



Climate Change

Recent activities of the Copernicus Climate Change Service (C3S) and plans for the next phase

Carlo Buontempo





Climate Change

Was 2019 the warmest year on record?

ESOTC 2019 | CLIMATE IN 2019 | GENERAL

European temperature

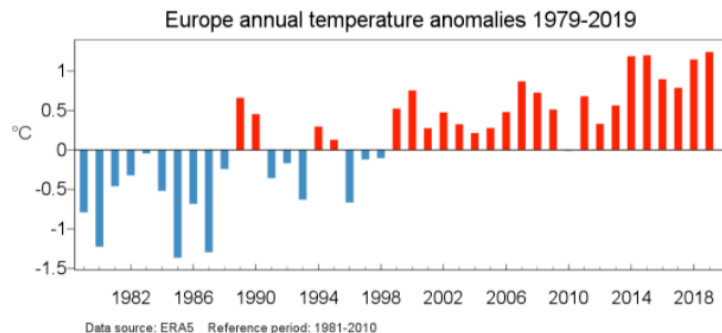
2019 IN CONTEXT | ANNUAL TEMPERATURE | SEASONAL TEMPERATURES | MAXIMUM AND MINIMUM TEMPERATURES



KEY MESSAGES

- 2019 was the warmest year on record, very closely followed by 2014, 2015 and 2018.
- 11 of the 12 warmest years in Europe have occurred since 2000.
- The whole of Europe was warmer than average, except for a few small areas.
- The largest annual temperature anomalies were in central and eastern Europe.
- All seasons were warmer than average, with summer being the fourth warmest since at least 1979.
- Annual mean minimum and maximum daily temperatures were warmer than average almost everywhere in Europe, with maximum temperatures generally showing larger anomalies than minimum temperatures.

2019 in context



European surface air temperature anomaly for annual averages from 1979 to 2019, relative to the annual average for the 1981-2010 reference period. Data source: ERA5 Credit: Copernicus Climate Change Service (C3S)/ECMWF/KNMI.

published annually in April since 2018



08:40 → 09:00
Freja Vamborg

➤ climate.copernicus.eu/ESOTC

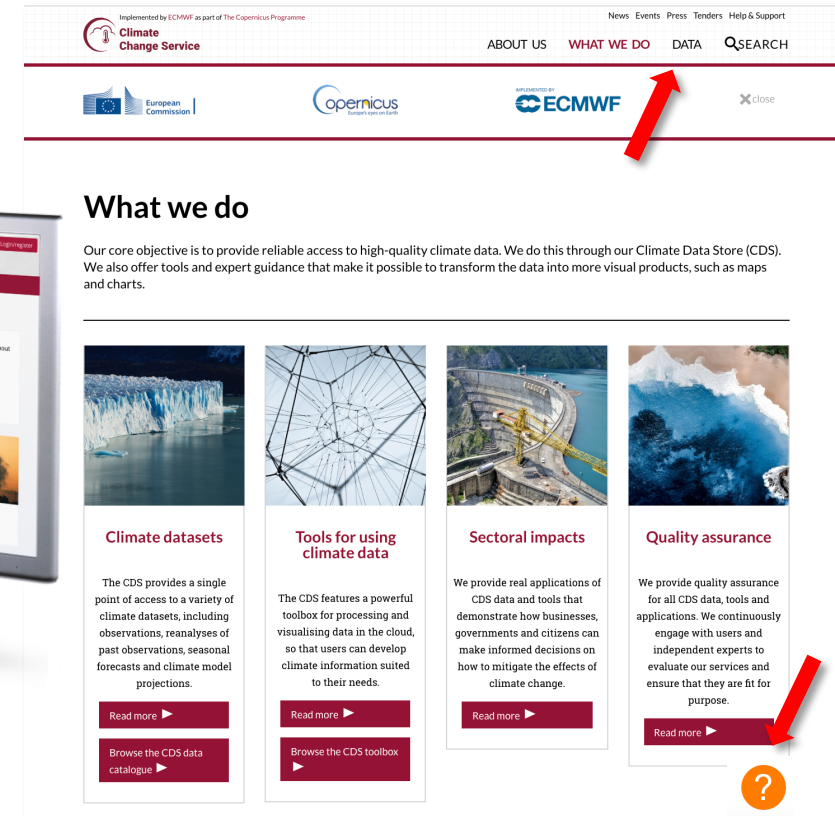
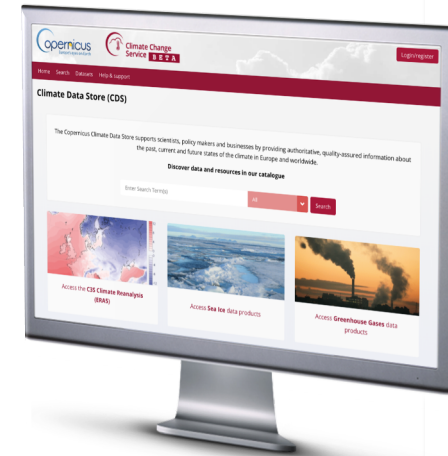




Climate Change

C3S offering

- Open and free access to climate data and information
- Toolbox
- Information on sectoral impacts
- Quality assurance
- Training and educational material
- Climate bulletins

