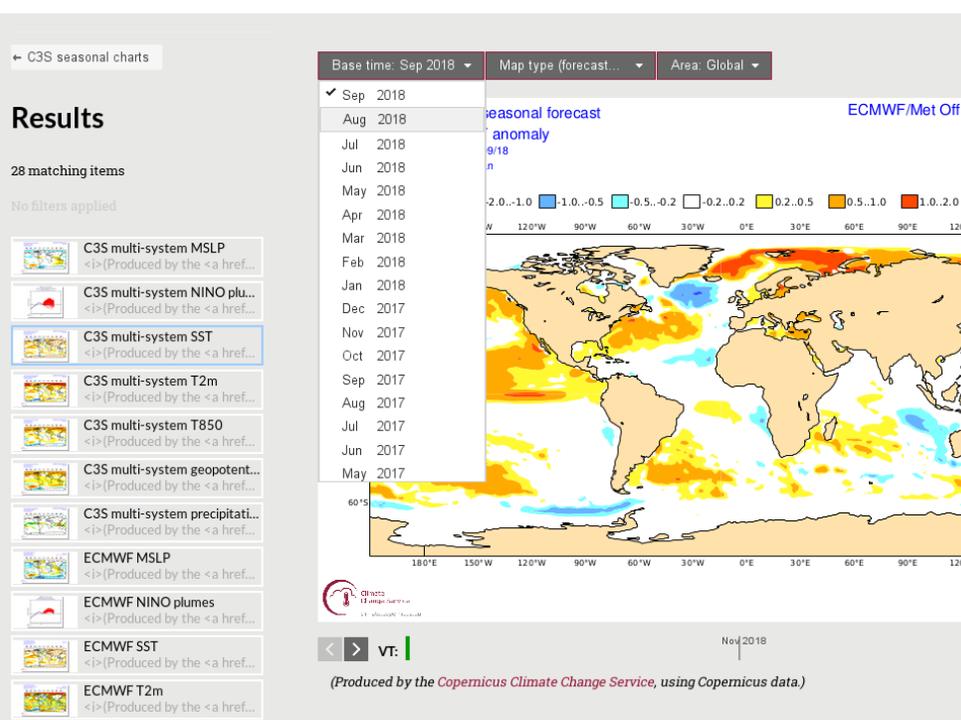




Climate Change

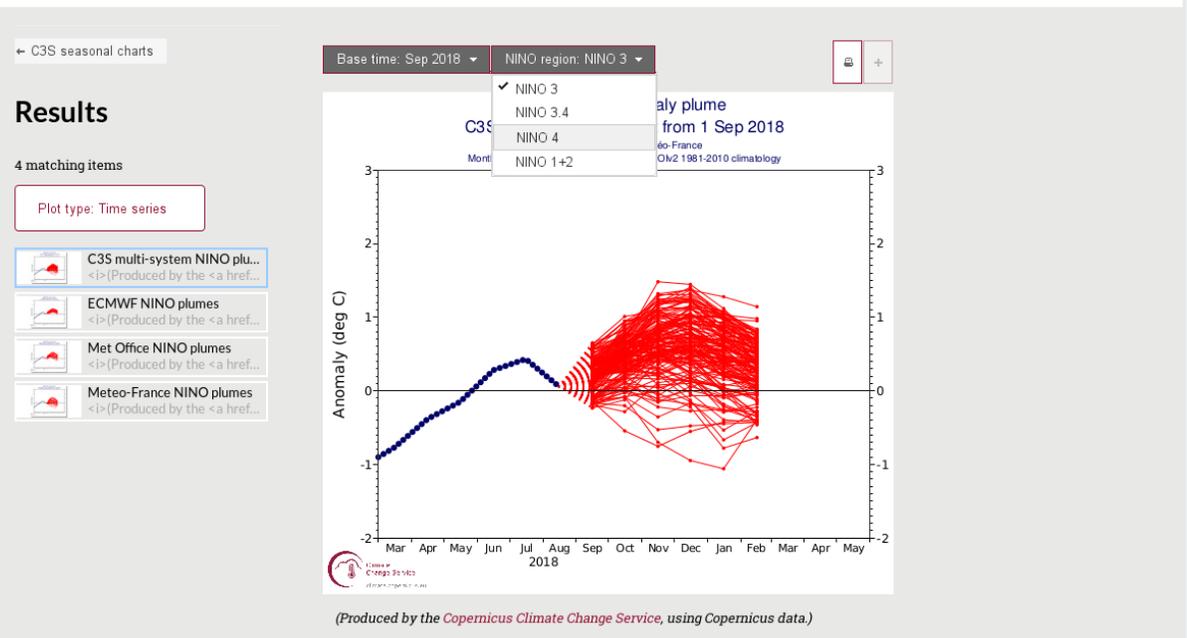
C3S seasonal forecasts – graphical products

C3S multi-system SST



C3S seasonal charts

C3S multi-system NINO plumes



https://climate.copernicus.eu/charts/c3s_seasonal/

IMPLEMENTED BY





Climate Change

C3S seasonal forecasts – CDS data service



Login/register

BETA

This is a new service -- your feedback will help us to improve it

Home Search Toolbox Datasets Help & support

Seasonal forecast monthly statistics on pressure levels from 2017 to present

[Overview](#)
[Download data](#)
[Documentation](#)

Originating centre

ECMWF
 UK Met Office
 Météo France
 Select all Clear all

Variable ?

