



Climate Change

# Climate Change Service

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# C3S in a nutshell

## Climate Data Store

- ECVs past, present and future
- Observed, reanalysed and simulated
- Derived climate indicators
- Tools to support adaptation and mitigation at global and European level
- Open and free access

## Sectoral Information System



water resources



land use



transport



energy



health



housing and built environment



environment



transport



climate change adaptation



coastal and marine resources

## Evaluation and Quality Control

- Monitors quality of C3S products and services
- Ensures C3S delivers state-of-the-art climate information to users
- Identifies gaps in service provision
- Bridges Copernicus with the research agenda in Europe (e.g. H2020, national research projects)

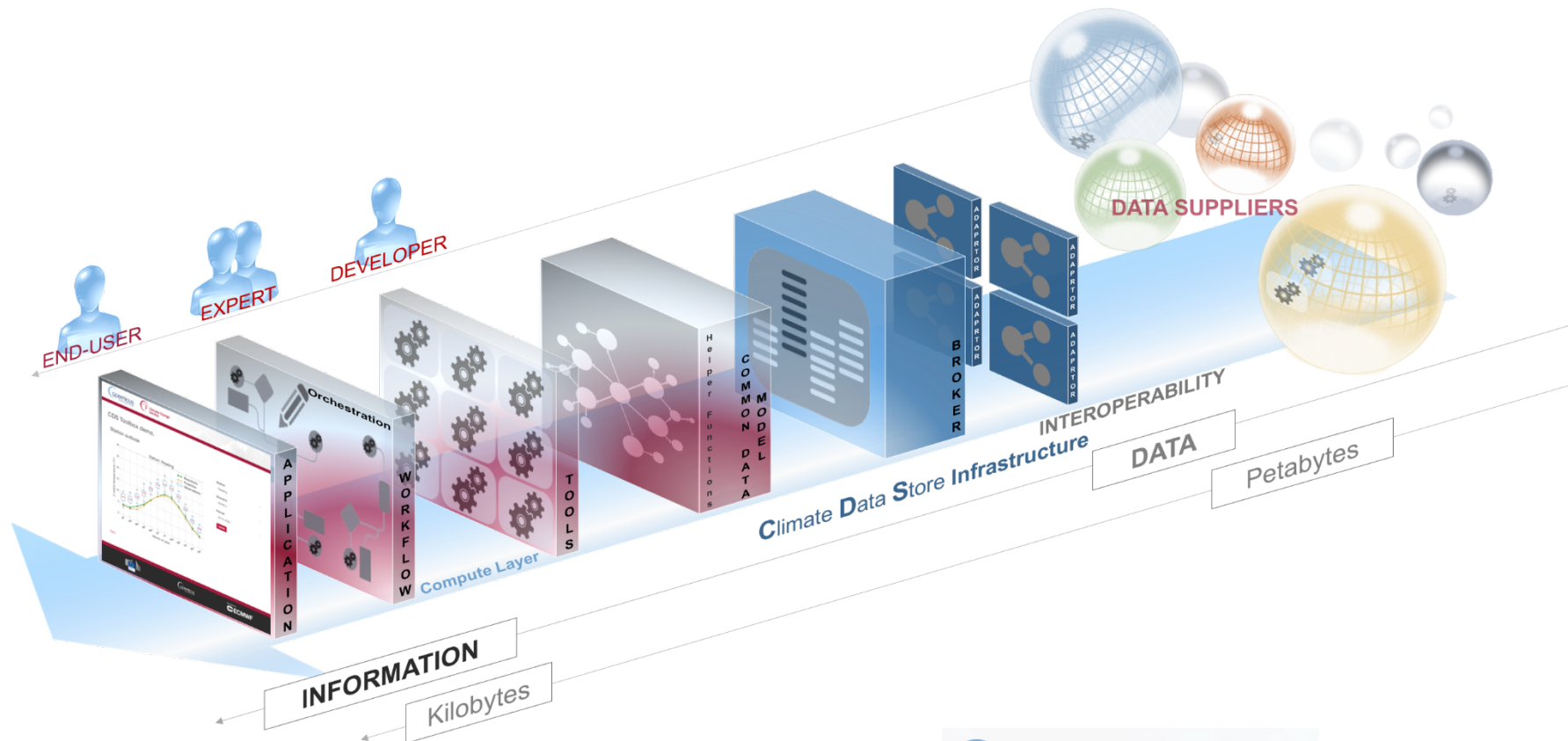
## Outreach and Dissemination

- Web content
- Public outreach
- Coordination with national outreach
- Liaison with public authorities
- Conferences, seminars
- Training and education



