

The Copernicus Climate Change Service (C3S)



Climate Change

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& the C3S team at ECMWF

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Copernicus

THE COPERNICUS PROGRAMME OBJECTIVES

The Union **Earth Observation** and monitoring programme

Increase general knowledge
on the state of the Planet



Protect people
and assets



Improve environmental
policy effectiveness



Monitor
the environment



Facilitate adaptation
to climate change

Foster downstream
applications in
a number of fields



Help managing emergency
and security related situations



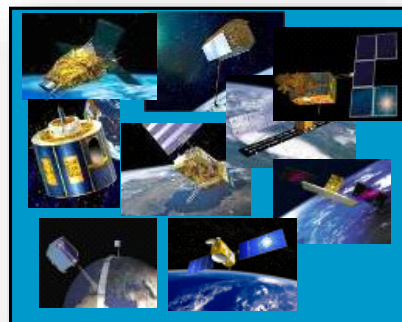
Copernicus

PROGRAMME ELEMENTS

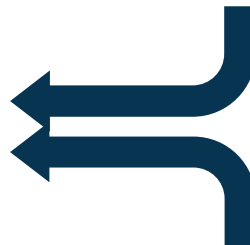


Copernicus Sentinels

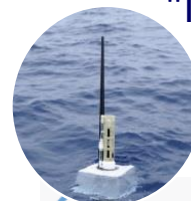
6 services use Earth Observation data to deliver ...



Other Satellites



"in-situ"



...added-value products



Copernicus

COPERNICUS SATELLITES

Sentinel Mission and Status

Key Features

**FULL, FREE
AND OPEN**



SENTINEL-1:
4-40m resolution, 3 day revisit at equator

2 Sats in orbit

Polar-orbiting, all-weather, day-and-night radar imaging



SENTINEL-2:
10-60m resolution, 5 days revisit time

2 Sats in Orbit

Polar-orbiting, multispectral optical, high-res imaging



SENTINEL-3:
300-1200m resolution, <2 days revisit

2 Sats in Orbit

Optical and altimeter mission monitoring sea and land parameters



SENTINEL-4:
8km resolution, 60 min revisit time

1st Launch in 2020

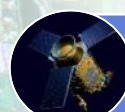
Payload for atmosphere chemistry monitoring on MTG-S