Geopotential
 U-component of wind
 Temperature
 V-component of wind
 Specific humidity
 Select all Clear all

Pressure level

10 hPa
 30 hPa
 50 hPa
 70 hPa
 100 hPa
 200 hPa
 300 hPa
 400 hPa
 500 hPa
 850 hPa
 925 hPa
 Select all Clear all

Contact

copernicus-support@ecmwf.int

License

[Licence to Use Copernicus Products](#)

Related data

[Seasonal forecast monthly statistics on single levels from 2017 to present](#)

[Seasonal forecast daily data on pressure levels from 2017 to present](#)

[Seasonal forecast daily data on single levels from 2017 to present](#)

[Seasonal forecast anomalies on pressure levels from 2017 to present](#)

[Seasonal forecast anomalies on single levels from 2017 to present](#)

IMPLEMENTED BY

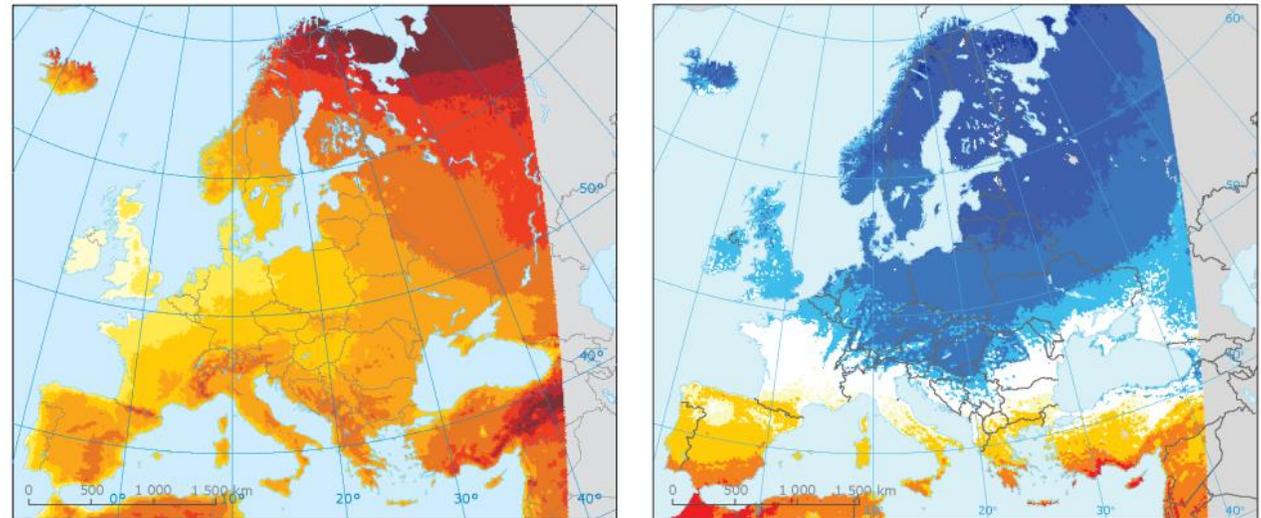
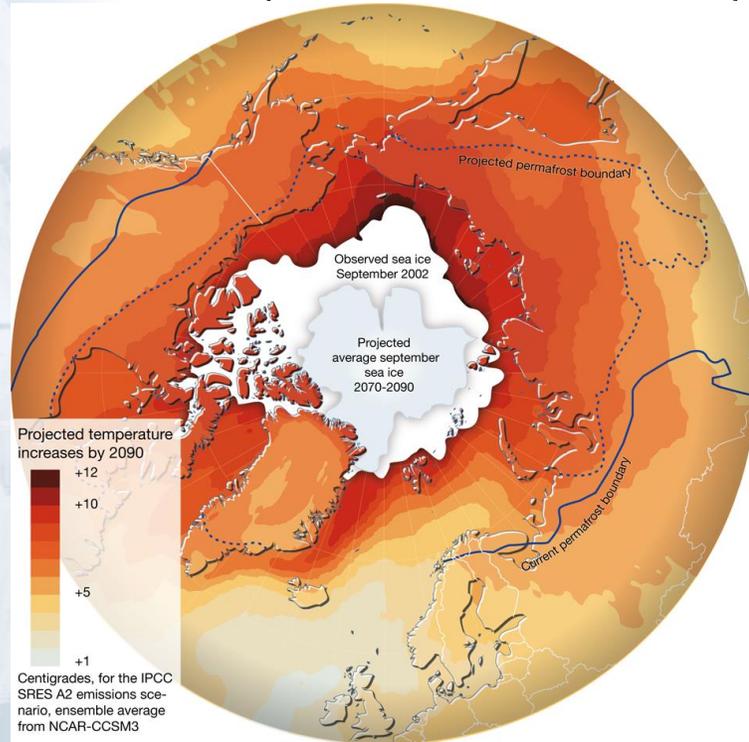




Climate
Change

Climate projections

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





Climate Change

Contributing to European Policies, EEA, GCOS and the WMO, ...