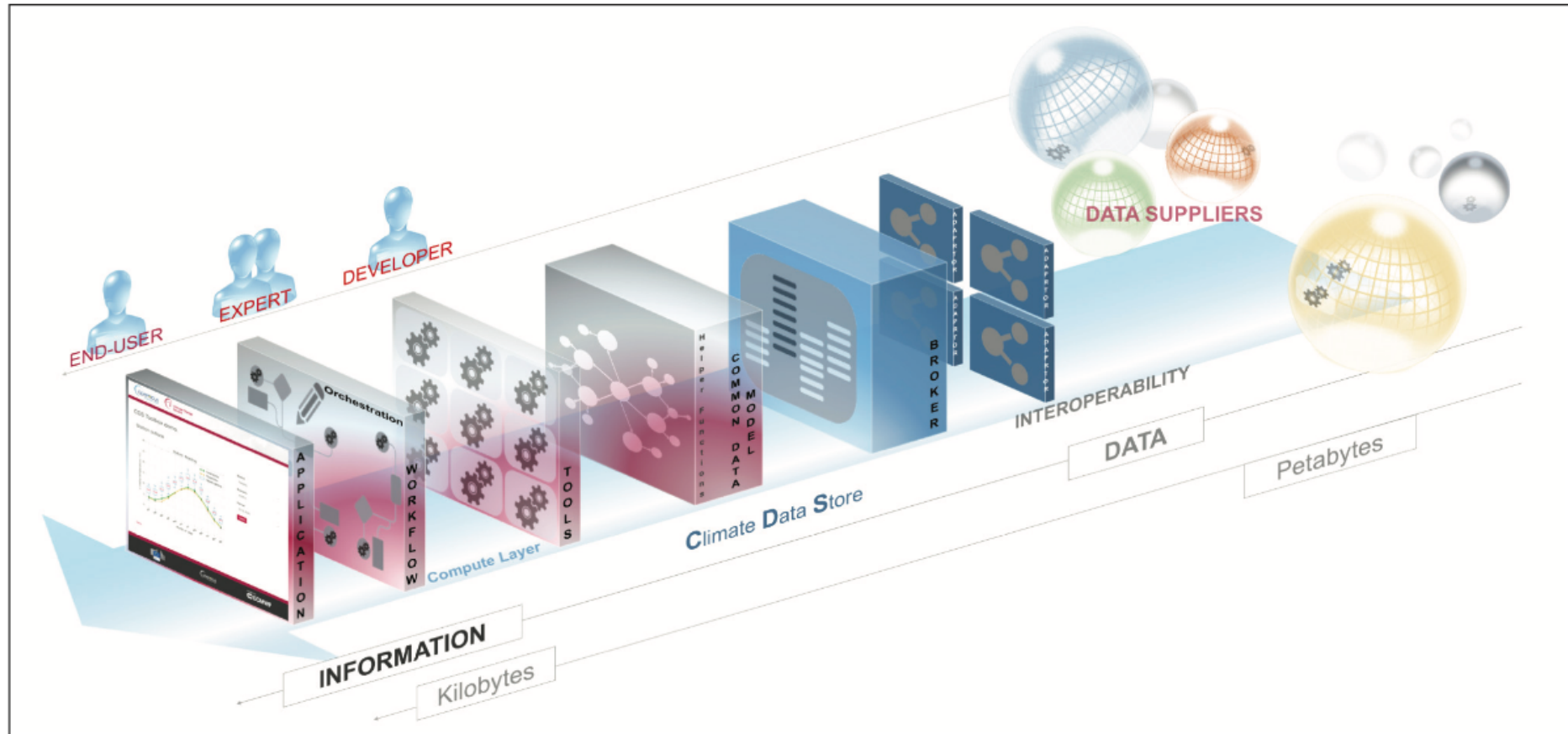


One-stop Climate Data Store

<http://climate.copernicus.eu>



Bringing the users to the data

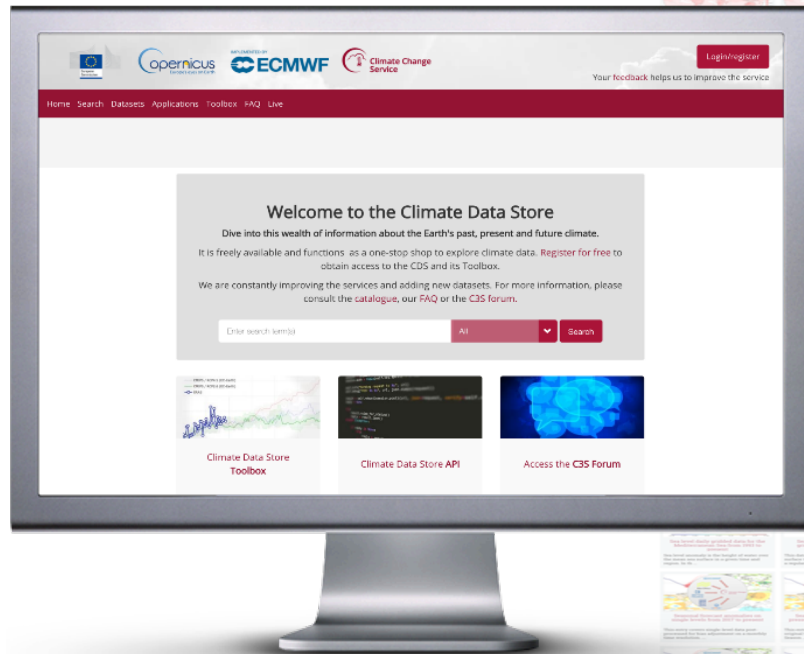


As part of Copernicus, ECMWF is developing the “Climate Data Store”, which is a Cloud-based service (SaaS) allowing solution to work directly on a number of (massive) datasets, stored at ECMWF and in a few other places in Europe (such as CMIP climate projections). <http://cds.climate.copernicus.eu>



Climate
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The Climate Data Store



- Registered users: **~ 45 000**
(it was **35 400** at the end of Feb)
- TB/day: **~50** (30-60)
- Datasets: **65**