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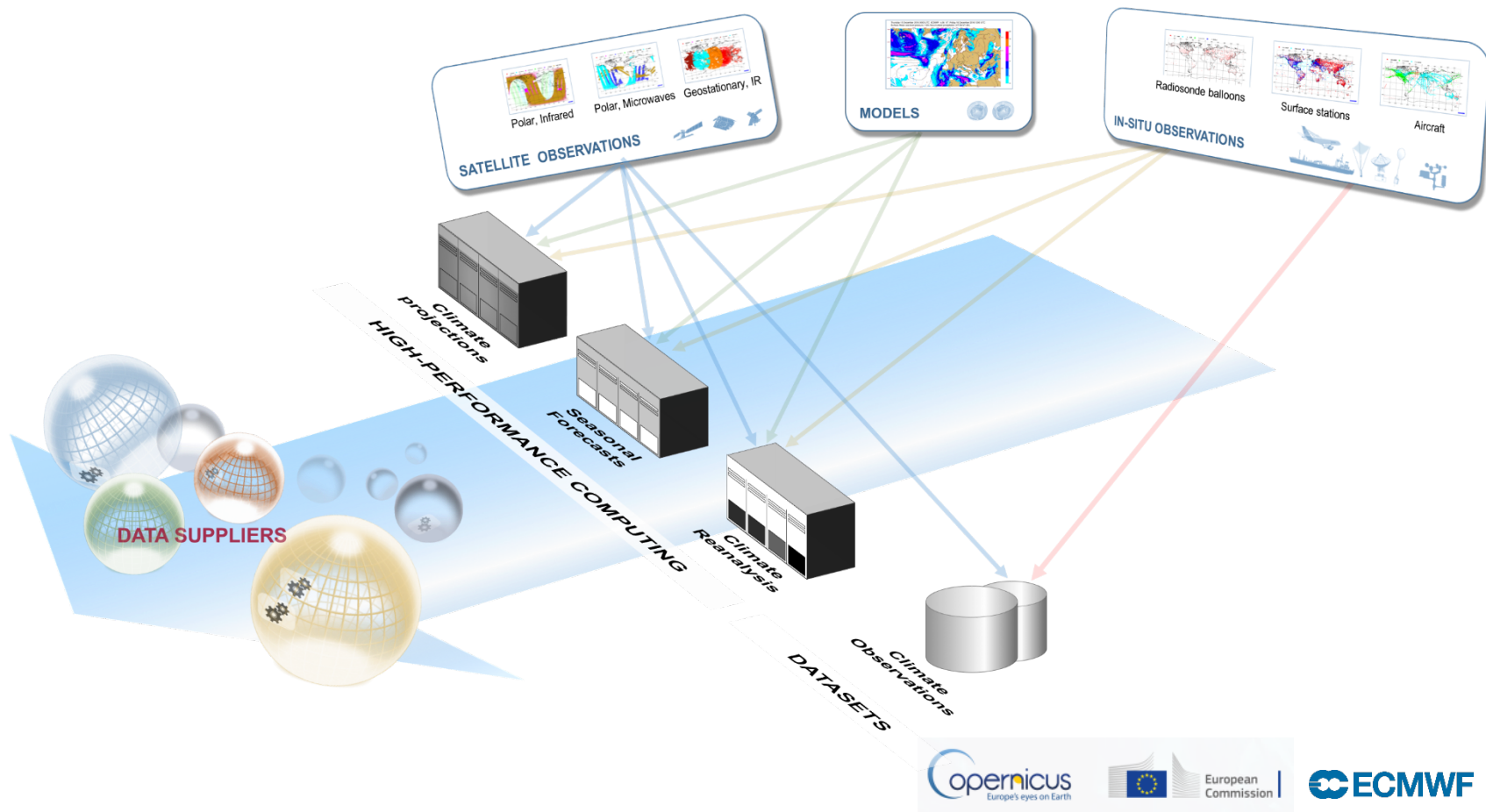
# Building the CDS infrastructure





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# What do we mean by Data?