WORLD METEOROLOGICAL ORGANIZATION
Weather · Climate · Water

Our mandate Programmes Projects Resources Media Events About us Extranet Search

Home — Media — Press Releases — WMO confirms 2017 among the three warmest years on record

Main · News · Press Release · News from Members · Multimedia · Contact us

WMO confirms 2017 among the three warmest years on record

Tags: Climate change Greenhouse gases Climate

18 Published 18 January 2018

Press Release Number: 18-01-2018

European Environment Agency

Search A-Z Glossary

Topics Countries Data and maps Indicators Publications Media About us The EEA is an agency of the European Union

Data and maps Indicators Global and European temperature Global and European ...

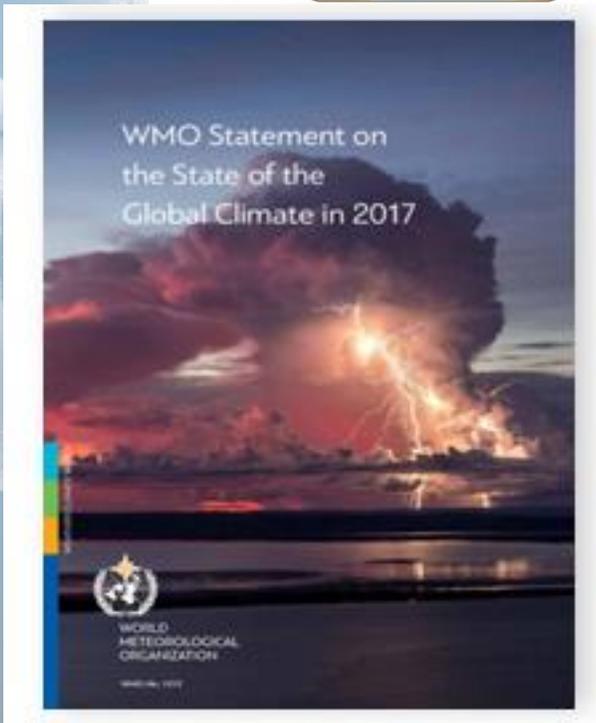
Global and European temperature

Indicator Assessment — Prod-4D: IND-4-en Also known as: CSI 012, CLIM 001 — Created 21 Mar 2018 — Published 16 May 2018 — Last modified 16 May 2018 — 19 min read

Topics: Climate change adaptation

Key messages

- According to different observational records of global average annual near-surface (land and ocean) temperature, the last decade (2008–2017) was 0.89 °C to 0.93 °C warmer than the pre-industrial average, which makes it the warmest decade on record. Of the 17 warmest years on record, 16 have occurred since 2000. The year 2017 was one of the world's three warmest years on record together with the years 2016 and 2015.
- The average annual temperature for the European land area for the last decade (2008–2017) was between 1.6 °C and 1.7 °C above the pre-industrial level, which makes it the warmest decade on record. In Europe, 2017 was colder than the previous 3 years.
- Climate models project further increases in global average temperature over the 21st century (for the period 2081–2100 relative to 1986–2005) of between 0.3 °C and 1.7 °C for the lowest emissions scenario (RCP2.6) and between 2.6 °C and 4.8 °C for the highest emissions scenario (RCP8.5).



WORLD METEOROLOGICAL ORGANIZATION
Weather · Climate · Water

Our mandate Programmes Projects Resources Media Events About us Extranet Search

Home — Programmes — Global Climate Observing System — Global Climate Indicators

Temperature and Energy Atmospheric Composition Ocean and Water Cryosphere

Surface Temperature Atmospheric CO₂ Ocean Acidification Glacier Mass Balance

Ocean Heat Sea Level Arctic and Antarctic Sea Ice Extent

Global Climate Indicators

Contact: gcoss@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.

Temperature

Running 60-month averages of global air temperature at a height of two metres (left-hand axis) and estimated change from the beginning of the industrial era (right-hand axis) according to different datasets: ERA-Interim (Copernicus Climate Change Service, ECMWF); GISTEMP (NASA); HadCRUT4 (Met Office Hadley Centre), NOAA GlobalTemp (NOAA); and JRA-55 (JMA). Credit: Copernicus Climate Change Service/ECMWF

...tries have agreed on the long-term goal of keeping the increase in global average temperature to well below 2 °C above pre-industrial levels and have agreed to aim to limit the increase to 1.5 °C. For the three highest of the four RCPs, the global average temperature is projected to exceed 2 °C compared with pre-industrial levels by 2050.

...temperature over Europe is projected to increase by the end of this century (2071–2100 relative to 1971–2000) in the order RCP4.5 and 2.5 °C to 5.5 °C under RCP8.5, which is more than the projected global average increase. The projected increase is largest across north-eastern Europe and Scandinavia in winter and southern Europe in summer. ... (those exceeding the 90th percentile threshold of a baseline period) have doubled between 1960 and 2017 in the area.