SENTINEL-5p:
7-68km resolution, 1 day revisit

1 Sat in Orbit

Mission to reduce data gaps between Envisat, and S-5



SENTINEL-5:
7.5-50km resolution, 1 day revisit

1st Launch in 2021

Payload for atmosphere chemistry monitoring on MetOp 2ndGen



SENTINEL-6:
10 day revisit time

1st Launch in 2020

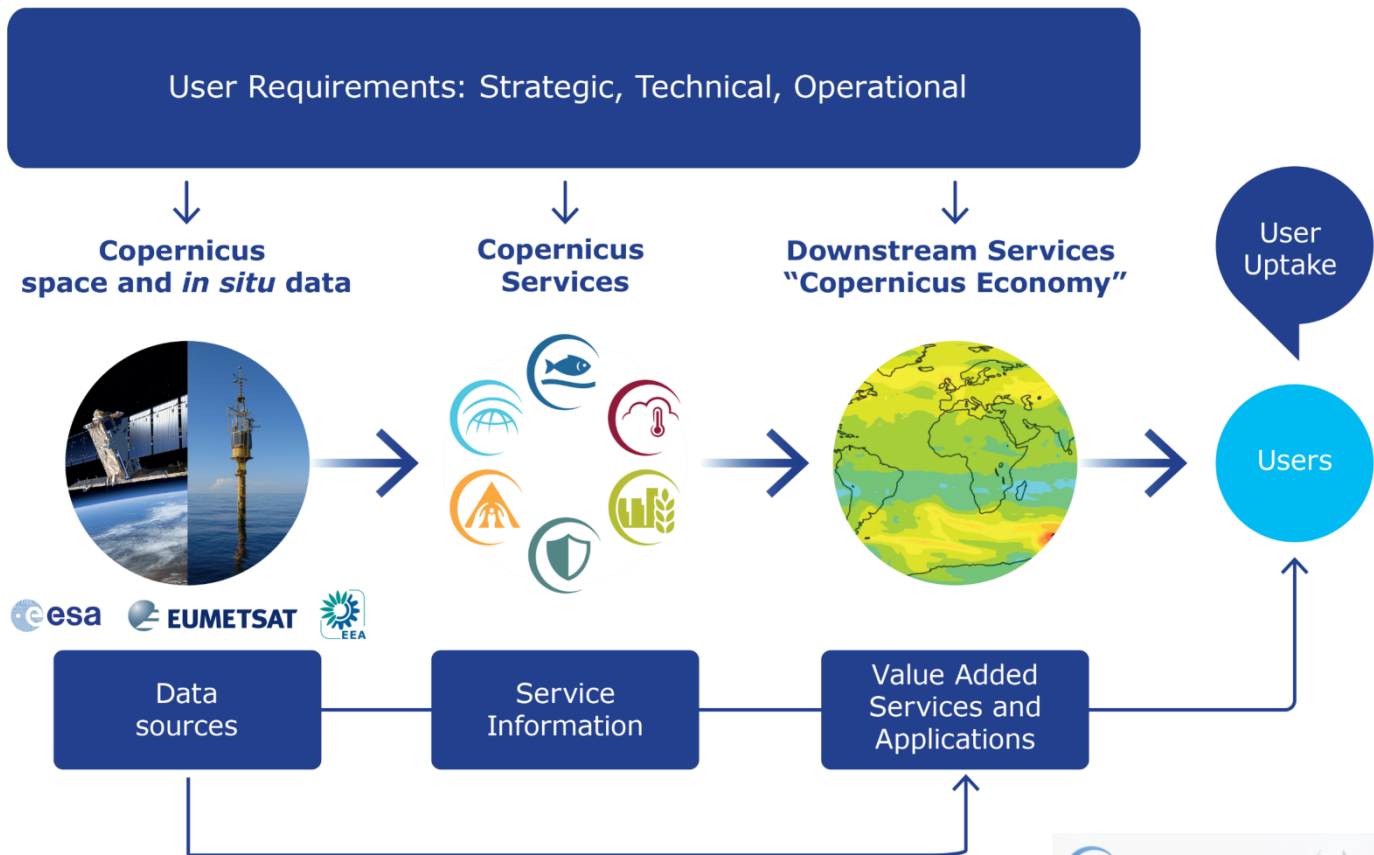
Radar altimeter to measure sea-surface height globally





Copernicus

COPERNICUS IS DRIVEN BY THE USERS





Climate
Change

The C3S mission

To support European adaptation and mitigation policies by:

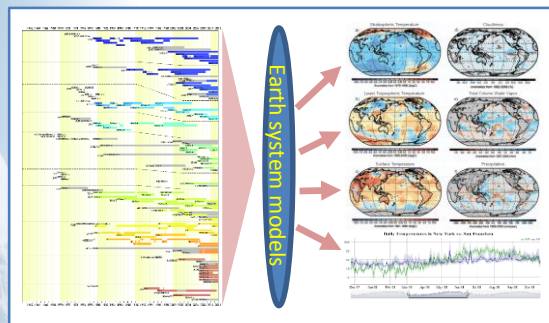
- Providing consistent and authoritative information about climate (past, present, future)
- Building on existing capabilities and infrastructures (nationally, in Europe and worldwide)
- Stimulating the market for climate services in Europe





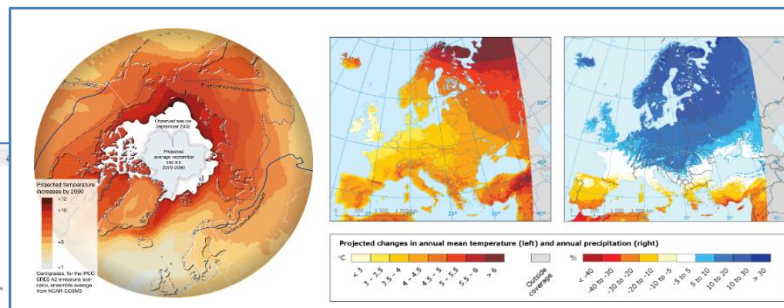
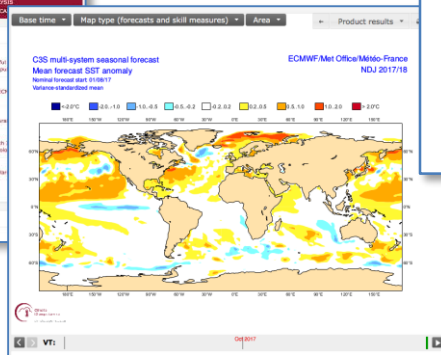
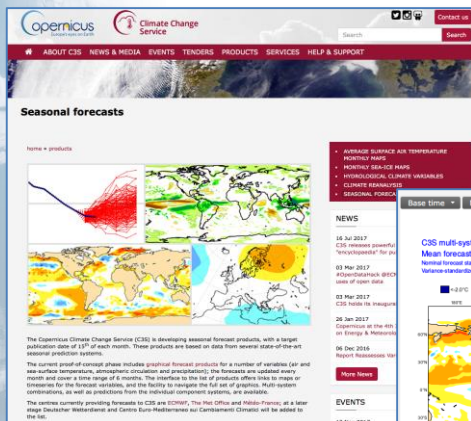
Climate Change