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# Developing the CDS portfolio



## Scientific basis:

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



Action engaged



In preparation  
(PIN or ITT out)



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 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

Climate Indicators



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## *In situ* observations

**Service:** Providing users with full access to the *in situ* instrumental data record, in usable form

### **How:**

- Support services for data rescue (C3S\_311a Lot 1)
- Harmonised access to climate data archives (C3S\_311a Lot 2)
- Harmonised access to data from reference networks (C3S\_311a Lot 3)
- Gridded ECV products for the European domain (C3S\_311a Lot 4)



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## Satellite observations

**Service:** Providing users with full and timely access to FCDRs and CDRs derived from satellite observations

**How:**

- Access to gridded ECV products ([C3S\\_312a](#), [C3S\\_312b](#))
- Reprocessing of EUMETSAT level-1b satellite data records ([C3S\\_311b](#))
- Satellite data rescue for input to climate reanalysis ([C3S\\_311c](#))



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## ECV products for CDS

- Initial set of ~ 30 ECVs planned for stages II and III
- Products will become available via the CDS during 2017/2018
- Additional/alternative ECV products to follow (e.g. NOAA CDRs, GPCP, ...)



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(PIN or ITT out)

C3S_312a	ECV products from observations	9 contracts, 12 ECVs	Started 2016Q4
C3S_311a	In situ observations (Lot 4)	High-resolution ECV products for Europe	Likely start 2017Q1
C3S_312b	ECV products from observations	Additional 8-10 ECVs	ITT in preparation
ERA5	Global atmospheric reanalysis	Atmosphere, land, sea state	Started 2016Q1
ORA5	Global ocean reanalysis	Ocean, sea ice	Complete



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# Atmosphere ECVs

	GCOS Status Report	C3S Technical Annex	CDS	Reanalysis	Observations
<b>Atmosphere (surface)</b>					
Air temperature	4.3.1	Stage III	2017	ERA5	C3S_311a
Wind speed and direction	4.3.2	Stage II	2017	ERA5	C3S_311a
Water vapour	4.3.3	Stage II	2017	ERA5	C3S_311a
Pressure	4.3.4		2017	ERA5	C3S_311a
Precipitation	4.3.5	Stage II	2017	ERA5	C3S_311a
Surface radiation budget	4.3.6	Stage II	2017	ERA5	C3S_312b
<b>Atmosphere (upper air)</b>					
Temperature	4.5.1		2017	ERA5	
Wind speed and direction	4.5.2	Stage II	2017	ERA5	
Water vapour	4.5.3		2017	ERA5	C3S_312b
Cloud properties	4.5.4	Stage II	2017	ERA5	C3S_312b
Earth radiation budget	4.5.5	Stage II	2017	ERA5	C3S_312b
<b>Atmosphere (composition)</b>					
Carbon dioxide	4.7.1	Stage II	2017		C3S_312a
Methane	4.7.2	Stage II	2017		C3S_312a
Other long-lived greenhouse gases	4.7.3	Stage III	2018		C3S_312b
Ozone	4.7.4	Stage II	2017	ERA5	C3S_312a
Aerosol	4.7.5	Stage II	2017		C3S_312a



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# Status for Oceanic ECVs

	GCOS Status Report	C3S Technical Annex	CDS	Reanalysis	Observations
<b>Ocean (physics)</b>					
Sea surface temperature	5.3.1	Stage II	2017	ORA5	C3S_312a
Subsurface temperature	5.4.1	Stage II	2017	ORA5	
Sea surface salinity	5.3.2		2018	ORA5	
Subsurface salinity	5.4.2	Stage III	2018	ORA5	
Sea surface currents	5.3.6		2018	ORA5	
Subsurface currents	5.4.3	Stage III	2018	ORA5	
Sea level	5.3.3	Stage II	2017	ORA5	C3S_312a
Sea state	5.3.4		2018	ERA5	
Sea ice	5.3.5	Stage II	2017	ORA5	C3S_312a
Ocean surface stress	NEW		2018	ORA5	
Ocean surface heat flux	NEW		2018	ORA5	
<b>Ocean (biochemistry)</b>					
Inorganic carbon	NEW		2018		C3S_312b
Ocean colour	5.3.7	Stage II	2018		C3S_312b



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# Status for Terrestrial ECVs

