

Climate Change

Climate change service

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Climate services in a nutshell



A **Climate Service** is the provision of climate information to assist decision-making. The service must respond to user needs, must be based on scientifically credible information and expertise, and requires appropriate engagement between the users and providers.

https://www.climateurope.eu/





Bringing the users to the data



As part of Copernicus, ECMWF developed 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





The Climate Data Store – highly operational with enhanced infrastructure



- Registered users: 45 000+
- TB/day: ~50 (30-60)
- Datasets: 65

EMS Society **Technology Achievement** Award 2019 awarded by the European Meteorological Society to the **Copernicus** Climate Data Store The Copernicus Climate Data Store supports climate services in Europe by providing eamless access to high-quality climate datasets, past, present and future. RW Riddaway

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Extended in July 2019 +1.3PB storage + 50% computational facilities

On-Premises Private Cloud

72+ nodes, 4000+ CPUs, 13TB RAM 3.9 PB usable (of which 380TB SSD)



Monitoring, Capacity building, reporting, backups, ...

Status on 1st June 2020



C3S user landscape



total users (from 1/1/2015):
active users:
Provenance:
Top 3 European countries:
Top 3 non-EU countries:

Data volume delivered:

~80K ~20K 66% Academic/ research UK, Germany, France China, USA, Indonesia

~5 PB

Number of new C3S user queries: 785 (av. 60 per week) Service desk customer satisfaction: 4.8 / 5 (96%)





But not all users speak 'data'

ERA5 monthly averaged data on single levels from 1979 to present





The strength of a common voice

Change

Annual publication since 2018

- Update of climate in Europe compared to long-term trends
- Builds on 20+ datasets in the CDS + others •
- Written by experts across the C3S community & other • **Copernicus services**

climate.copernicus.eu/ESOTC







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European

Commission

CECMWF



Climate Change

Current activities and enhanced continuity

Climate data production and delivery







Climate variables in C3S

(satellite ECVs)

Atmospheric physics Precipitation Surface radiation budget CCI / Uni. Maryland / NASA / NOAA Water vapour Cloud properties Earth radiation budget Atmospheric composition Carbon dioxide **Coordination with ESA-CCI and other** Methane national projects Ozone Aerosol Ocean Sea surface temperature Coordination with ESA-CCI / Sea level **OSI-SAF** Sea ice Ocean colour Land hydrology & cryosphere Lakes **Coordination with ESA-CCI, GloboLakes,** Glaciers Arc-Lake, HydroWeb Ice sheets & ice shelves Soil moisture Land biosphere Albedo **Coordination with ESA-CCI**, Land cover CGL, QA4ECV, LSA-SAF Fraction of absorbed photosynthetic Leaf area index Fire





Higher spatial and temporal resolution for reanalyses

Florence Thu 13 Sep 2018, 01 UTC for ERA-Interim Florence Thu 13 Sep 2018, 01 UTC for ERA5 Accumulated precipitation (mm) Mean sea level pressure (hPa) 75°W 80°W 80°W 75°W

ERA-Interim

ERA5





World leading reanalysis: ERA5



1950 – 1979 Complete (5th March 2020)

1979 – present Complete. NRT stream runs RT – 1 day

Hersbach et al. 2020 https://doi.org/10.1002/qj.3803





Satellite reprocessing and data rescue





Regional reanalyses – increasing spatial resolution

European Domain



Available in the CDS (> 900 users): UERRA, 1961 – mid 2019 @ 11/5.5km

Currently in production: CERRA, 1980–May 2021 @5.5km SMHI, Météo-France, MET Norway **Arctic Domain**



Currently in production: (red sub domains) CARRA, July 1997 – June 2020 @ 2.5km

Proof of concept: (grey domain) 1-year pan-Arctic reanalysis, Sep 2017/18 @ 3.75km Met Norway, DMI, SMHI, IMO, FMI and Météo-France.





Multi-system seasonal forecast service



Graphical products: https://climate.copernicus.eu/charts/c3s_seasonal/ **Data service:** https://cds.climate.copernicus.eu/cdsapp#!/search?type=dataset **Operational service:** 6-month forecasts issued monthly

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

International prominence:

- **NCEP** joined the service in November 2019
- ECCC and JMA planned for 2020
- **BoM** expression of interest for 2021





Example: November prediction for DJF 2019-2020 mean sea-level pressure

C3S multi-system seasonal forecast Mean MSLP anomaly Nominal forecast start: 01/11/19 Variance-standardized mean

ast ECMWF/Met Office/Météo-France/CMCC/DWD/NCEP DJF 2019/20 C3S prediction





CECMWF

opernicus

European Commission



More climate indicators – better climate service

Increase ECV portfolio from 22 to 35 ECVs

• Potential ECVs include: river discharge, permafrost, LST, snow, upper-air temperature, surface ocean currents, ...