Status at end of May 2020



Climate Change

Simplicity and coherence

Access the data: reanalyses

Home Search Datasets Applications Your requests Toolbox Help & support

Search results

Search dataset

All **Datasets**

Showing 1-2 of 2 results for **Reanalysis** x

Sort by

Relevancy

Title

Product type

- Climate projections (4)
- Reanalysis (2)
- Satellite observations (11)
- Seasonal forecasts (6)
- Sectoral climate indices (2)

Spatial coverage

- Global (2)

Temporal coverage

- Past (2)

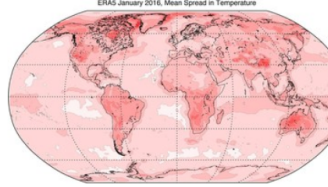
ERA5 hourly data on pressure levels from 2000 to present

Overview **Download data** Documentation

ERA5 is the fifth generation ECMWF atmospheric reanalysis of the global climate. Reanalysis combines model data with observations from across the world into a globally complete and consistent dataset using the laws of physics. This principle, called data assimilation, is based on the method used by numerical weather prediction centres, where every so many hours (12 hours at ECMWF) a previous forecast is combined with newly available observations in an optimal way to produce a new best estimate of the state of the atmosphere, from which an updated, improved forecast is issued. Reanalysis works in the same way, but at reduced resolution to allow for the provision of a dataset spanning back several decades. Reanalysis does not have the constraint of issuing timely forecasts, so it is more time to collect observations, and when going further back in time, to allow for the ingestion of improved versions of the original observations, which all benefit the quality of the reanalysis product.

The assimilation system is able to estimate biases between observations and to sift good-quality data from poor quality data. The laws of physics allow for estimates at locations where data coverage is low, such as for surface temperature in the Arctic. The provision of estimates at each grid point around the globe for each regular output time, over a long period always using the same format, makes reanalysis a very convenient and popular dataset to work with.

The observing system has changed drastically over time, and although the assimilation system can resolve data from the initially much sparser networks will lead to less accurate estimates. For this reason, ERA5 includes an uncertainty



- ERA5 hourly data on pressure levels from 2000 to present**
ERA5 is the fifth generation ECMWF atmospheric reanalysis of the global climate. Reanalysis combines model data with observations from across the world into a globally complete and consistent dataset...
- ERA5 hourly data on single levels from 2000 to present**
ERA5 is the fifth generation ECMWF atmospheric reanalysis of the global climate. Reanalysis combines model data with observations from across the world into a globally complete and consistent dataset...

EQC tab (from Q2 2020)

ERA5 hourly data on pressure levels from 2000 to present

Overview **Download data** Documentation

Variable

At least one selection must be made

<input type="checkbox"/> Divergence	<input type="checkbox"/> Fraction of cloud cover	<input type="checkbox"/> Geopotential
<input type="checkbox"/> Ozone mass mixing ratio	<input type="checkbox"/> Potential vorticity	<input type="checkbox"/> Relative humidity
<input type="checkbox"/> Specific cloud ice water content	<input type="checkbox"/> Specific cloud liquid water content	<input type="checkbox"/> Specific humidity
<input type="checkbox"/> Specific snow water content	<input type="checkbox"/> Temperature	<input type="checkbox"/> Specific rain water content
<input type="checkbox"/> V-component of wind	<input type="checkbox"/> Vertical velocity	<input type="checkbox"/> U-component of wind
		<input type="checkbox"/> Vorticity (relative)

Pressure level

At least one selection must be made

<input type="checkbox"/> 1 hPa	<input type="checkbox"/> 2 hPa	<input type="checkbox"/> 3 hPa
<input type="checkbox"/> 5 hPa	<input type="checkbox"/> 7 hPa	<input type="checkbox"/> 10 hPa
<input type="checkbox"/> 20 hPa	<input type="checkbox"/> 30 hPa	<input type="checkbox"/> 50 hPa
<input type="checkbox"/> 70 hPa	<input type="checkbox"/> 100 hPa	<input type="checkbox"/> 125 hPa
<input type="checkbox"/> 150 hPa	<input type="checkbox"/> 175 hPa	<input type="checkbox"/> 200 hPa
<input type="checkbox"/> 225 hPa	<input type="checkbox"/> 250 hPa	<input type="checkbox"/> 300 hPa
<input type="checkbox"/> 350 hPa	<input type="checkbox"/> 400 hPa	<input type="checkbox"/> 450 hPa
<input type="checkbox"/> 500 hPa	<input type="checkbox"/> 550 hPa	<input type="checkbox"/> 600 hPa
<input type="checkbox"/> 650 hPa	<input type="checkbox"/> 700 hPa	<input type="checkbox"/> 750 hPa
<input type="checkbox"/> 775 hPa	<input type="checkbox"/> 800 hPa	<input type="checkbox"/> 825 hPa
<input type="checkbox"/> 850 hPa	<input type="checkbox"/> 875 hPa	<input type="checkbox"/> 900 hPa
<input type="checkbox"/> 925 hPa	<input type="checkbox"/> 950 hPa	<input type="checkbox"/> 975 hPa
<input type="checkbox"/> 1000 hPa		

Product type

<input checked="" type="checkbox"/> Reanalysis	<input type="checkbox"/> Ensemble members	<input type="checkbox"/> Ensemble mean
<input type="checkbox"/> Ensemble spread		