	GCOS Status Report	C3S Technical Annex	CDS	Reanalysis	Observations
<b>Land (hydrology)</b>					
Lakes	6.3.4	Stage III	2018		C3S_312b
Soil moisture	6.3.16	Stage III	2017	ERA5	C3S_312a
<b>Land (cryosphere)</b>					
Snow	6.3.5	Stage II	2017	ERA5	
Glaciers	6.3.6	Stage II	2017		C3S_312a
Ice sheets and ice shelves	6.3.7	Stage II	2018		C3S_312b
Permafrost	6.3.8	Stage III	2018		C3S_312b
<b>Land (biosphere)</b>					
Albedo	6.3.9	Stage II	2017		C3S_312a
Land cover (including vegetation type)	6.3.10	Stage III	2018		C3S_312b
Fraction of absorbed photosynthetically	6.3.11	Stage II	2017		C3S_312a
Leaf area index	6.3.12	Stage III	2017		C3S_312a
Fire	6.3.15	Stage II	2018		C3S_312b



Action engaged



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(PIN or ITT out)



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# Climate reanalysis

**Service :** Providing users with access to a physically consistent set of ECV estimates, by combining models with observations

## **How:**

- Production of global climate reanalyses (ECMWF)
- Higher-resolution reanalysis for Europe (C3S\_322 Lot 1)
- Higher-resolution reanalysis for the Arctic (C3S\_322 Lot 2)
- Lower-resolution centennial reanalysis (no action yet)



