



Climate Change

The Copernicus Climate Change Service: building the house

Joaquín Muñoz-Sabater & the C3S team





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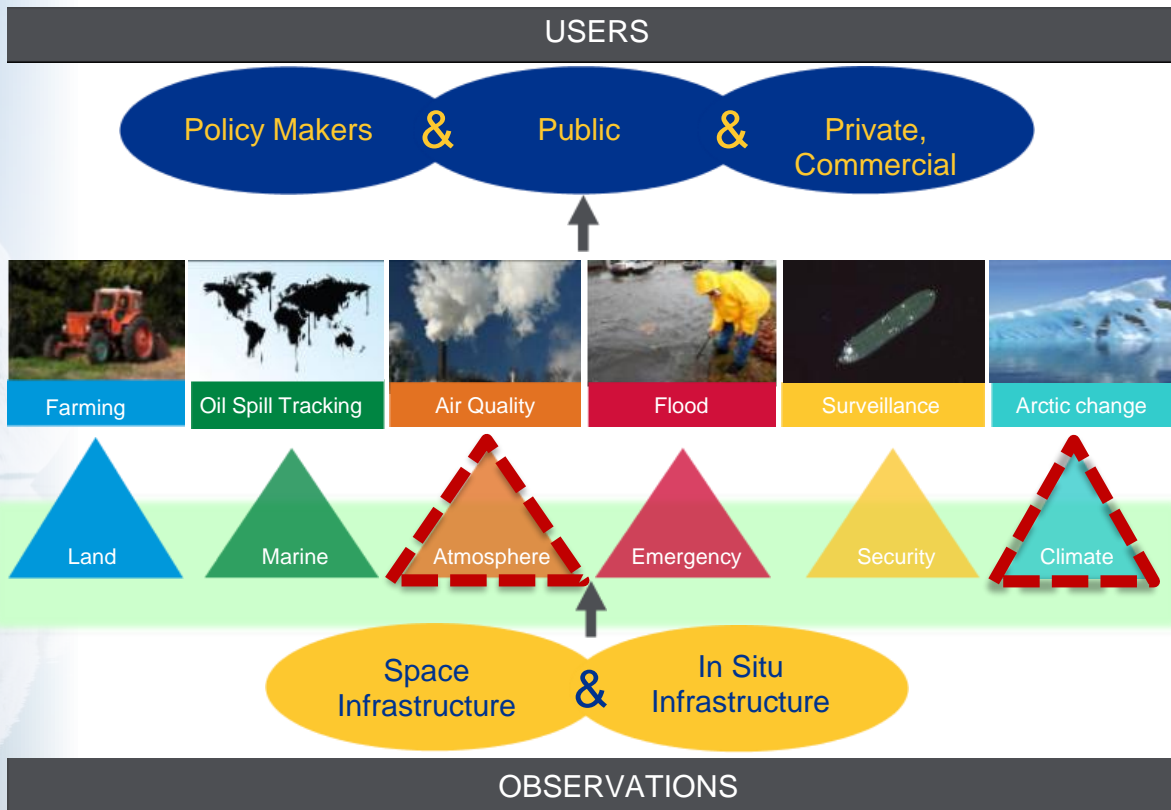
Overview

- Overview of Copernicus and the Climate Change Service (C3S)
- The Climate Data Store
- Sectorial Information Systems
- Evaluation and Quality Control
- Outreach & Dissemination



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The Copernicus Programme - Services



Different Needs

Examples of areas covered

6 Information Services

Sustainable observation capabilities

ECMWF operates the *Copernicus Climate Change Service (C3S)* and *Copernicus Atmosphere Monitoring Service (CAMS)* on behalf of the European Commission





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The Climate Change Service (C3S)

“The service will help to meet the needs and requirements for a wide variety of C3S services, ranging from the monitoring of climate change impact on different sectors of society to long-term planning and policy development.”

C3S Vision

- To be an authoritative source of climate information for Europe
- To build upon national investments and complement national climate service providers
- Enable the market climate services