C3S: ACCESS TO PAST, PRESENT AND FUTURE CLIMATE INFORMATION



Observations and climate reanalyses
Seasonal forecast data and products

Climate model simulations
Sectoral climate impact indicators



<http://climate.copernicus.eu>



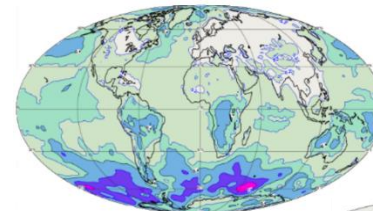
Climate Change

C3S: Reanalysis based Essential Climate Variables (30km global ERA5) Builds upon IFS modelling and Data Assimilation

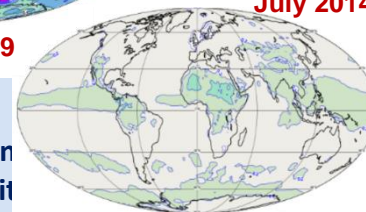
Hourly data and increased number of parameters

Uncertainty estimate

Spread in Surface Pressure



January 1979



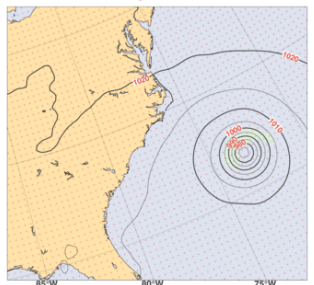
July 2014

Reflects variations in:

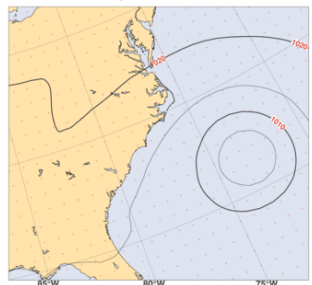
- ingested observing system
- flow-dependent sensitivity

Courtesy: Philip Brohan

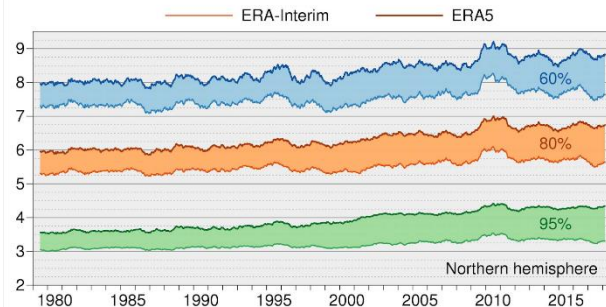
Florence Thu 13 Sep 2018, 01 UTC for ERA5