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# ERA5: State of production

## Production Streams (Cy41r2, TL639/TL319):

**NRT:** 2505 (HRES), 2506 (EDA) (was 2443/2445)

*(June) Dec 2014 – Sept 2016*

**2010:** 2502 (HRES), 2501 (EDA)

*Jan 2009 – Jul 2014*

**2000:** 2504 (HRES), 2503 (EDA)

*Jan 1999 – Aug 2004*

**1990:** 2928 (HRES), 2929 (EDA), starting

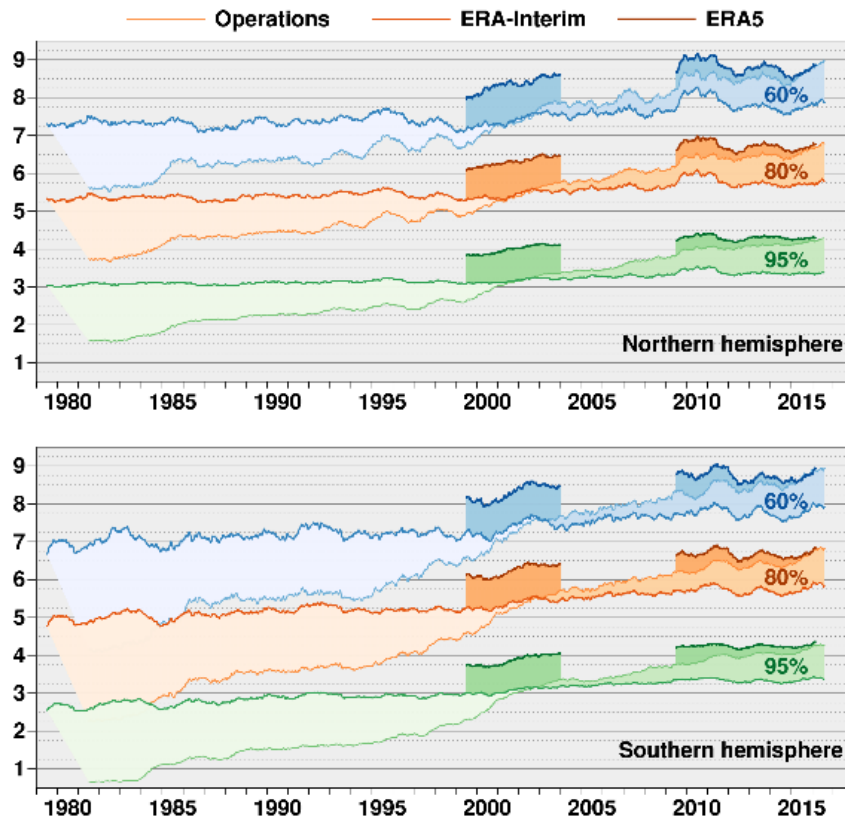
**Troposphere** looks very promising

**Stratosphere:** some issues with trends

**Mesosphere:** unrealistic tropical jet (41r2)

**1979:** issues over southern hemisphere

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





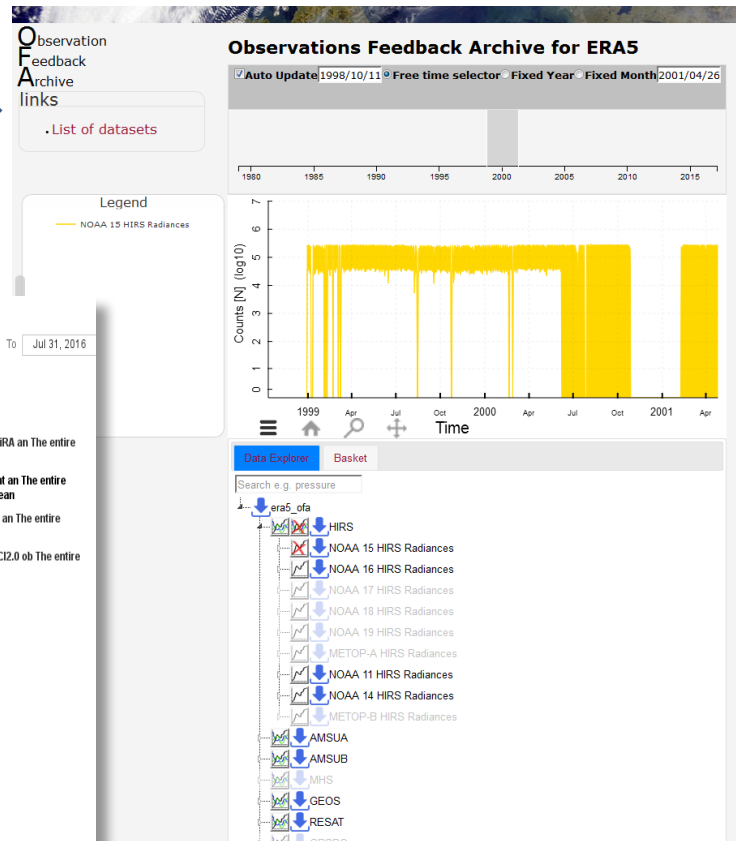
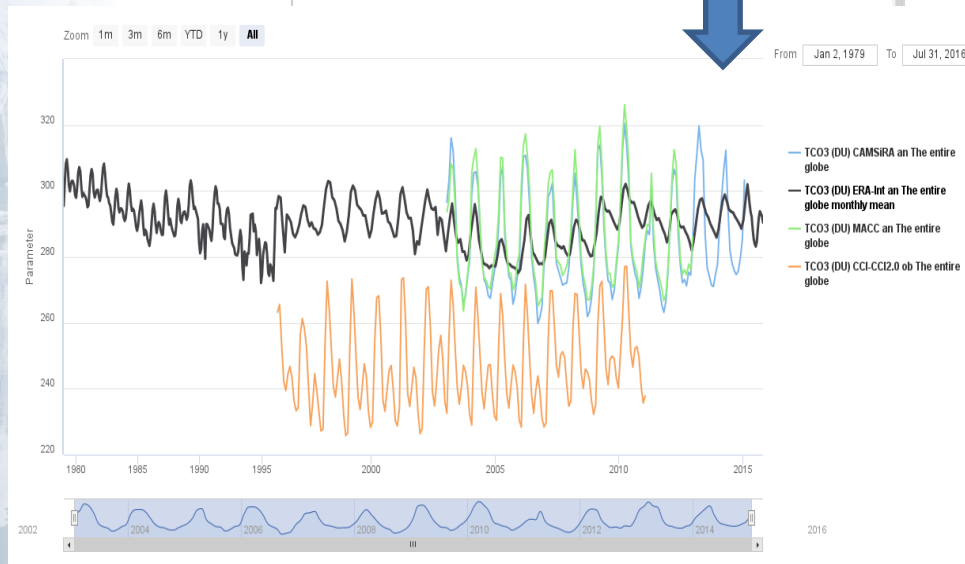
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# Climate reanalysis: Data access tools

**Observation Feedback Archive:** Explore, select, plot and download observations used in ERA5



**Climate Monitoring Facility:** Explore, compare, plot ECV estimates from multiple sources





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## Seasonal forecasts

**Service:** Providing users with timely access to the best possible seasonal forecasts, by combining model data from multiple providers

**How:**

- Production of seasonal forecast data by core providers (C3S\_433)
- Development and production by future providers (C3S\_433)
- Multi-system product generation and dissemination (ECMWF)