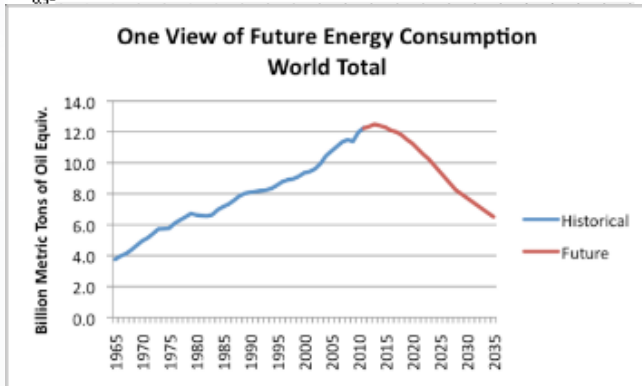
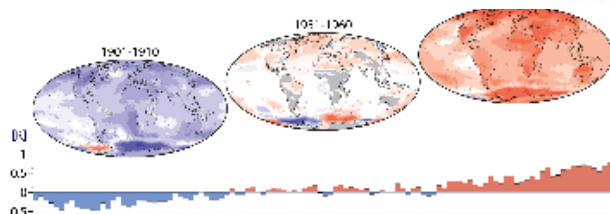
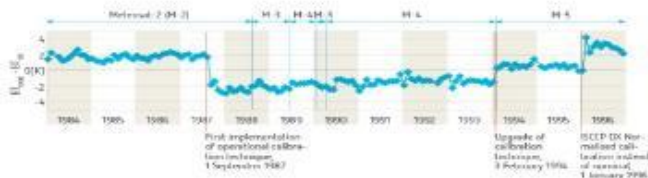
Supported users: Climate monitoring (GCOS), policy implementation (Climate ADAPT), application sectors, climate research, climate modellers, business, entrepreneurs developing climate services.



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The Climate Change Service (C3S)



Questions addressed in the Service

- How is climate changing?
 - Earth observations
 - Reanalyses
- Will climate change continue/accelerate?
 - Predictions
 - Projections
- What are the societal impacts?
 - Climate indicators
 - Sectorial information



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C3S - Development timeline

Mid-term review



2014 2015 2016 2017 2018 2019 2020 2021

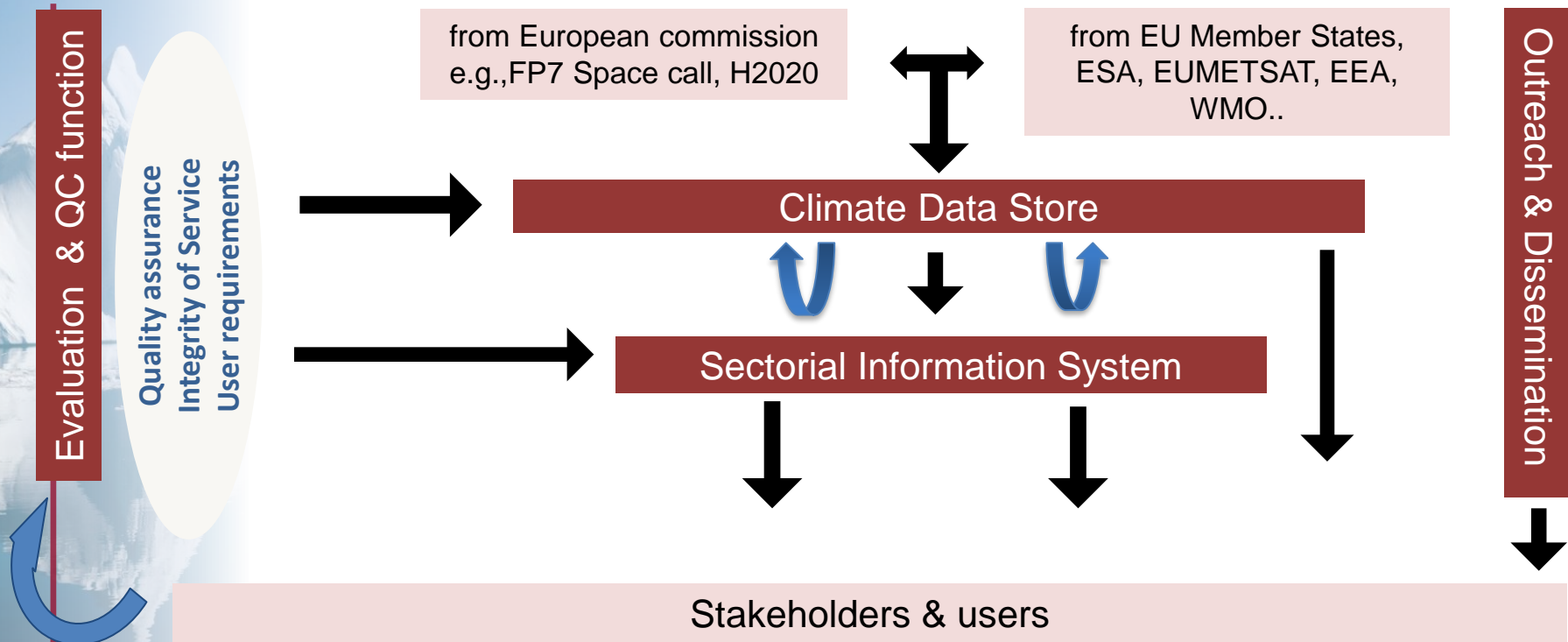
Signature of Delegation Agreement First C3S General Assembly C3S first operations





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C3S in a nutshell





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Where is the C3S now?

We are building the store.
Soon we will open the door to customers.



Today is about putting products on the shelves.