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



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

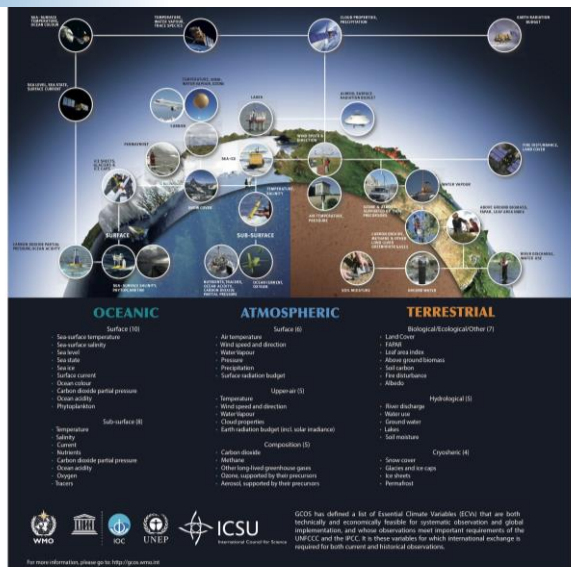


Credit: H. Hersbach, ECMWF



Climate Change

C3S: EO based Essential Climate Variables



- Large uptake by Copernicus of Science in Europe (e.g. ESA Climate Change Initiative, EUMETSAT SAFs, etc.)
- Copernicus is a resource to WMO State of Climate, GCOS climate indicators, contributes to CEOS-CGMS Climate data records inventory

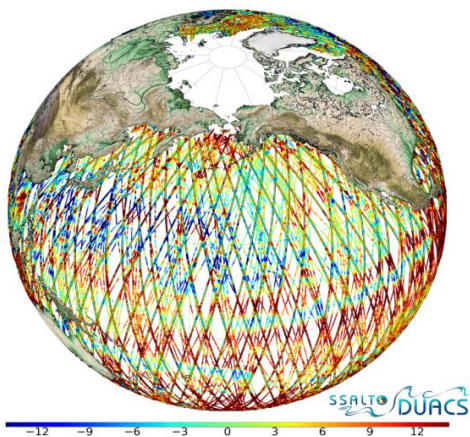
Science $\xrightarrow{\text{uptake}}$ Operations
CCI CCI+ C3S

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

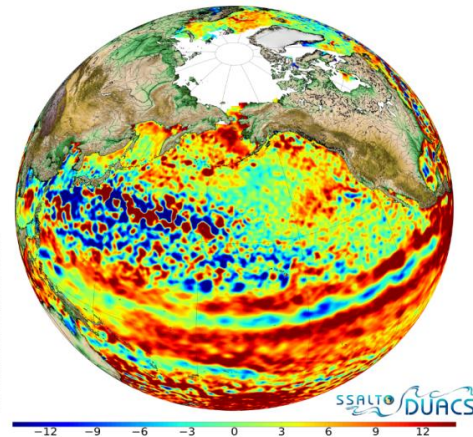
Sea Level ECV production service



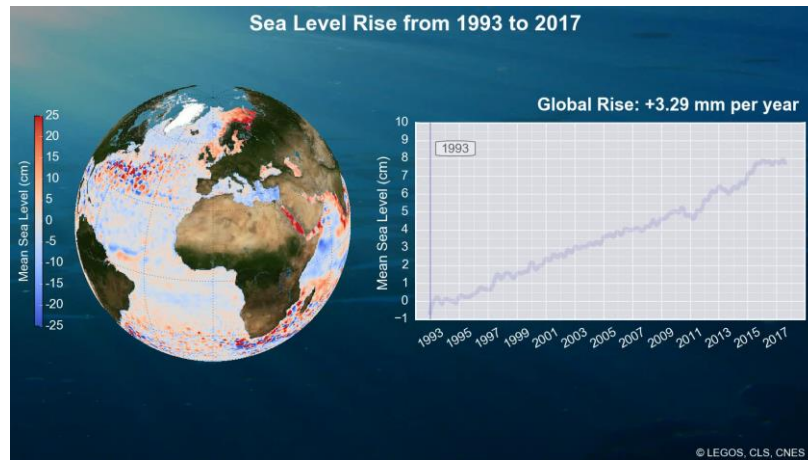
From satellite **along-track**
measurements...



... to sea level gridded maps...