...several extreme heat waves since 2000 (2003, 2006, 2007, 2010, 2014, 2015 and 2017). Under a high emissions scenario, extreme heat waves as strong as these or even stronger are projected to occur as often as every two years in the second half of the 21st century. In southern Europe, they are projected to be particularly strong.

Global average temperature stay below 2 °C above pre-industrial levels?

Surface temperatures relative to the pre-industrial period

Global average near surface temperatures relative to the pre-industrial period

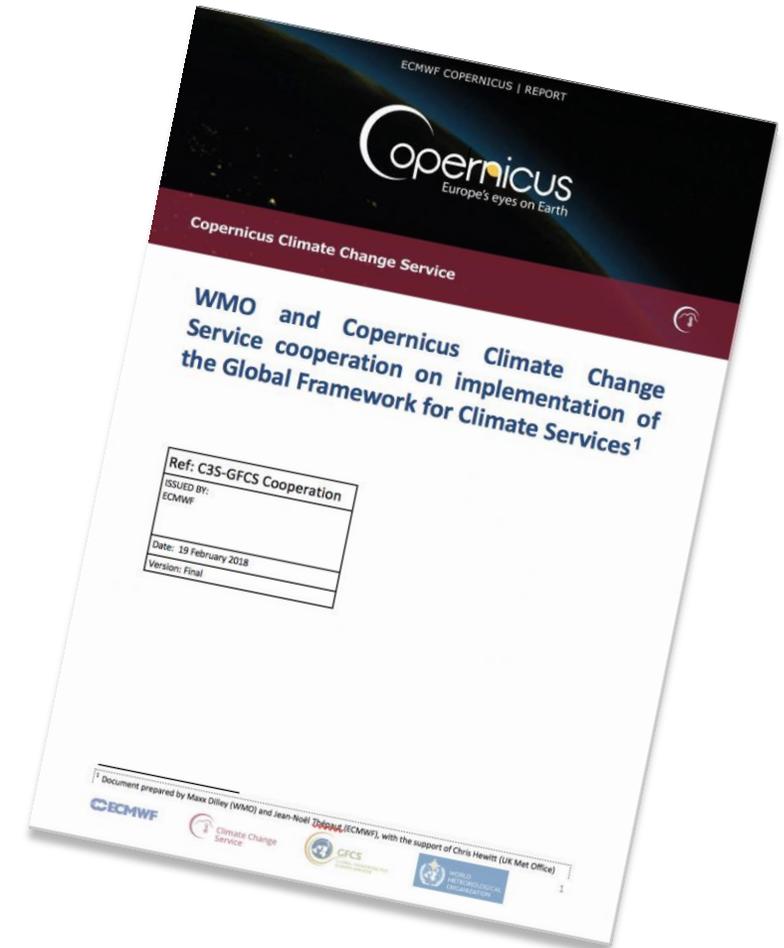




Climate
Change

C3S contributions to WMO GFCS

- Finalisation of a report on WMO and Copernicus Climate Change Service cooperation on implementation of the Global Framework for Climate Services (March 2018)
- Highlights of cooperation:
 1. Strengthening the global architecture for climate services information
 2. Stakeholder engagement at country level
 3. Targeted technical assistance and training for capacity development
- Participation to some RCCs activities (RCOFs)
- Exploration of extending the C3S Climate Data Store to non C3S datasets relevant to WMO GFCS (e.g. non Euro-CORDEX)



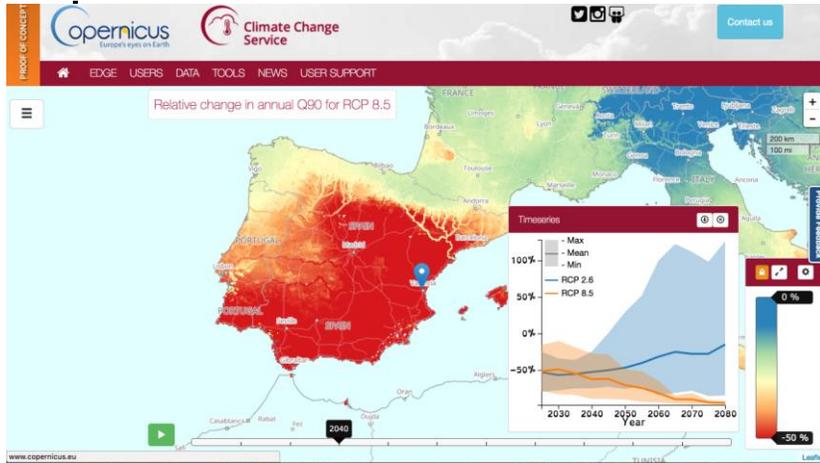
The report can be found [here](#)



Climate Change

Sectoral Information System

Proof-of-concepts of climate services: Demonstration of the value chain with end-to-end



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, good practices, tools and compelling use cases.