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Climate Data Store Content



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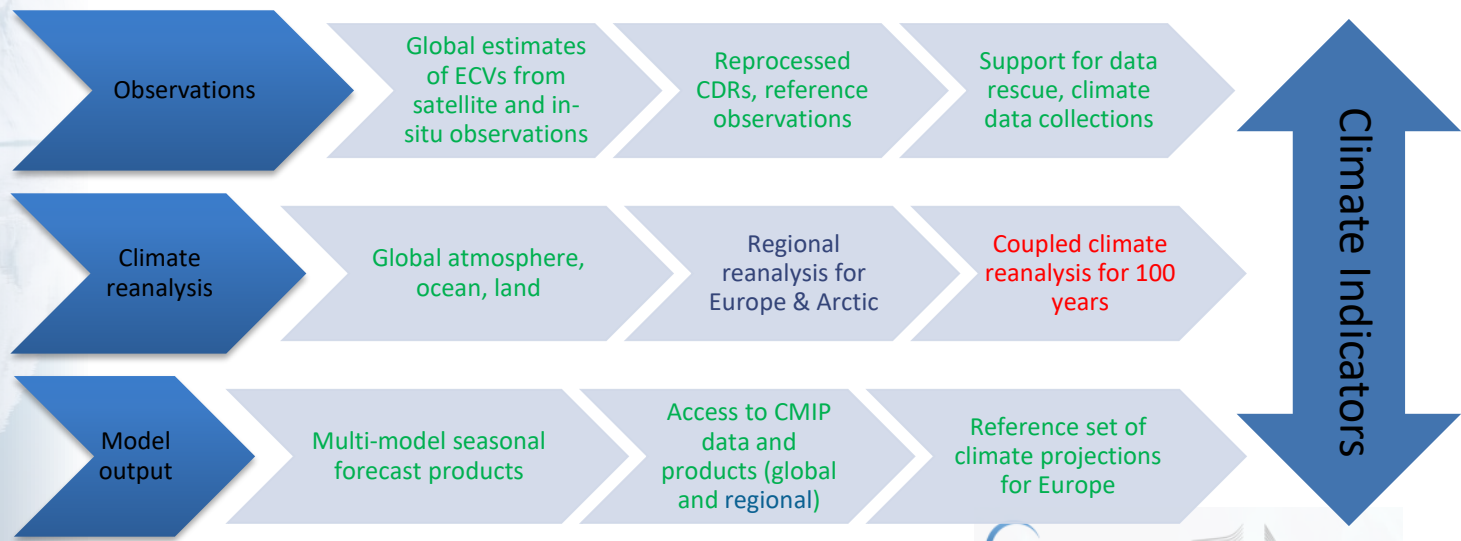
Developing the CDS portfolio



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





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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, ...)



Action engaged



In preparation
(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	Started 2017Q1
C3S_312b	ECV products from observations	Additional 8-10 ECVs	ITT soon
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
Atmosphere (surface)					
Air temperature	4.3.1	Stage III	2017	ERA5	C3S_311a
Wind speed and direction	4.3.2	Stage III	2017	ERA5	C3S_311a
Water vapour	4.3.3	Stage III	2017	ERA5	C3S_311a
Pressure	4.3.4		2017	ERA5	C3S_311a
Precipitation	4.3.5	Stage III	2017	ERA5	C3S_311a
Surface radiation budget	4.3.6	Stage III	2017	ERA5	C3S_312b
Atmosphere (upper air)					
Temperature	4.5.1		2017	ERA5	
Wind speed and direction	4.5.2	Stage III	2017	ERA5	
Water vapour	4.5.3		2017	ERA5	C3S_312b
Cloud properties	4.5.4	Stage III	2017	ERA5	C3S_312b
Earth radiation budget	4.5.5	Stage III	2017	ERA5	C3S_312b
Atmosphere (composition)					
Carbon dioxide	4.7.1	Stage III	2017		C3S_312a
Methane	4.7.2	Stage III	2017		C3S_312a
Other long-lived greenhouse gases	4.7.3	Stage III	2018		C3S_312b
Ozone	4.7.4	Stage III	2017	ERA5	C3S_312a
Aerosol	4.7.5	Stage III	2017		C3S_312a

-  Action engaged
-  In preparation (PIN or ITT out)

Not yet included:

- Existing ECV products (e.g. NOAA CDRs, CM-SAF products, GPCP, ...)
- Regional reanalysis products



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Oceanic ECVs

	GCOS Status Report	C3S Technical Annex	CDS	Reanalysis	Observations
Ocean (physics)					
Sea surface temperature	5.3.1	Stage III	2017	ORA5	C3S_312a
Subsurface temperature	5.4.1	Stage III	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 III	2017	ORA5	C3S_312a
Sea state	5.3.4		2018	ERA5	
Sea ice	5.3.5	Stage III	2017	ORA5	C3S_312a
Ocean surface stress	NEW		2018	ORA5	
Ocean surface heat flux	NEW		2018	ORA5	
Ocean (biochemistry)					
Inorganic carbon	NEW		2018		C3S_312b
Ocean colour	5.3.7	Stage III	2018		C3S_312b