Progressive transition -> use of Sentinel data

 cloud properties, ozone, aerosols, sea-ice thickness, sea level, SST, ocean colour, soil moisture, lakes, ice sheets, land cover, fire radiative power.

Enhancement of individual ECV services

- Cross-signposting ECV products with other data suppliers
- Increased collaboration (brokering/contracting) with ESA-CCI & EUMETSAT SAF, and other Copernicus Services to maximize the data services provision









Refining products

High-resolution ensemble of global climate integrations Coupled with the ocean for cross-domain consistency if possible

- Constrained by SST to provide the correct low-frequency variability
- High-resolution climatological information including rare/extreme events.

Next full-observing-system global coupled global reanalysis (ERA6)

- State-of-the-art NWP system, data assimilation system coupled with the ocean and improved coupling with land
- Will make use of the new and reprocessed datasets as delivered by C3S

Next regional reanalyses at high resolution

- Centennial reanalysis for the European domain, based on the dense network of observations in the 20th century
- Truly pan-Arctic reanalysis









Climate Change

Current activities and enhanced continuity

Recent developments







Operational Evaluation and Quality Control (EQC)

- Three coordinated EQC contracts for CDS and SIS (>100 person-years of effort)
- EQC operational for datasets; tools and applications to be added (autumn)
- Dashboard to monitor service performance via KPIs in place
- User Requirements Database
 operational







Operational EQC for CDS datasets

Easy access quality information via synthesis table

Quality assessment Download data Documentation Overview This is a new feature, work in progress. Should any inconsistency be found, please report to copernicus.support@ecmwf.int The CDS datasets are independently assessed by the Evaluation and Quality Control (EQC) function of C3S. EQC encompasses a framework of processes aimed to assure technical and scientific quality harmonized across all dataset types available through the CDS. During the EQC process, the documentation provided with the dataset is scrutinized and data are checked for usability and reliability. Variable: Sea ice concentration × Variable: Sea ice concentration Latest updated on 27/05/2020 INTRODUCTION USER DOCUMENTATION ACCESS INDEPENDENT ASSESSMENT Toolbox compatibility Data check Dataset overview User guide Temporal and spatial coverage and resolution Scientific methodology Archive Expert evaluation Providers Uncertainty guantification Dataset maturity Summary of independent assessment Dataset version Validation

100+ quality assurance reports available, more to be added

Continuous improvement via user feedback





EQC – monitoring service efficiency





Data provision speed and queuing time Compliance with the INSPIRE Directive

Length of downtime periods

Reactiveness of web pages

User perception monitoring

COS Web Portal - Web section reactiveness (docur-ciso)] • CDS Web Portal - Web section reactiveness (docur-ciso)] • CDS Web Portal - Web section reactiveness (docur-ciso)] • CDS Web Portal - Web section reactiveness (docur-ciso)] • CDS Web Portal - Web section reactiveness (docur-ciso)] • CDS Web Portal - Web section reactiveness (docur-ciso)] • CDS Web Portal - Web section reactiveness (docur-ciso)] • CDS Web Portal - Web section reactiveness (docur-ciso)] • CDS Web Portal - Web section reactiveness (docur-ciso)] • CDS Web Portal - Web section reactiveness (docur-ciso)] • CDS Web Portal - Web section reactiveness (docur-ciso)] • CDS Web Portal - Web section reactiveness (docur-ciso)] • CDS Web Portal - Web section reactiveness (docur-ciso)] • CDS Web Portal - Web section reactiveness (docur-ciso)] • CDS Web Portal - Web section reactiveness (docur-ciso)]



Calculation of service KPIs from multiple sources

- Rating widgets implemented throughout the CDS
- Online dashboard to track service performance



Operational user requirements database (URDB)

>3000 user requirements under investigation

The Copernicus Climate Change Service Home Requirements - User Requirements Database										
Home / Requirements										
List of Requirements Showing 3400 requirements Filter results Export results										
ID	SUMMARY	TOPIC	SUBJECT	ORIGIN	OWNER	EDIT				
C35- 000001	Provide a comprehensive database for climate data where we can choose the variables according to our needs	SIS General	Website	Interview	admin	Edit				
C3S- 000002	Provide indicators tailored to the tourism sector: TCI/CIT/HCI	SIS Data	New data request	Interview	admin	Edit				
C3S- 000003	Provide indicators tailored to the tourism sector: sea level rise data	SIS Data	New data request	Interview	admin	Edit				
C35- 000004	Provide indicators tailored to the tourism sector: Fire Weather Index	SIS Data	New data request	Interview	admin	Edit				
C3S-	Provide indicators tailored to the tourism sector: Snow reliability indicator	SIS	New data request	Interview	admin	Edit				

First User Requirements Analysis Documents (URAD) delivered to inform future service evolution





Clear ECV access for users

	Providers visibility and
Home Search Datasets Applications Toolbox FAQ& Live	mapping
EUMETSAT Satellite Application Facilities	

Overview

Utilising specialist expertise from the EUMETSAT Member States, Satellite Application Facilities (SAFs) are dedicated centres of excellence for processing satellite data. They form an integral part of the distributed EUMETSAT Application Ground Segment.