C3S Sectoral Applications cover: water management, energy, agriculture and forestry, health, tourism, infrastructure, insurance, biodiversity, disaster risk reduction, transports, coastal areas, marine and fisheries, etc.

WHAT WILL THE INFORMATION BE USED FOR?

The wealth of climate information will be the basis for generating a wide variety of climate indicators aimed at supporting adaptation and mitigation policies in Europe in a number of sectors. These include, but are not limited to, the following:

- WATER MANAGEMENT** (Water tap icon)
- AGRICULTURE & FORESTRY** (Leaf icon)
- TOURISM** (Suitcase icon)
- INSURANCE** (Umbrella icon)
- TRANSPORT** (Bus icon)
- ENERGY** (Wind turbines icon)
- HEALTH** (Red cross icon)
- INFRASTRUCTURE** (House icon)
- DISASTER RISK REDUCTION** (Warning sign icon)
- COASTAL AREAS** (Ship icon)

C3S WILL DELIVER SUBSTANTIAL ECONOMIC VALUE TO EUROPE BY:

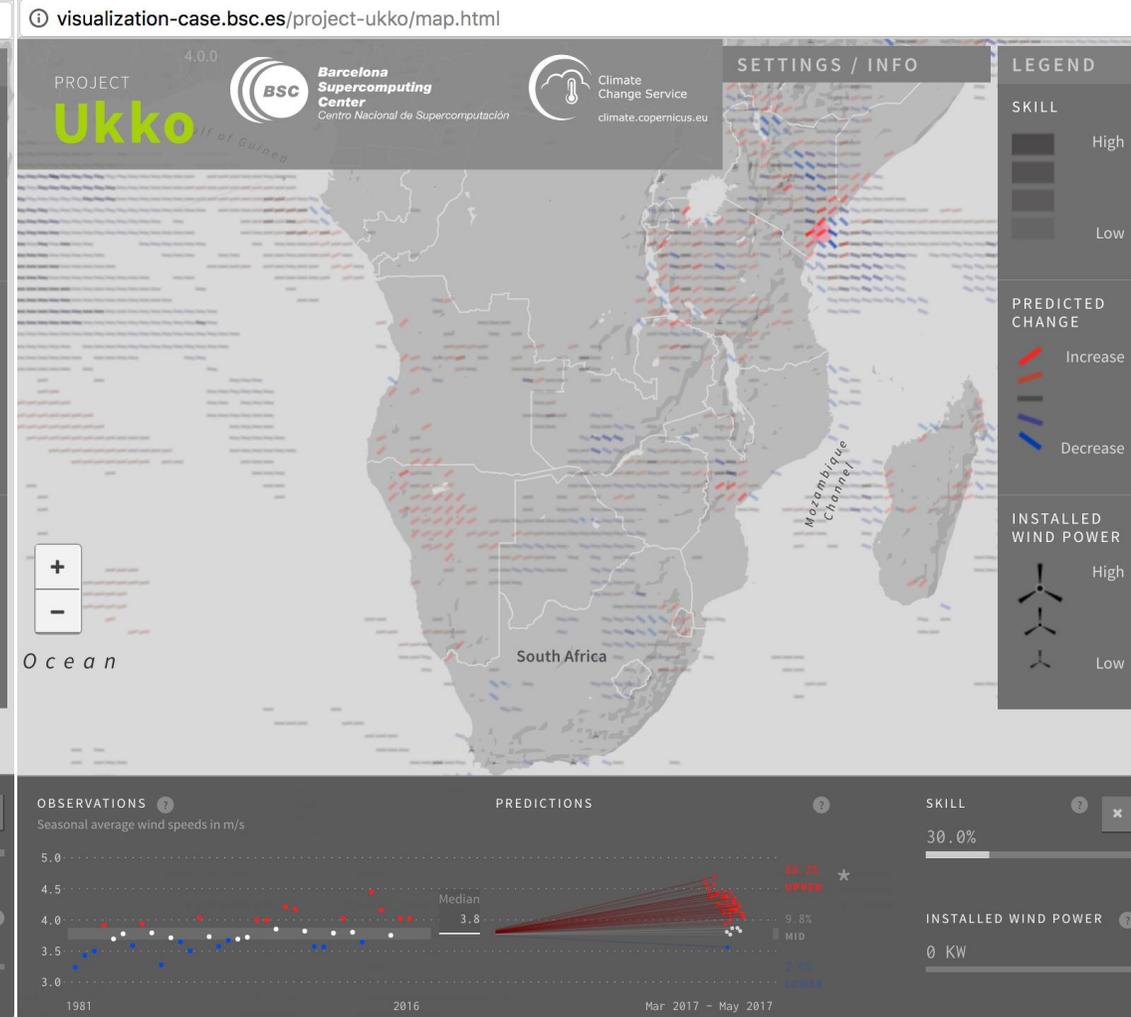
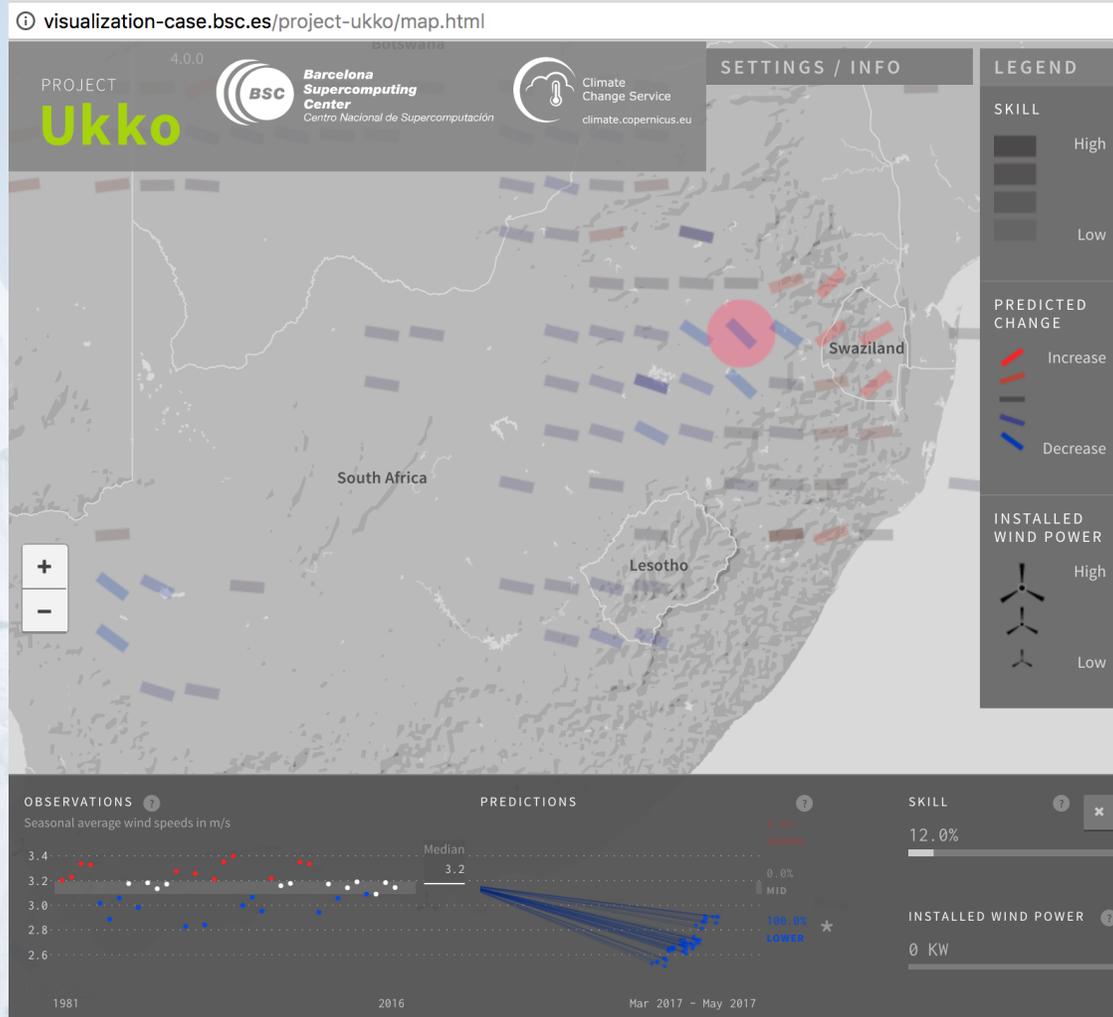
- 1 INFORMING**
POLICY DEVELOPMENT TO PROTECT CITIZENS FROM CLIMATE-RELATED HAZARDS SUCH AS HIGH-IMPACT WEATHER EVENTS
- 2 IMPROVING**
PLANNING OF MITIGATION AND ADAPTATION PRACTICES FOR KEY HUMAN AND SOCIETAL ACTIVITIES
- 3 PROMOTING**
THE DEVELOPMENT OF NEW SERVICES FOR THE BENEFIT OF SOCIETY