Action engaged



In preparation
(PIN or ITT out)



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Terrestrial ECVs

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



Action engaged



In preparation
(PIN or ITT out)



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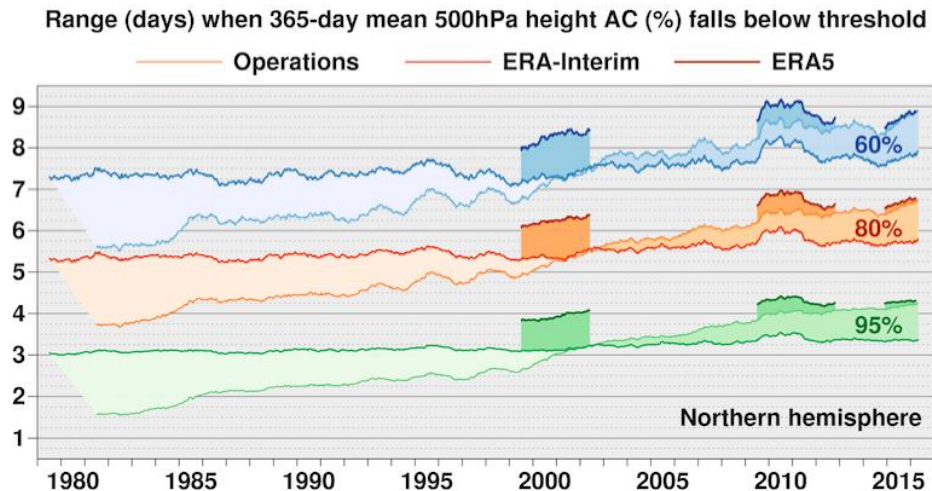
Climate Data Store: Reanalyses

ERA5 global reanalysis:

- Atmosphere/land/wave parameters
- 31 km global resolution, 137 levels
- Hourly output from 1979 onward
- Based on IFS Cy41r2 (March 2016)
- Using improved input observations
- Ensemble data assimilation
- Providing uncertainty estimates

Regional reanalysis:

- European + Arctic domains
- Higher spatial resolution
- Workshop organised 2016 Q2
- Competitive call issued 2016 Q4, bids under evaluation





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ERA5: Data release schedule

ERA5 release plan:

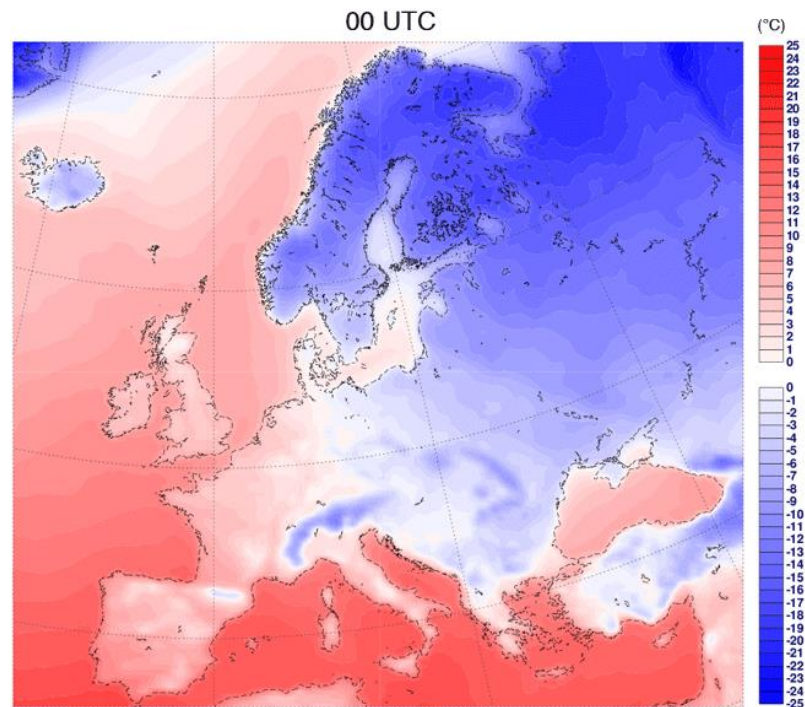
Nov 2016 **Test data (Jan-Feb 2016)**

June 2017 **Hourly data from 2010 - 2016**

July 2017 **Daily updates at short delay**

Apr 2018 **Complete from 1979 onward**

Reanalysis is now an operational
service provided by ECMWF



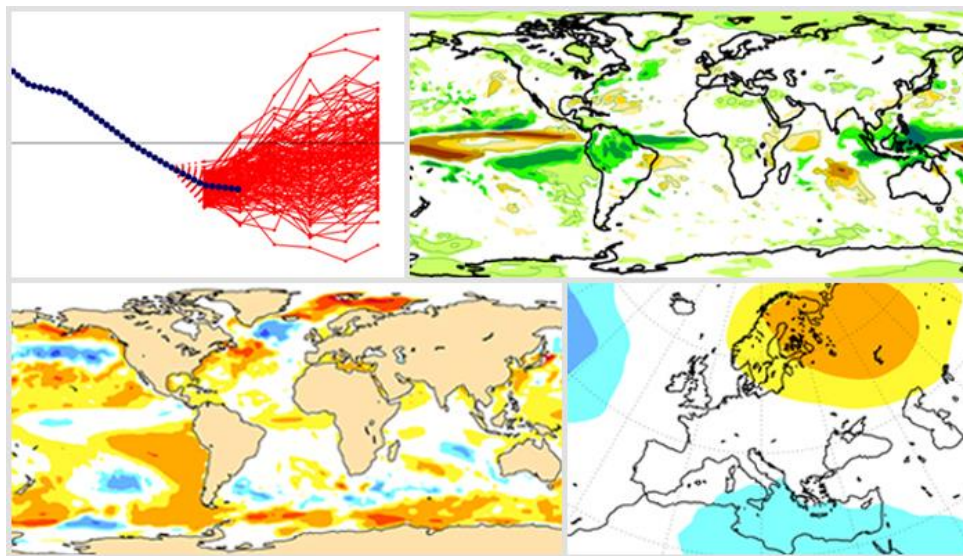
ERA5 hourly temperatures for January 2016



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Seasonal forecasts - first release 12/2016

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



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



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Seasonal forecasts - content

Variables:

- sea-level pressure
- geopotential height
- precipitation
- air temperature

Type of plots:

- maps:
 - global
 - pre-defined regions
- time series

Publication schedule:

- monthly updates
- published on each 15th

The screenshot shows the Copernicus Climate Change Service website. At the top, there are logos for Copernicus (Europe's eyes on Earth) and the Climate Change Service. A search bar and social media icons are also present. A navigation menu includes links for Home, About C3S, News & Media, Events, Tenders, Products, Services, and User Support. The main content area is titled "C3S seasonal charts" and displays 28 matching items. A filters sidebar on the left allows users to refine results by parameters (MSLP, SST, T2m, T850, geopotential height, precipitation) and plot types (Maps, Time series). The main grid shows various forecast charts, including maps and time series plots for different variables and systems (C3S multi-system, ECMWF, Met Office, Meteo-France).

Copernicus
Europe's eyes on Earth

Climate Change Service

Contact us

Search

Search

Home ABOUT C3S NEWS & MEDIA EVENTS TENDERS PRODUCTS SERVICES USER SUPPORT

C3S seasonal charts

28 matching items
No filters applied

Filters

Show All

Parameters

- MSLP (4)
- SST (8)
- T2m (4)
- T850 (4)
- geopotential height 500hPa (4)
- precipitation (4)

Plot type

- Maps (24)
- Time series (4)

Centres

- C3S multi-system (7)
- ECMWF (7)
- Met Office (7)
- Meteo-France (7)

C3S multi-system MSLP

C3S multi-system NINO plumes

C3S multi-system SST

C3S multi-system T2m

C3S multi-system T850

C3S multi-system geopotential

C3S multi-system precipitation

ECMWF MSLP

ECMWF NINO plumes

ECMWF SST

ECMWF T2m

ECMWF T850

ECMWF geopotential

ECMWF precipitation

Met Office MSLP

Met Office NINO plumes

Met Office SST

Met Office T2m

Met Office T850

Met Office geopotential

Met Office precipitation

Meteo-France MSLP

Meteo-France NINO plumes

Meteo-France SST

Meteo-France T2m



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Climate Data Store

Infrastructure and toolbox



CDS infrastructure (Telespazio UK):
alpha version Jan 2017, beta version
summer 2017