The eight EUMETSAT SAFs of provide users with operational data and software products, each one for a dedicated user community and application area

EUMETSAT Secretariat supervises and coordinates the overall activities of the SAF network, ensuring that the SAFs in operations are providing reliable and timely operational services related to the meteorological and environmental issues.

The SAF Network manages and coordinates interfaces between the SAFs themselves and between SAFs and other EUMETSAT systems, overseeing the integration and operations of SAFs into the overall ground segment infrastructure. During this process EUMETSAT ensures that services are delivered in the most reliable and cost-effective way.

For more information, please refer to the EUMETSAT SAFs website or each of the SAF Projects listed in the following table.

Brokered SAF datasets to C3S:

SAF project	SAF contact	Data source	Spatial coverage	Spatial resolution	TCDR	ICDR	Temporal resolution	Instrument	Variables	License	SAF DOI	CDS Catalogue
CM SAF @	.contact.cmsaf@dwd.de	CM SAF CLARA- A2	Global	0.25*	01/1982-12/2018		Monthly (Daily for individual variables)	AVHRR	- Surface downwelling shortwave flux - Surface upwelling shortwave flux	link		link (Please select CM-SAF products)
	osisaf-prod@met.no		Global	12.5km;	01/1978-12/2015	01/2016-01/2020	Monthly (Daily for individual variables)	SMMR, SSM/I and SSMIS	- Sea ice concentration	link		link (Please select OSI-SAF products)

Record updated 2020-02-10 18:06:15 UTC







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Increasing toolbox accessibility



Learning bundles

Resampling and aggregate data (to be published)
About the common data model (to be published)

European Commission

opernicus

A BARAA A AMAN

CECMWF

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



Climate Change

Current activities and enhanced continuity

User engagement, sector specific applications, communication & dissemination







Empowering expert users









Dynamic user support





Sectoral impact – the future of snow tourism

+

Snow tourism is an important economic activity in European mountain areas

Elevation:

800m

•

Mountain Tourism Meteorological & Snow Indicators

This is a technology demonstrator and not an operational service

tain Tourism Meteorological and Snow Indicators" provide pan-European information relevant to snow reliability, and hence the operating iditions of winter ski resorts under past and future climate co plication you can explore all 39 indicators characteriz and snow conditions, with and without snow management. ing), computed in a similar manner for all mountain regions urope at the scale of NUTS-3 regions and by steps of 100 m elevation on flat terrain Hover over the (?) symbol for help on each menu. In the future, this demonstrator will be re-implemented using the C3S toolbox.



- A pan-European climate change assessment of past and future operating conditions
- Snow Indicators derived from **EURO-CORDEX** climate projections for all 100 m elevation band & all European mountainous areas
- Interactive Map to navigate aggregated time / space dataset

https://climate.copernicus.eu/european-tourism-indicators?g=european-tourism-applications





Sectoral impact – Swiss national association for cable cars

Linking climate information & economic data enables understanding of the vulnerability of climate risk

Climate change projections are essential for strategic planning and climate adaptation

1) **Seasonal reviews**: provide climate variables (e.g. snow depth) to co-explain key economic figures, such as skier days and revenues

2) **Strategic planning**: Mountain and Snow Indicators used to support market analyses comparing different regions e.g. snowmaking hours.

3) **Empowerment**: Enable association members to use the service for their individual business requirements



Seilbahnen Schweiz Remontées Mécaniques Suisses Funivie Svizzere Pendicularas Svizras









The C3S – Climate-Adapt portal: a critical link in the chain

Climate Change Services are essential to climate change adaptation, as they provide climate information and knowledge by means of accessible, reliable, timely, and user oriented products.



Europear



Communication – rapidly growing media impact

C3S equalled or surpassed NASA and NOAA as the preferred climate source for European Media.

20 x the number of clippings compared with the previous year's analysis of annual coverage.

More top-tier outlets and increased circulation to over **16 billion** from **2 million**.









C3S has reached the highest amount of coverage by ca. 300 media mentions more than its competitors. This can be traced back to various factors (see below), most prominently the timing of the report. C3S published the news almost a full month before the other institutions.







Emerging policy & societal requirements





SHARING ADAPTATION INFORMATION ACROSS EUROPE



United Nations Climate Change







CEN – European Committee for Standardization CENELEC – European Committee for Electrotechnical Standardization

ISO 14090 https://www.iso.org/standard/68507.html

ISO 14091 <u>https://www.iso.org/standard/68508.html</u>

TCFD TASK FORCE ON CLIMATE-RELATED FINANCIAL DISCLOSURES





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www.copernicus.eu climate.copernicus.eu

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