... to derive
Ocean
Monitoring
Indicators



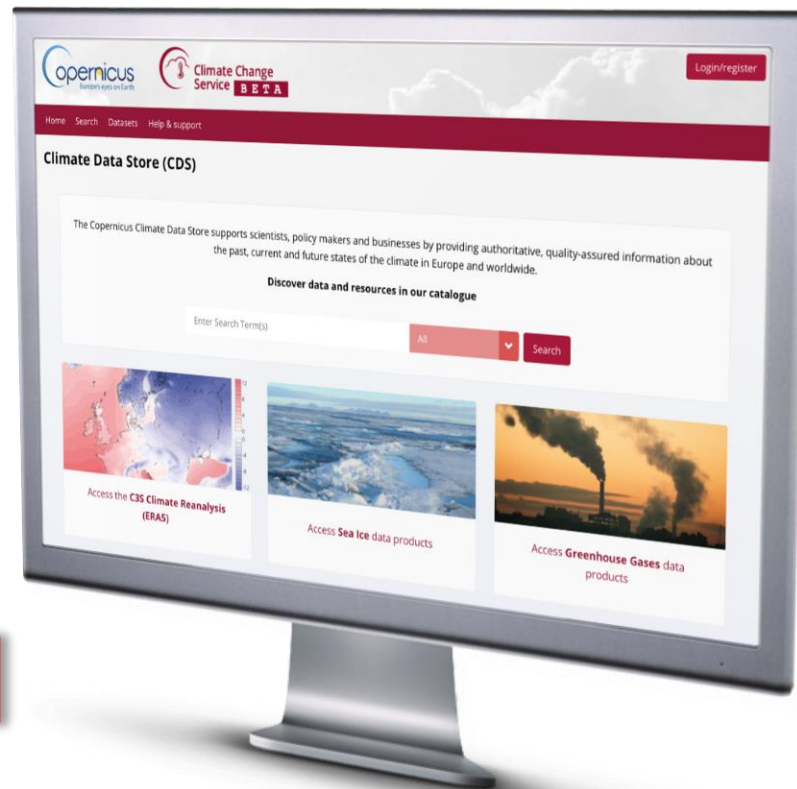


Climate
Change

What C3S offers to its users

- Access to climate data
- Tools needed to use the data
- Information on sectoral impacts
- Quality assurance
- User support and training
- Climate change assessments
- Outreach and communication

A one-stop Climate Data Store





Climate Change

Access to climate datasets before the CDS...

ESGF Portal at CEDA

Home About Us Contact Us

Enter text: Search Reset Display 10 2 results per page [More Search Options]

1. **corsea.output.AFR-44.DM.ECMWF-ERNAINT-evaluation.v15141**
 Data Mode: [containing.shm](#)
 Version: 20140004
 Total Number of Files for all variables: 5
 [Show Metadata] [Show Files] [THREDDS Catalog] [WGS]

Dataset Metadata
 ID: corsea.output.AFR-44.DM.ECMWF-ERNAINT-evaluation.v15141
 Version: 20140004
 Total Number of Files for all variables: 5
 [Show Metadata] [Show Files] [THREDDS Catalog] [WGS]

Details
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 Data Mode: [containing.shm](#)
 Version: 20140004
 Total Number of Files for all variables: 5
 [Show Metadata] [Show Files] [THREDDS Catalog] [WGS]

Metadata
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 Data Mode: [containing.shm](#)
 Version: 20140004
 Total Number of Files for all variables: 5
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Time Frequency
 Hourly
 Daily
 Monthly
 Quarterly
 Annually

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 Total Number of Files for all variables: 5
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Driving Model
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 Version: 20140004
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Domain
 Global
 Regional
 Local

ECMWF
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 Version: 20140004
 Total Number of Files for all variables: 5
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SPES
 Data Mode: [containing.shm](#)
 Version: 20140004
 Total Number of Files for all variables: 5
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Start Date
 1979
 1981
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 2001
 2003
 2005
 2007
 2009