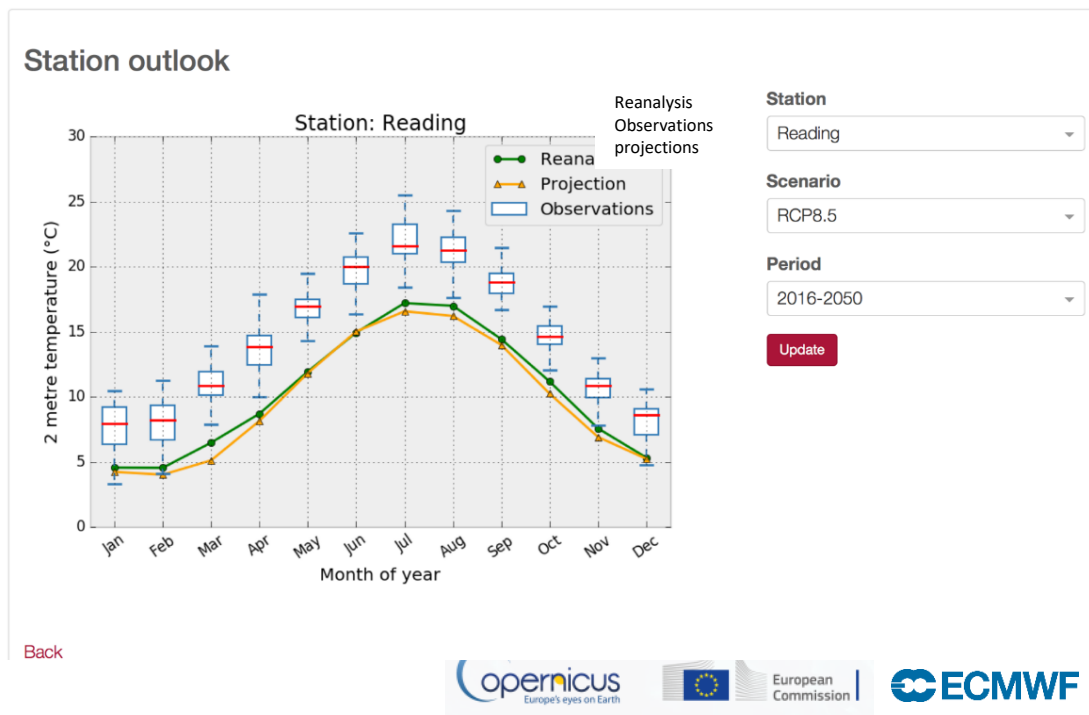
CDS toolbox (B-open, IT): incremental
until 2019

Technical challenges:

- Diversity of users
- Diversity of data sets
- Very large data volumes
- Data residing at different locations
- Interoperability, efficiency
- User-defined workflows
- Variety of presentation methods
- Need for interactivity
- Access via API
- User management
- Performance monitoring



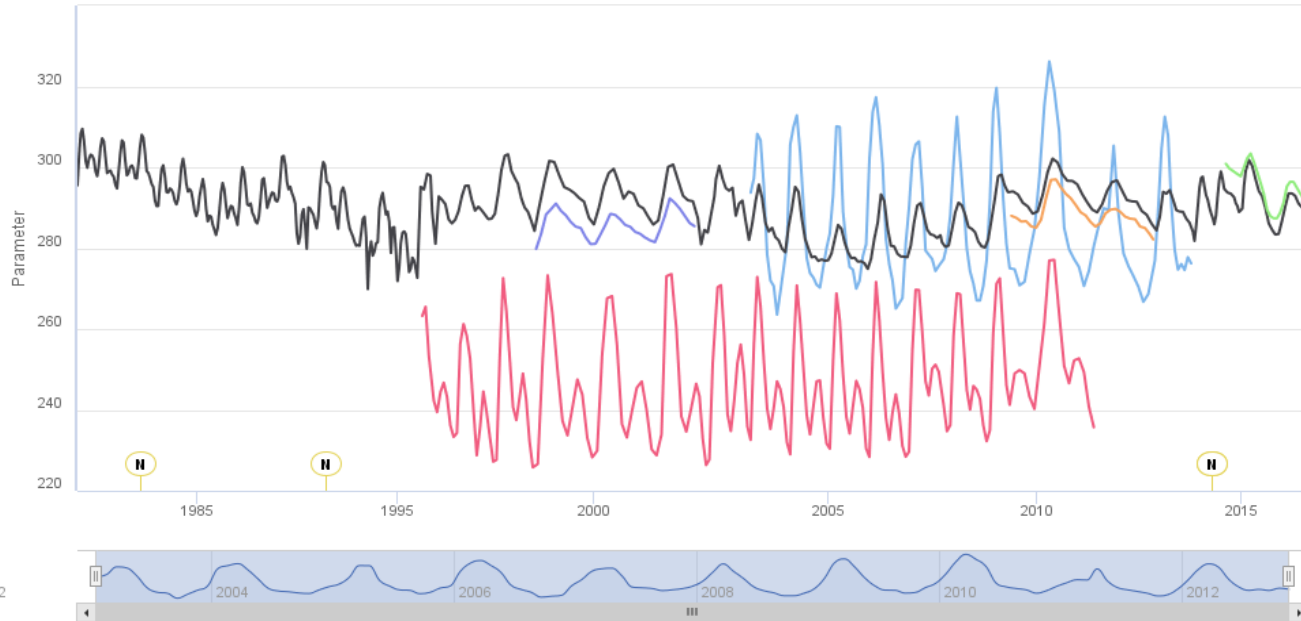
CDS Toolbox demo.