Year

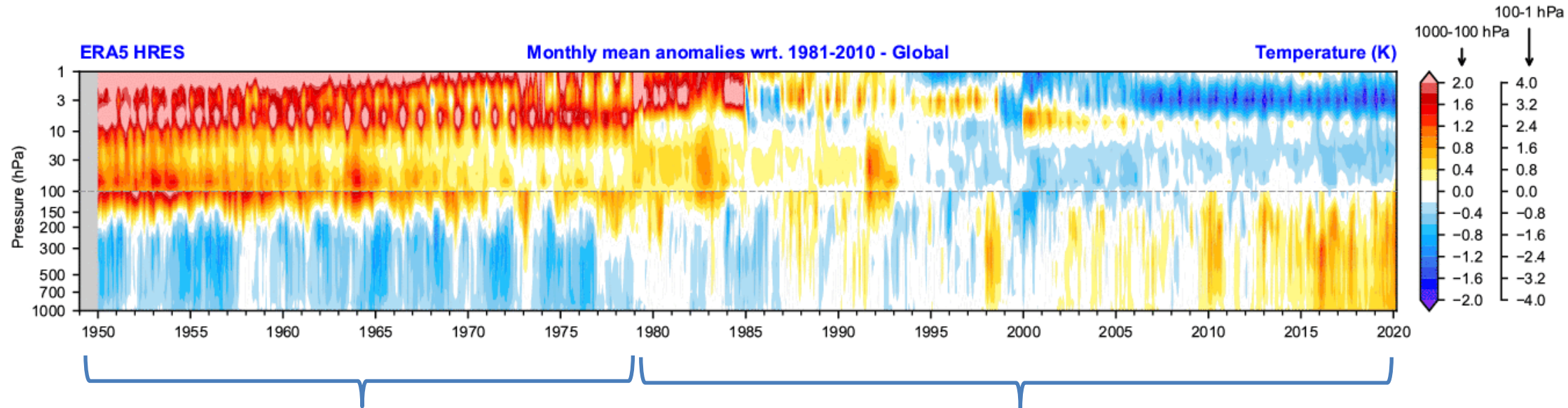
At least one selection must be made

<input type="checkbox"/> 2000	<input type="checkbox"/> 2001	<input type="checkbox"/> 2002
<input type="checkbox"/> 2003	<input type="checkbox"/> 2004	<input type="checkbox"/> 2005
<input type="checkbox"/> 2006	<input type="checkbox"/> 2007	<input type="checkbox"/> 2008



Climate Change

ERA5 Production Status



1950 – 1979

Complete (5th March 2020)

1979 – present

Complete. NRT stream runs RT – 1 day

- Run in discrete streams. *e.g.* 4 for 1950 – 1979
- 1940 - 1950 extension (to run 2020/21) planned
- Good representation of continuous change in:
 - Tropospheric temperatures (global warming) ; and
 - Mid-lower stratospheric temperatures (cooling)
- Representation of upper stratosphere (above 10 hPa) more challenging, *esp.* before 2006