Climate Change

Seasonal forecasts for wind indicators

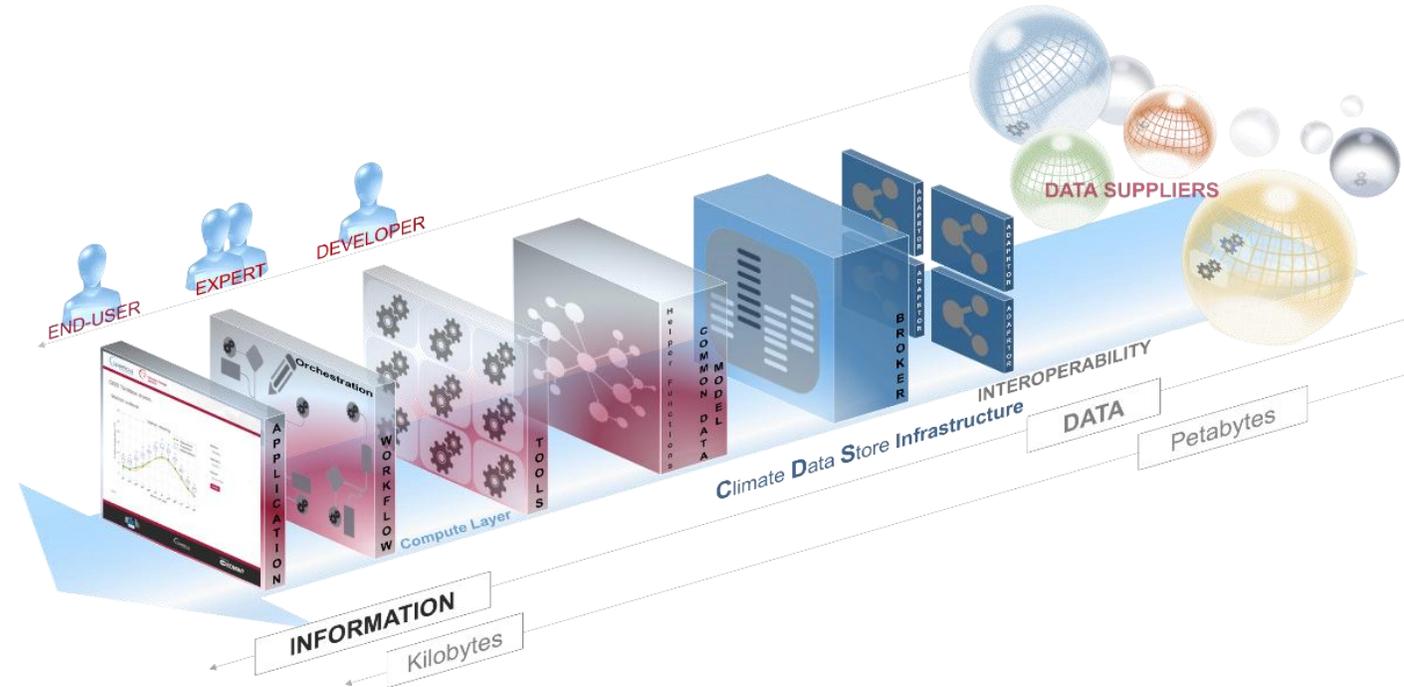
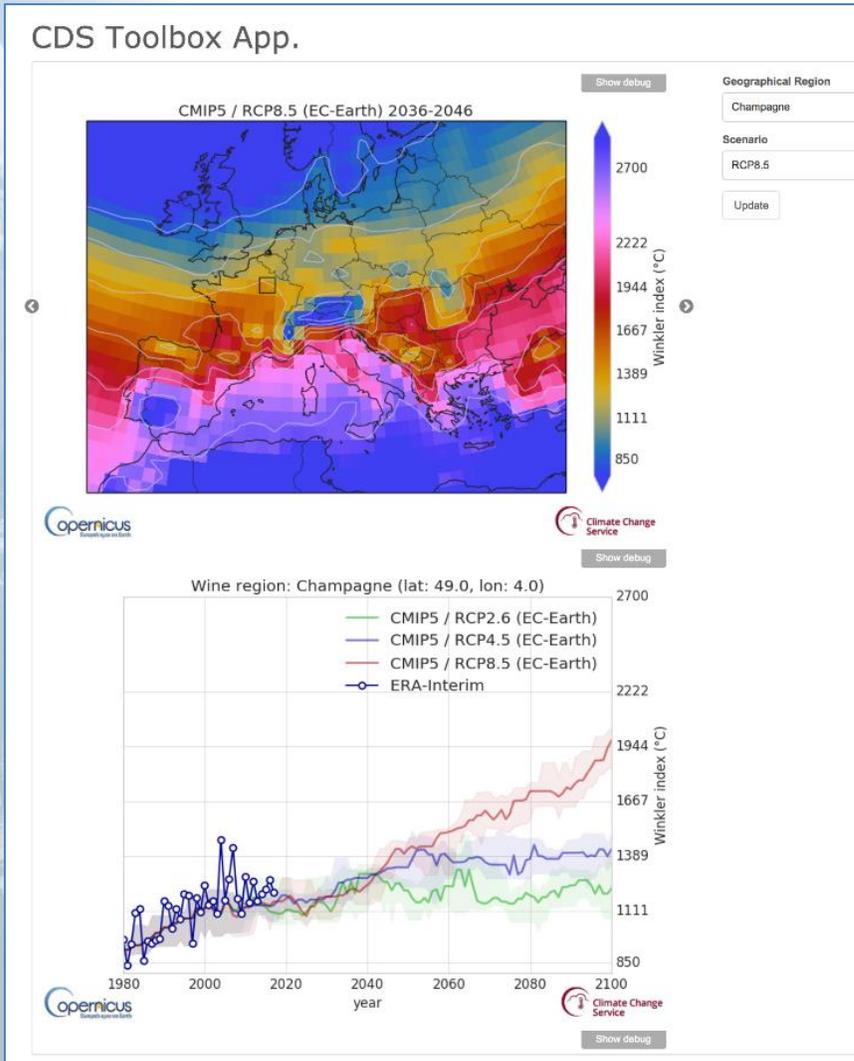




Climate Change

C3S infrastructure

CDS concept: Access to tools, workflows and applications



The CDS and its Tool Box allows managing and handling “climate objects” in a seamless way and within a unified environment.