Global Total Column Ozone

Zoom 1m 3m 6m YTD 1y **All**



MACC (CAMS) reanalysis

ERA-interim

ERA5 (stream I)

(stream II)

(stream III)

ESA-CCI

Volcanic eruptions



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S e c t o r a l I n f o r m a t i o n S y s t e m



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Sectoral Information System

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:



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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Evaluation and Quality Control



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EQC: Engaged and future activities



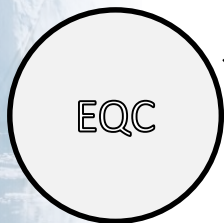
Action engaged



In preparation (PIN or ITT out)



Not started



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



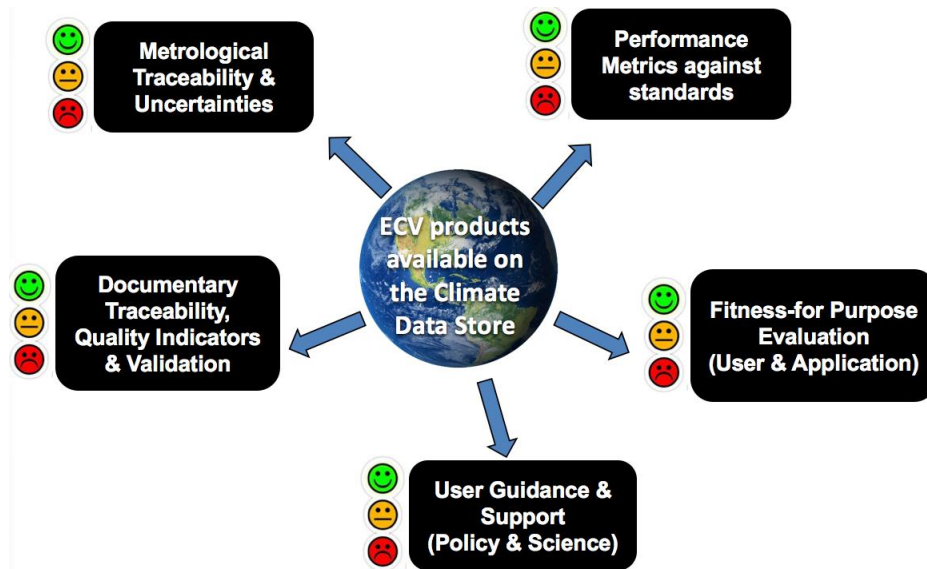


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Quality assurance framework for earth observations

C3S_511: Quality assessments of ECV products

- Single-product assessments
- Multi-products assessments
- Thematic product assessments





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Outreach & Communication



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Events

Event	Date	Location	C3S contribution
SIS workshop	17-19 October 2016	Hampshire, UK	Presentations, workshops
Open Data Institute Summit 2016	1 November	London, UK	Expo stand, branding, sponsoring
GEOXII	9-11 November	St. Petersburg, Russia	Expo stand, posters, video,
COP22	7-18 November	Marrakesh, Morocco	Poster session, panel discussion
Conference for Young Scientists “Meteorology, Hydrology and Environment Monitoring”	16-17 November	Kiew, Ukraina	Brochure article, branding, sponsoring, promotional material
Wissenswertes	28-30 November	Bremen, Germany	Expo stand promotional talks, branding, sponsoring, promotional material
C3S European Climatic Energy Mixes webinar	14 December	Online	Presentations + Q&A
C3S General Assembly	6-10 March 2017	Toulouse, France	Presentations, workshops
EQC workshop	12-14 June 2017	Barcelona, Spain	Presentations, workshops
Attribution workshop	October 2017	Prague (TBC)	Presentations, workshops
5th International Reanalysis Conference (with WCRP)	13-17 November 2017	Rome, Italy	Presentations, workshops



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Media activity

COP22: Copernicus 'Europe's eyes on earth' observes a year of extremes

Temperatures, wildfires and CO2 acceleration monitored throughout 2016

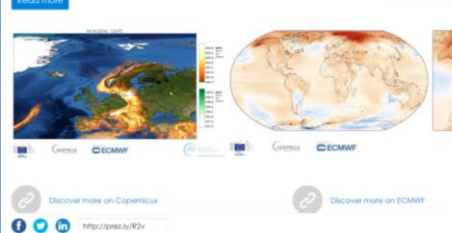
Monday, November 14, 2016 —

- January to October 2016 the warmest period on record
- Wildfires linked to high temperatures and dry conditions
- CO2 concentrations pass and remain above 400 ppm

On 4 November 2016, the Paris Agreement on climate change entered into force, but despite this historic achievement the heat is still on to keep the size in global temperature below 2°C.