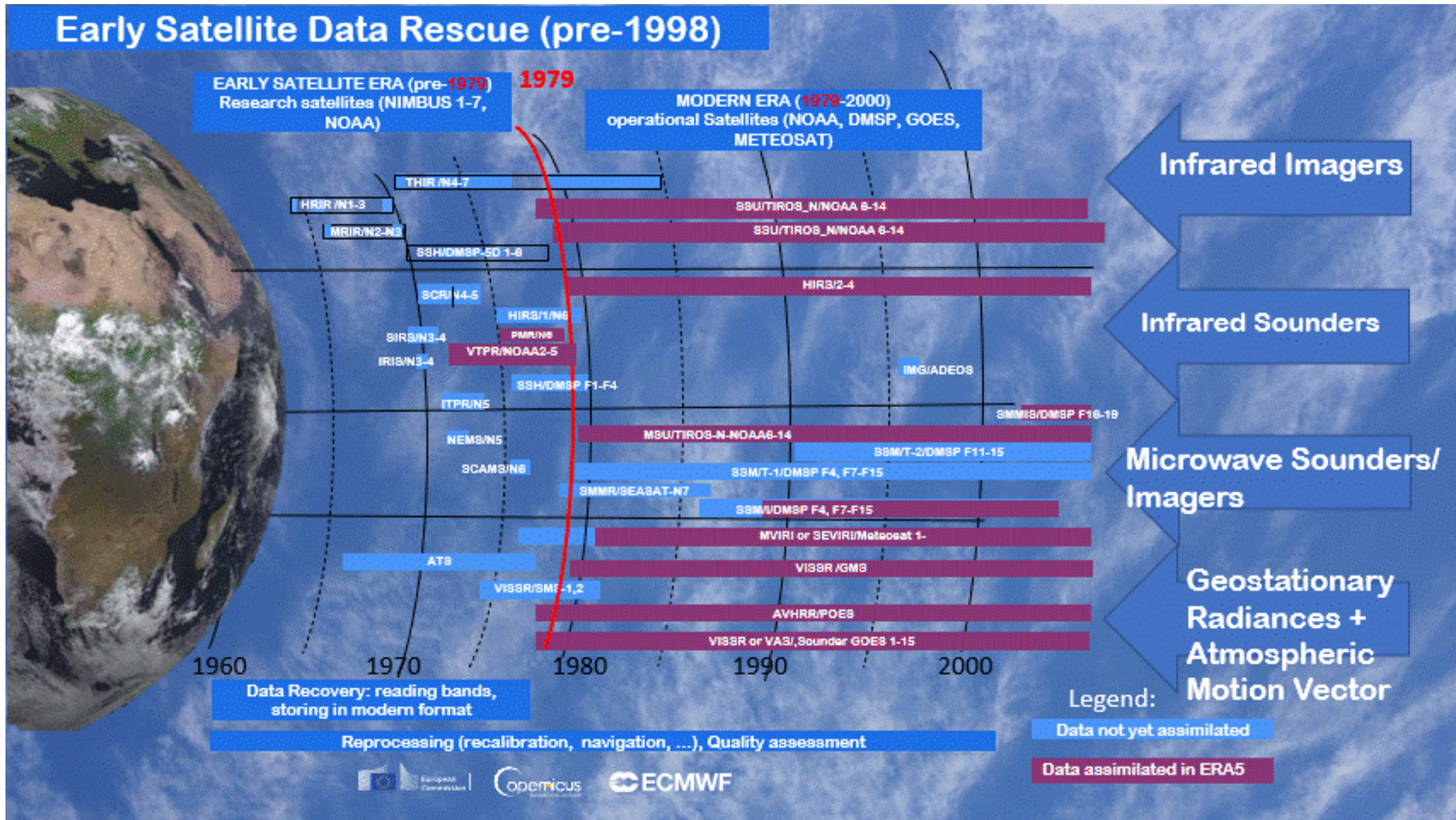


10:40-10:50
Joaquin
Munoz-Sabater



Climate Change

Satellite Reprocessing and Data Rescue





Climate Change

Climate variables in C3S

(satellite ECVs)

Atmospheric physics

- Precipitation
- Surface radiation budget
- Water vapour
- Cloud properties
- Earth radiation budget

Coordination with CM-SAF / ROM SAF / ESA CCI / Uni. Maryland / NASA / NOAA



Atmospheric composition

- Carbon dioxide
- Methane
- Ozone
- Aerosol

Coordination with ESA-CCI and other national projects



Ocean

- Sea surface temperature
- Sea level
- Sea ice
- Ocean colour

Coordination with ESA-CCI / OSI-SAF



Land hydrology & cryosphere

- Lakes
- Glaciers
- Ice sheets & ice shelves
- Soil moisture

Coordination with ESA-CCI, GloboLakes, Arc-Lake, HydroWeb



Land biosphere

- Albedo
- Land cover
- Fraction of absorbed photosynthetic
- Leaf area index
- Fire

Coordination with ESA-CCI, CGL, QA4ECV, LSA-SAF





Climate
Change

C3S seasonal prediction component

Multi-system seasonal forecast service



Operational service: 6-month forecasts issued every month on the 13th

- Graphical products through C3S webpage

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

- Data service through CDS

<https://cds.climate.copernicus.eu/cdsapp#!/search?type=dataset>

Non-European providers:

NCEP - joined the service in November 2019;

ECCC and JMA - planned for 2020;

BoM - expression of interest for 2021.

European contributions to C3S:

- provision of forecasts, allowing users from around the world the benefit of state-of-the art data and information;

C3S support to member-state activities:

- generation of graphical and digital (data) products;
- support to member-state development and operational activities in seasonal forecasting;
- access to data from other providers and associated user support.



Climate Change

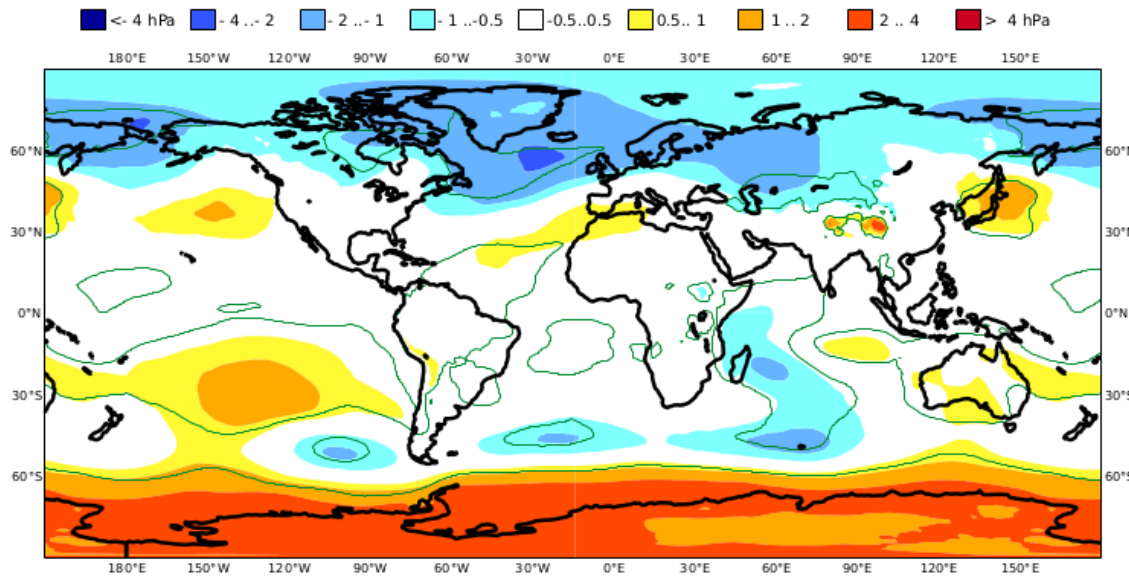
Skill of the multi-system seasonal predictions

C3S prediction

C3S: ECMWF contribution
Mean MSLP anomaly
Nominal forecast start: 01/11/19
Ensemble size = 51, climate size = 600