OSISAF
 OCEAN AND SEA ICE

ABOUT OSISAF PRODUCTS DOCUMENTATION COMMUNITY

Home / List of products

List of products

Domain: Sea Ice

Thumbnail	Title	Identifier	Status	Satellite Input	Level	Frequency	Timeliness	Spatial coverage	Spatial sampling
	Global Sea Ice Concentration (SSMIS)	OSI-401-b	Operational	DMSF/SSMIS and Metop/ASCAT	L3	1 per day	5 h	Global	10 km
	Global Sea Ice Edge	OSI-402-c	Operational	DMSF/SSMIS and Metop/ASCAT	L3	1 per day	5 h	global	10 km
	Global Sea Ice Type	OSI-403-c	Operational	DMSF/SSMIS and Metop/ASCAT and CCOM-WAIGS-2	L3	1 per day	5 h	global	10 km
	Global Sea Ice Emmissivity	OSI-404	Operational	DMSF/SSMIS	L3	1 per day	5 h	global	10 km
	Global Low Resolution Sea Ice Drift	OSI-405-c	Operational	Metop/ASCAT and CCOM-WAIGS-2	L3	1 per day	6 h	Global	62.5 km
	Medium Resolution Sea Ice Drift	OSI-407	Operational	Metop/AVHRR	L3	2 per day	6 h	Northern Hemisphere	20 km

```

ssh cds@cds-test.climate.copernicus.eu -- 117x34
ssh cds@cds-test.climate.copernicus.eu
6468 0c 6 13:23 dt_med_twosoft_phy_14_20051207.nc.gz
1810 0c 6 13:23 dt_med_twosoft_phy_14_20051208.nc.gz
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897 0c 6 13:23 dt_med_twosoft_phy_14_20051205.nc.gz
976 0c 6 13:23 dt_med_twosoft_phy_14_20051206.nc.gz
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227 0c 6 13:23 dt_med_twosoft_phy_14_20051231.nc.gz
226 Transfer complete
f52p pwd
227 /c1-c3s/Products/SEALEVEL/regional-merl-terranon/dt-grids-two-sat-merged/phy/2005/ is the current directory
f52p
  
```



Climate
Change

Catalogue of climate datasets

Home Search Datasets Toolbox Help & support

Search results

Search dataset All Datasets

Sort by

Relevancy

Title

Product type

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

Variable domain

- Atmosphere (composition) (3)
- Atmosphere (surface) (4)
- Atmosphere (upper air) (4)
- Land (biosphere) (1)
- Land (cryosphere) (2)
- Land (hydrology) (2)
- Ocean (physics) (5)

Spatial coverage

Temporal coverage

Glaciers elevation and mass change data from 1894 to 2014 from the Fluctuation of Glaciers Database
A glacier is defined as a perennial mass of ice, and possibly firn and snow, originating on the land surface from the recrystallization of snow or other forms of solid precipitation and showing eviden...

Glaciers extent data from 1995 to 2015 from the Randolph Glacier Inventory
A glacier is defined as a perennial mass of ice, and possibly firn and snow, originating on the land surface from the recrystallization of snow or other forms of solid precipitation and showing eviden...

Methane data from 2002 to present derived from satellite sensors
Methane (CH4) is the second most significant greenhouse gases that has increased in concentration in the atmosphere directly due to human activities, from the viewpoint of the radiative forcing of cli...

Sea surface temperature daily gridded data from 1991 to 2010 produced by ESA-CCI
This dataset provides daily values for sea surface temperature and sea ice fraction over a regular grid with no missing values in space or in time. The initial satellite data from the Along Track Scan...

Water quality indicators for European rivers
This dataset contains modelled data for phosphorous and nitrogen concentrations and loads. The data comes from the Swedish Meteorological and Hydrological Institute E-HYPE model at catchment level f...

Water quantity indicators for Europe
This dataset contains modelled data for water runoff and wetness, river flow, snow water equivalent, soil water content and other water related quantities for the European region. These variables wer...

CMIP5 daily data on pressure levels
This catalogue entry provides daily climate projections on pressure levels from a large number of models, members and time periods computed in the framework of fifth phase of the Coupled Model Intercomp...

CMIP5 daily data on single levels
This catalogue entry provides daily climate projections on single levels from a large number of experiments, models, members and time periods computed in the framework of fifth phase of the Coupled ...

CMIP5 monthly data on pressure levels
This catalogue entry provides monthly climate projections on pressure levels from a large number of experiments, models, members and time periods computed in the framework of fifth phase of the Cou...

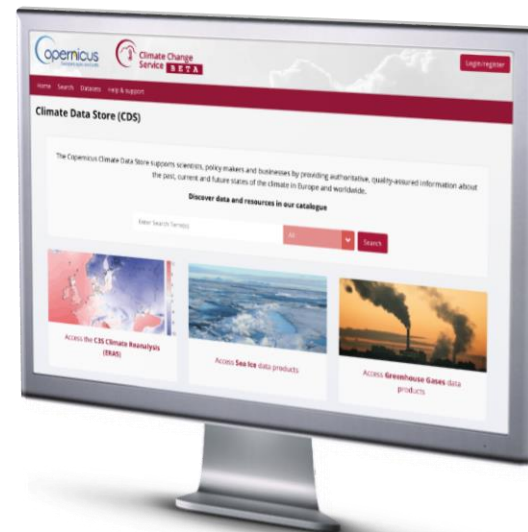
Seasonal forecast monthly statistics on single levels from 2017 to present
Seasonal forecasts provide a long-range outlook of changes in the Earth system over periods of a few weeks or months, as a result of predictable changes in some of the slow-varying components of the s...