Climate Change

Evaluation and Quality Control (EQC) for the CDS

Home Search Datasets Help & support

Copernicus Europe's eyes on Earth Climate Change Service BETA

Global glaciers elevation changes and mass balance

Time series of glacier-wide changes in elevation and changes in mass

Overview Download data Interactive map **data quality**

The **Glacier Change Service** provides time series of glacier-wide changes in:

- **Elevation** from terrestrial, air and space borne geodetic surveys
- **Changes in mass** from glaciological in-situ measurements.

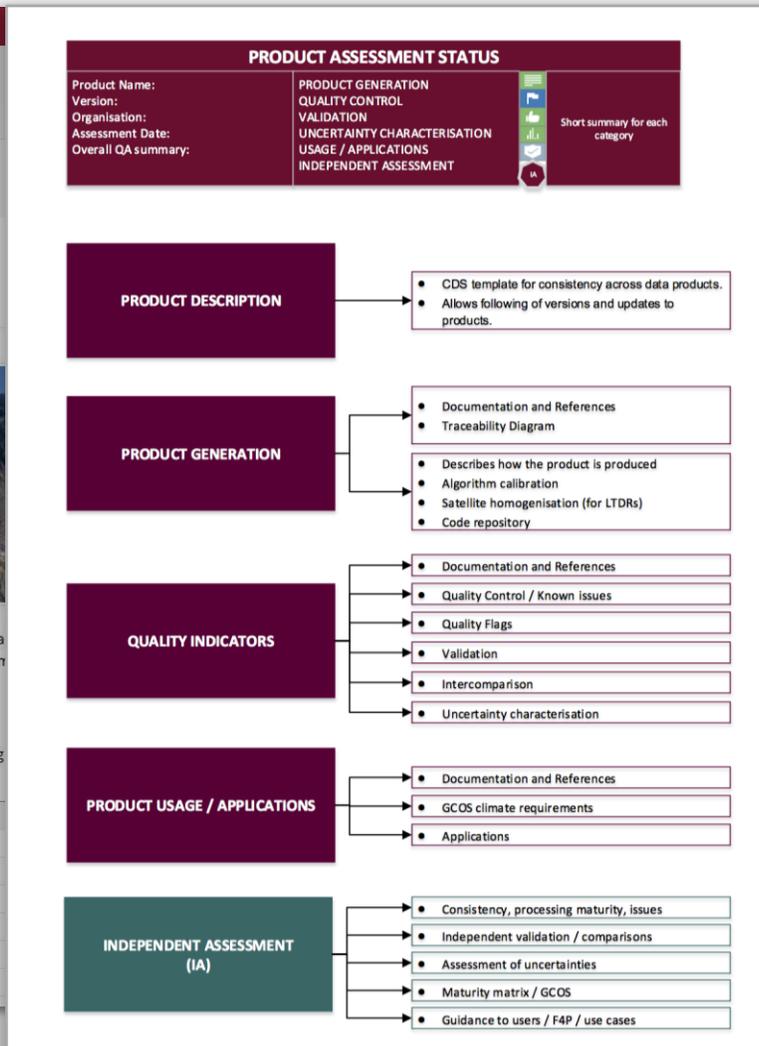
Both subsets are provided as **ESRI shapefiles** containing the location of the glacier label point in geographic coordinates (longitude and latitude in degrees), which are referenced to the WGS84 datum, and some general statistic information about the glacier. Both shapefiles come with one ancillary **.csv** file containing the time series of observed glacier changes and information of the original sources.

Note: The mass balance series consists of usually continuous annual balance measurements. The elevation change series consist of multi-annual changes with sometimes overlapping survey periods. For combining mass balance and elevation change data need again to be converted to annual change rates and mass changes need to be converted to $850 \text{ kg} \cdot \text{m}^{-3}$.

Keywords: glacier, change series, geodetic elevation change, glaciological mass balance

Reference | Citation: WGMS (2016): Fluctuations of Glaciers Database. World Glacier Monitoring DOI:10.5904/wgms-fog-2016-08. WGMS downloads

DATA DESCRIPTION	
Global glaciers elevation changes and mass balance	
Spatial coverage:	World Glacier Monitoring Service
Spatial resolution:	25km
Temporal coverage:	1850-2015
Temporal resolution:	from annual to decadal
Data format:	ESRI shapefiles



Quality of data

- Assessments
- User guidance
- Gaps and limitations

Quality of tools

- Fitness for purpose
- Best practices

Quality of service

- Speed, responsiveness
- System availability,
- ...





Implemented by ECMWF as part of The Copernicus Programme

**Climate
Change Service**

[News](#) [Events](#) [Press](#) [Tenders](#) [Help & Support](#)

[ABOUT US](#)

[WHAT WE DO](#)

[DATA](#)

[SEARCH](#)



[X close](#)

Get involved with the Copernicus Climate Change Service

Thank You