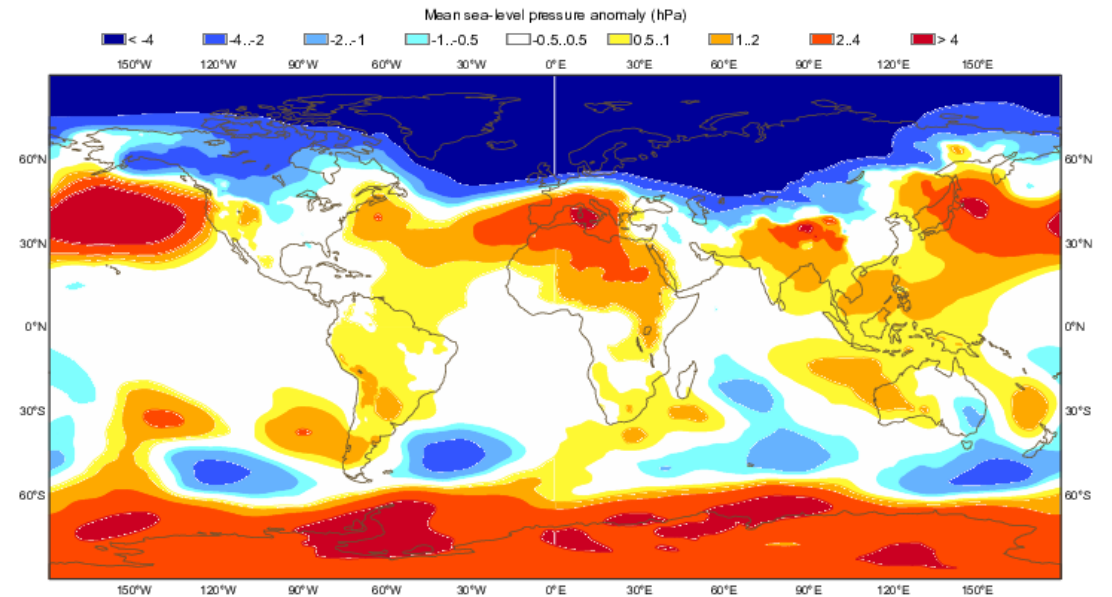
DJF 2019/20

Solid contour at 1% significance level



'Observation'

ERA5 anomaly (Reference period: 1993-2016)
DJF 2019/2020





Climate Change

Enhanced Toolbox performances



cedric.bergeron

Logout

Your feedback helps us to improve the service

Home Search Datasets Applications Your requests Toolbox FAQ Live

Near surface meteorological variables from 1979 to 2018 derived from bias-corrected reanalysis

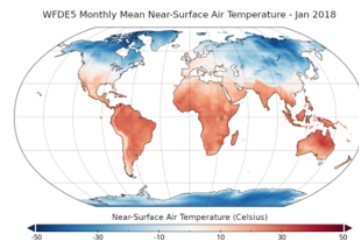
Overview Download data Documentation

This dataset provides bias-corrected reconstruction of near-surface meteorological variables derived from the fifth generation of the European Centre for Medium-Range Weather Forecasts (ECMWF) atmospheric reanalyses (ERA5). It is intended to be used as a meteorological forcing dataset for land surface and hydrological models.

The dataset has been obtained using the same methodology used to derive the widely used water, energy and climate change (WATCH) forcing data, and is thus also referred to as WATCH Forcing Data methodology applied to ERA5 (WFDE5). The data are derived from the ERA5 reanalysis product that have been re-gridded to a half-degree resolution. Data have been adjusted using an elevation correction and monthly-scale bias corrections based on Climatic Research Unit (CRU) data (for temperature, diurnal temperature range, cloud-cover, wet days number and precipitation fields) and Global Precipitation Climatology Centre (GPCC) data (for precipitation fields only). Additional corrections are included for varying atmospheric aerosol-loading and separate precipitation gauge observations. For full details please refer to the product user-guide.

This dataset was produced on behalf of Copernicus Climate Change Service (C3S) and was generated entirely within the Climate Data Store (CDS) Toolbox. The toolbox source code is provided in the documentation tab.

More details about the products are given in the Documentation section.



Contact

copernicus-support@ecmwf.int

Licence

[Licence to Use Copernicus Products](#)

Publication date

2020-02-01

References

DOI: [10.24381/cds.20d54e34](https://doi.org/10.24381/cds.20d54e34)

DATA DESCRIPTION	
Data type	Grid
Horizontal coverage	Global land
Horizontal resolution	0.5° x 0.5°
Vertical coverage	Surface
Vertical resolution	Single level
Temporal coverage	From 1979 to 2018
Temporal resolution	Hourly
File format	NetCDF 4
Conventions	Climate and Forecast (CF) Metadata Convention v1.7
Update frequency	No updates expected

MAIN VARIABLES		
Name	Units	Description
Grid-point altitude	m	The altitude of each grid-point. Values correspond to altitudes of CRU grid-points.
Near-surface air	K	The temperature of air at 2 metres above the surface of land, sea or inland waters. Values are derived from ERA5 2m air temperature with an elevation

**Dataset produced by the CDS
Toolbox**

Near surface meteorological variables from 1979 to 2018 derived from bias-corrected reanalysis





Climate Change

Enhanced CDS Toolbox documentation

An easier and teaching Toolbox documentation



9:30-10:00
Edward Comyn-Platt

Climate Change Service
Beta version

Search CDS Toolbox documentation

Home

- Tutorials
- How-to guides

Application gallery

- Anomaly plot
 - Calculate time mean and standard deviation
 - Calculate climatologies
- Dynamic map
 - Dynamic map geometries
 - Plot map
- Calculate trends
 - Extract a time series and plot graph
- Calculate Growing Degree Days (GDD) index
 - Use CDO functions
- Double axis
 - Magics default
 - Magics title
 - Magics contour name
 - Magics contour interval
 - Magics contour list
 - Magics contour palette
- Learning bundles
- Glossary
- API

CDS Toolbox documentation » Application gallery

Application gallery

Surface air temperature anomalies relative to 1981-2010

Calculate Time Mean and Standard Deviation

Calculate climatologies

Dynamic map

Climate Change Service
Beta version

Search CDS Toolbox documentation

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- Tutorials
 - Tutorial 1 - Getting started with the CDS Toolbox
 - Tutorial 2 - Set up a CDS Toolbox application
 - Tutorial 3 - Create a climate graph application
 - Tutorial 4 - Create an input user interface
 - Tutorial 5 - Develop an application based on the example of a climate indicator
- How-to guides
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- Glossary
- API

CDS Toolbox documentation » Tutorials

Tutorials

Tutorial 1 - Getting started with the CDS Toolbox

This introductory tutorial gives an overview of the CDS Toolbox for new users. It provides a comprehensive overview of the Toolbox Editor and the application development process, including running simulations.