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# Seasonal forecasts - outlook 6 months ahead

Seasonal forecasts | Copernicus Climate Change Service - Mozilla Firefox

Seasonal forecasts | ... x Seasonal forecasts | ... x ECMWF | C3s\_seas... x

climate.copernicus.eu/seasonal-forecasts

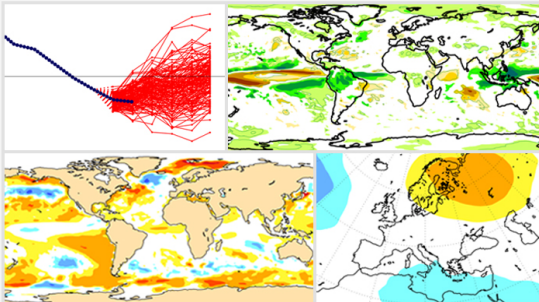
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ABOUT C3S NEWS & MEDIA EVENTS TENDERS PRODUCTS SERVICES USER SUPPORT

## Seasonal forecasts

home » products



The Copernicus Climate Change Service (C3S) is developing seasonal forecast products, with a target publication date of 15<sup>th</sup> of each month. These products are based on data from several state-of-the-art seasonal prediction systems.

The current proof-of-concept phase includes graphical forecast products for a number of variables (air and sea-surface temperature, atmospheric circulation and precipitation); the forecasts are updated every month and cover a time range of 6 months. The interface to the list of products offers links to maps or timeseries for the forecast variables, and the facility to navigate the full set of graphics. Multi-system combinations, as well as predictions from the individual component systems, are available.

The centres currently providing forecasts to C3S are ECMWF, The Met Office and Météo-France; at a later stage Deutscher Wetterdienst and Centro Euro-Mediterraneo sui Cambiamenti Climatici will be added to the list.

Graphical forecast products

- AVERAGE SURFACE AIR TEMPERATURE MONTHLY MAPS
- CLIMATE REANALYSIS
- SEASONAL FORECASTS

### NEWS

13 Dec 2016  
#OpenDataHack: @ECMWF - explore creative uses of open data

06 Dec 2016  
Report Reassesses Variations in Global Warming

28 Nov 2016  
Copernicus at Wissenswerte

17 Nov 2016  
C3S and CAMS at COP22

01 Nov 2016  
ODI Summit and Awards 2016

More News

### EVENTS

13 Nov 2017  
5th International Conference on Reanalysis

06 Mar 2017  
C3S General Assembly

22 Feb 2017  
Copernicus Symposium on Climate Services for

Full

Free

Open

<http://climate.copernicus.eu/seasonal-forecasts>



European  
Commission







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# Climate projections

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

## **How:**

### *Global climate projections:*

- Access to ESGF via the Climate Data Store (C3S\_34a Lot 1)
- Multi-model global product generation (C3S\_34a Lot 2)
- Reference set of climate projections for Europe (C3S\_34a Lot 3)

### *Regional climate projections:*

- Access to CORDEX simulations for the European domain (C3S\_34b Lot 1)
- Production of additional climate projections for Europe (C3S\_34b Lot 2)



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# Sectoral Information System

## 7 Proof-of-concepts with end-to-end demonstrators

### 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 in Europe in a number of sectors. We include, but are not limited to, the following:



**WATER  
MANAGEMENT**



**AGRICULTURE  
AND FORESTRY**



**TOURISM**



**INSURANCE**



**TRANSPORT**



**ENERGY**



**HEALTH**



**INFRASTRUCTURE**



**DISASTER RISK  
REDUCTION**



**COASTAL AREAS**

### 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

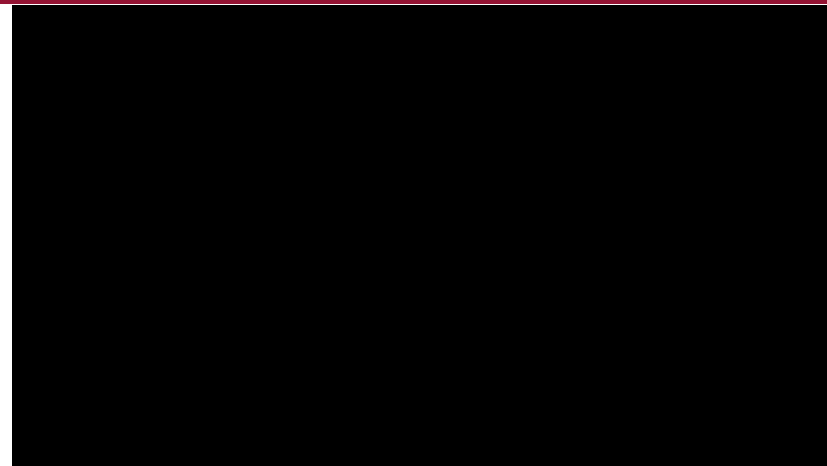
THE DEVELOPMENT OF NEW SERVICES FOR THE BENEFIT OF SOCIETY



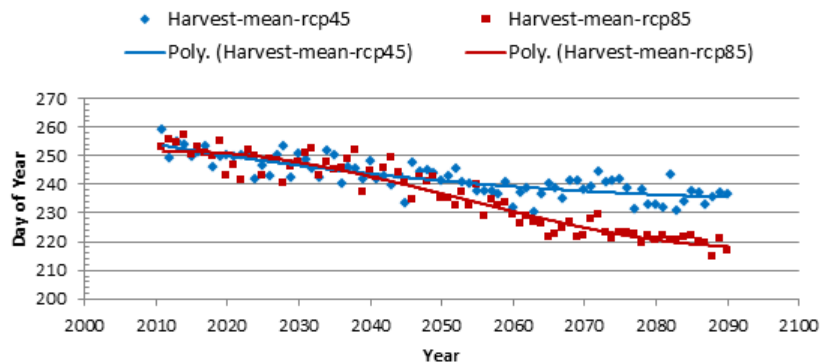
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# Very convincing POCs and demonstrators

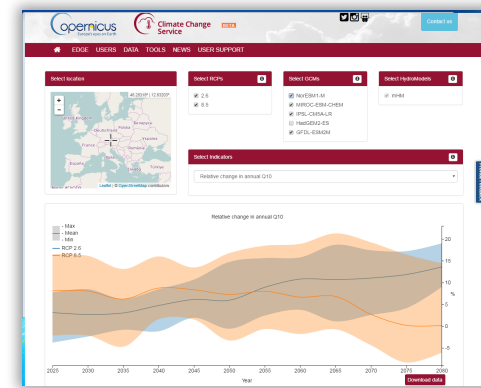
- Climate information is tailored to meet Sectoral needs



Mean Harvest Predictions



Predicted vine harvest date advances by 18 days (RCP4.5) and 32 days (RCP8.5)





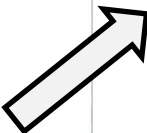
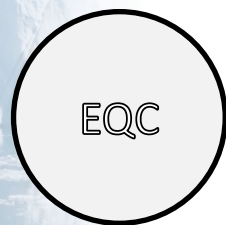
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# Evaluation and Quality Control



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## EQC: Engaged and future activities



Quality assurance for seasonal forecasts

Quality assurance framework for earth observations

Quality assurance for climate projections

Quality assessment of ECV products and reanalyses

Sectoral gap analysis and user requirements

**EQC of operational SIS**

Ensures C3S is state-of-the-art  
Identifies gaps in the Service  
Bridges Copernicus with Research Agenda in Europe (e.g. H2020, national research projects)  
Monitors continually, quality of C3S products and services  
“Quality Assurance” body  
Contributes and develops URDB/SES/etc documents



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# Contractors and sub-contractors contributing to C3S

*Up to date, **131 different entities** from **20 European countries** and **3 international organisations** are involved in 54 contracts as a contractor or subcontractor counting for 225 participations in contracts managed by ECMWF.*

+ International  
Organisations





## CLIMATE SERVICES FOR YOUR OPERATIONS

climate.copernicus.eu

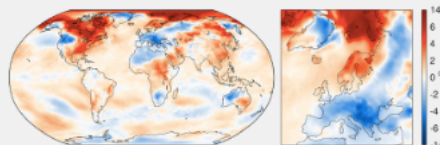
### IN FOCUS



### C3S holds its inaugural General Assembly

03 Mar 2017

### MONTHLY MAPS



### Average surface air temperatures for January 2017

January 2017

### NEWS



03 Mar 2017  
#OpenDataHack @ECMWF  
- explore creative uses of open data



03 Mar 2017  
C3S holds its inaugural General Assembly



26 Jan 2017  
Copernicus at the 4th International Conference on Energy & Meteorology (ICEM)