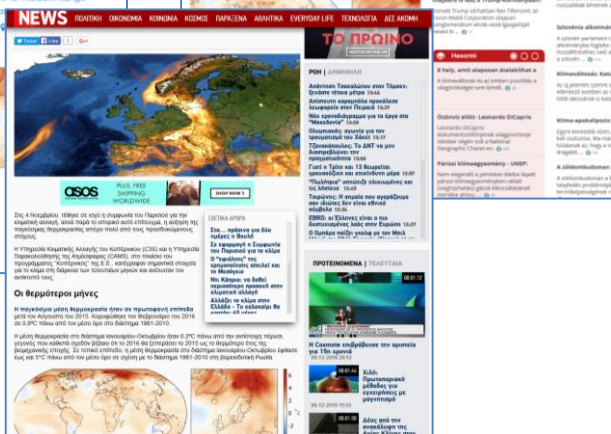
The Copernicus Climate Change Service (C3S) and Atmosphere Monitoring service (CMS), part of the EU's Copernicus earth observation programme, recorded, re-analysed and released significant climatic information throughout 2016, noting the effect and impact of a still changing climate.

Read more



Audrey Lebas
Junior Media Relations Officer
ICF Maetra

Silke Zollinger
Copernicus Communication Press and
Events Manager
European Centre for Medium-Range
Weather Forecasts



COP22: Temperatures, wildfires and CO2 – Copernicus 'Europe's eyes on earth' observes a year of extremes



Mon, 14/11/2016 - 03:19
The Copernicus Climate Change Service (C3S) and Atmosphere Monitoring service (CMS), part of the EU's Copernicus earth observation programme, recorded, re-analysed and released significant climatic information throughout 2016, noting the effect and impact of a still changing climate.

Read more

New milestone in climate change monitoring: ECMWF unveils ERAS preview



Wed, 02/11/2016 - 20:37
One year after the Paris Agreement, the European Centre for Medium-Range Weather Forecasts (ECMWF) launches its most powerful global climate monitoring tool to date, ERAS.

Read more

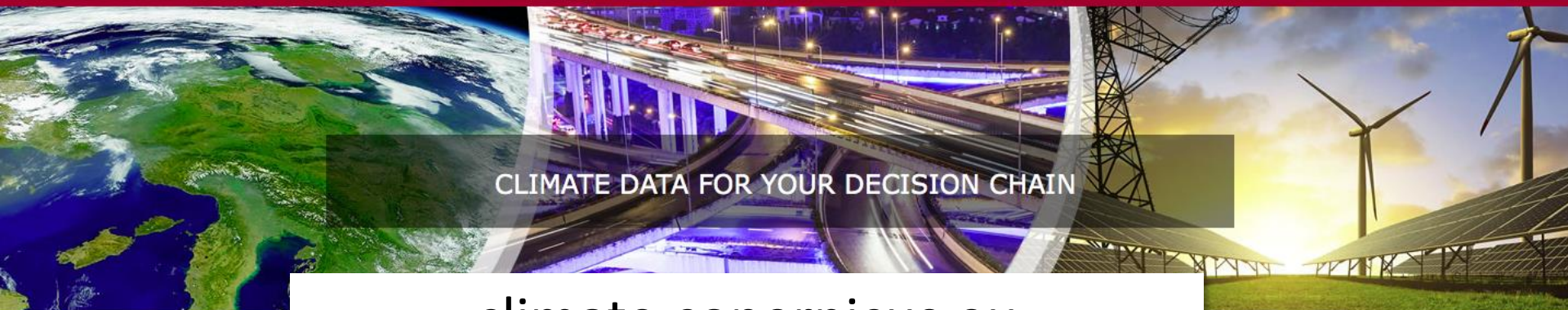
What's in store? Copernicus Climate Change Service meets industry partners to present interim results on climate change data accessibility



Thu, 13/10/2016 - 12:38
The European Union's Copernicus Climate Change Service (C3S) convenes the first meeting of its Sectoral Information System (SIS) network of partners on 17-19 October, officially sharing the progress to date of seven groundbreaking projects to provide enhanced free climate change data and information.

Read more

We continue to promote C3S activity to the media – sectoral and mainstream - where appropriate to do so. We have recently experimented with multi-media releases via our Press & PR agency to make information easier for the media to consume. <https://ecmwf.prezly.com/cop22-copernicus-europes-eyes-on-earth-observes-a-year-of-extremes#>



CLIMATE DATA FOR YOUR DECISION CHAIN

climate.copernicus.eu

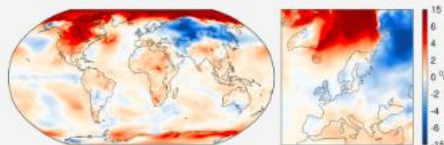
IN FOCUS



#OpenDataHack @ECMWF - explore creative uses of open data

13 Dec 2016

MONTHLY MAPS



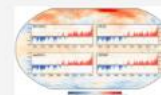
Average surface air temperatures for November 2016

November 2016

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