#Keywords: Tutorial, Getting started, Overview, User interface, Application development, Simulation, Running

Tutorial 2 - Set up a CDS Toolbox application

This tutorial shows how to set up a CDS Toolbox application, including defining the application's metadata and creating the application's user interface.

#Keywords: Tutorial, Application setup, User interface, Metadata, Application development

Tutorial 3 - Create a climate graph application

This tutorial shows how to create a climate graph application, including defining the data sources and the graph's layout.

#Keywords: Tutorial, Climate graph, Data sources, Graph layout, Application development

Climate Change Service
Beta version

Search CDS Toolbox documentation

Home

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- API

CDS Toolbox documentation » How-to guides

How-to guides

Toolbox user interface

- Changing the layout of the Toolbox Editor
- Reading and interpreting documentation descriptions
- Sharing an application
- Tagging revisions and restoring an old version of your code

Retrieve data

- Retrieving data
- Retrieving time series and extracting point information
- Using output widgets

Process data

- Using mathematical operations and unit conversion (to be published)
- Calculating climatologies and anomalies (to be published)
- Resampling and aggregate data (to be published)
- About the common data model (to be published)
- Selecting and filtering data (to be published)

Magics contour plot

Plot data

<https://cds.climate.copernicus.eu/toolbox/doc/index.html>



Climate
Change

Evaluation and Quality Control (EQC)

- Three coordinated EQC contracts for CDS and SIS (>100 person-years of effort)
- EQC function now operational; initially for datasets; tools and applications follow in autumn
- Dashboard to monitor service performance via KPIs in place; rating widgets implemented
- User Requirements Database operational; currently ~ 3,000 user requirements
- First User Requirement Analysis Documents delivered to inform service evolution





EQC function is becoming operational

Overview Download data **Quality assessment** Documentation

This is a new feature, work in progress. Should ar

The CDS datasets are independently assessed by th assure technical and scientific quality harmonized dataset is scrutinized and data are checked for usa

Variable:
Sea ice concentration ✕

Variable: [Sea ice concentration](#) Latest updated on 27/05/2020

INTRODUCTION	USER DOCUMENTATION	ACCESS	INDEPENDENT ASSESSMENT
Dataset overview	User guide	Toolbox compatibility	Data check
Temporal and spatial coverage and resolution	Scientific methodology	Archive	Expert evaluation
Providers	Uncertainty quantification		Dataset maturity
Dataset version	Validation		Summary of independent assessment
Data update	Inter-comparison		

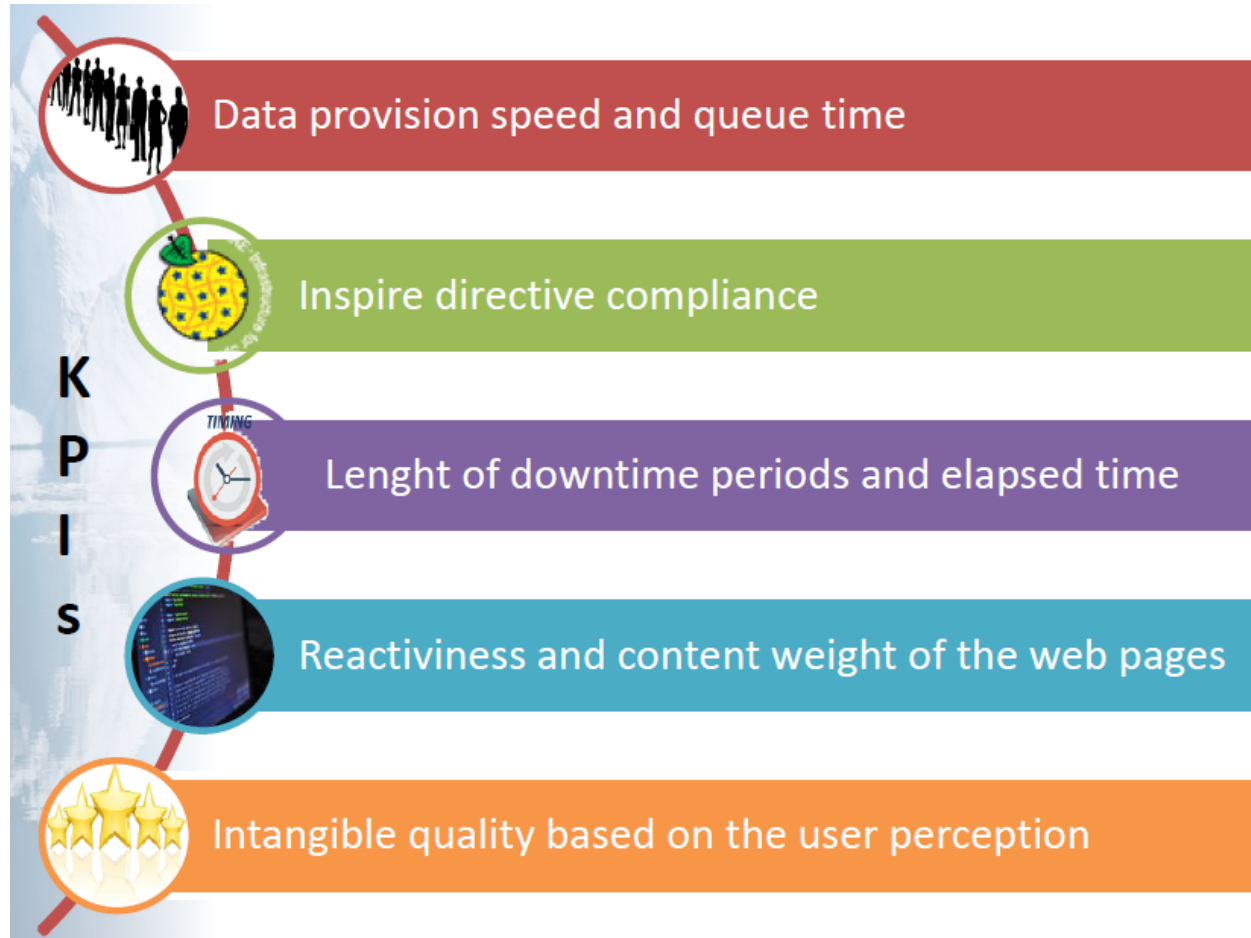
- EQC tab now available for datasets in the CDS catalogue
- Easy-access quality information via Synthesis Table
- 100+ Quality Assurance reports initially available, more will be added successively
- EQC for tools and applications will follow in Q3
- Continuous improvement through user feedback



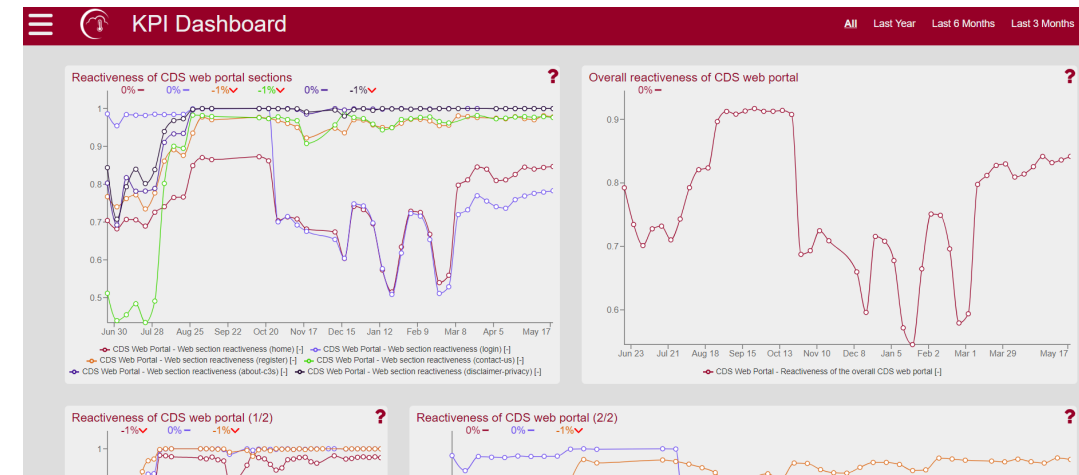
Climate
Change

Evaluation and Quality Control (EQC)

Monitoring of service performance



- Calculation of service KPIs from multiple sources
- Rating widgets implemented throughout the CDS





Climate Change

Sectoral Information System



Agriculture



Insurance



Biodiversity



Shipping



Coastal areas



Storm surges



Energy



Tourism



Health



Water management



Infrastructure



USERS



CLIMATE DATA STORE



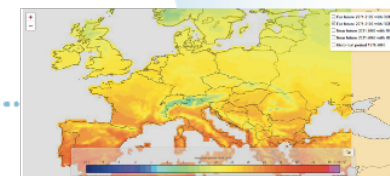
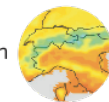
Benchmarks of good practice

Quality assured data

Tools

PRACTICAL EXAMPLES

Documentation



Tools and applications

Case studies

Sector relevant data



10:00-10:20

Chiara

Cagnazzo





Climate
Change

E v o l u t i o n

- New tools for applications.
- Climate attribution prototype.
- Increased number of ECVs (up to 35).
- Decadal predictions (initial focus on case studies).
- Stronger links with ESFG, CMIP6, CORDEX.
- Enhanced handling of uncertainty in reanalyses.
- Expansion of the realm of EQC → “total quality”.



Climate
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Questions?

For more info:

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climate.copernicus.eu

The screenshot shows the homepage of climate.copernicus.eu. At the top, there is a navigation bar with the 'Climate Change Service' logo on the left, which includes the text 'Implemented by ECMWF as part of The Copernicus Programme'. On the right side of the navigation bar are links for 'News', 'Events', 'Press', 'Tenders', and 'Help & Support'. Below these are 'ABOUT US', 'WHAT WE DO', 'DATA', and a search icon labeled 'SEARCH'. The main header area features logos for the 'European Commission', 'Copernicus Europe's eyes on Earth', and 'IMPLEMENTED BY ECMWF'. A large banner image of icebergs in the ocean is overlaid with a grey box containing the text: 'We provide authoritative information about the past, present and future climate, as well as tools to enable climate change mitigation and adaptation strategies by policy makers and businesses.' Below the banner, there is a section titled 'Key products and services' with a small image of a waterfall and a question mark icon. The URL 'www.copernicus.eu' is visible in the bottom left corner of the page.