Seasonal forecast monthly statistics on pressure levels from 2017 to present
Seasonal forecasts provide a long-range outlook of changes in the Earth system over periods of a few weeks or months, as a result of predictable changes in some of the slow-varying components of the s...

Seasonal forecast daily data on pressure levels from 2017 to present
Seasonal forecasts provide a long-range outlook of changes in the Earth system over periods of a few weeks or months, as a result of predictable changes in some of the slow-varying components of the s...

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...

Seasonal forecast daily data on single levels from 2017 to present
Seasonal forecasts provide a long-range outlook of changes in the Earth system over periods of a few weeks or months, as a result of predictable changes in some of the slow-varying components of the s...





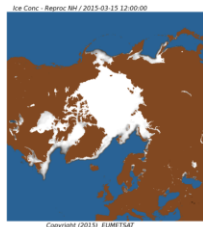
Climate Change

ECV products from Earth observations

Sea ice monthly and daily gridded data from 1978 to present

Overview Download data Documentation

This dataset provides daily values for sea ice concentration, sea ice edge and sea ice type and monthly values for sea ice thickness. These four variables are important markers for climate change studies since sea ice greatly influences the surface albedo and air exchanges of energy, moisture and carbon. The sea-ice distribution, including polynyas and margins, also has an important infl on marine ecosystems. Changes in the distribution of sea ice affect these ecosystems and a number of activities such as shipping and tourist operations.



Sea ice edge, sea ice concentration and sea ice type were computed from satellite passive microwave brightness temperatures from the series of SMMR, SSM/I and SSM/IS sensors. Sea ice thickness were computed from Ku-Band radar altimeter measurements collecting the Envisat and CryoSat-2 satellite missions. Ice thicknesses from Envisat satellite (October 2002 to October 2010) have less coverage and highertainty than thicknesses from CryoSat-2 (November 2010 - March 2015), however the combined dataset provides a valuable unique observational record of ice variability.

From 1978 up to April 2015 the data records provided by this dataset have sufficient length, consisten continuity to dete climate variability and change. From April 2015 onwards, satellite data were processed us same algorithms and processingronment but consistency and continuity have not been extensively verified.

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

DATA DESCRIPTION	
Horizontal coverage	Sea ice concentration and edge: global ocean split in Northern and Southern heme (Lambert EASE/EASE2 projection).
	Sea ice thickness and type: northern hemisphere (Lambert EASE2 projection).

Sea ice monthly and daily gridded data from 1978 to present

Overview Download data Documentation

Variable

At least one selection must be made

- Sea ice concentration
- Sea ice edge
- Sea ice type
- Sea ice thickness

Select all

Year

At least one selection must be made

- 1978
- 1981
- 1984
- 1987
- 1990
- 1993
- 1996
- 1999
- 2002
- 2005
- 2008
- 2011
- 2014
- 2017
- 1979
- 1982
- 1985
- 1988
- 1991
- 1994
- 1997
- 2000
- 2003
- 2006
- 2009
- 2012
- 2015
- 2018
- 1980
- 1983
- 1986
- 1989
- 1992
- 1995
- 1998
- 2001
- 2004
- 2007
- 2010
- 2013
- 2016

Select all

Month

At least one selection must be made

- January
- February
- March
- April
- May
- June

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Search results

Search dataset All Datasets

Sort by Relevancy

Showing 1-11 of 11 results for Satellite observations

- Glaciers elevation and ma from the Fluctuation of GI**
A glacier is defined as a perennial mass of ic from the recrystallization of snow or other fi
- Glaciers extent data from 1995 to 2015 from the Randolph Glacier Inventory**
A glacier is defined as a perennial mass of ice, and possibly firm and snow, originating on the land surface from the recrystallization of snow or other forms of solid precipitation and showing eviden...
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- Sea surface temperature daily gridded data from 1991 to 2010 produced by ESA-CCI**
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- Sea ice monthly and daily gridded data from 1978 to present**

Product type

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

Variable domain

- Atmosphere (composition) (3)
- Land (biosphere) (1)
- Land (cryosphere) (2)
- Ocean (physics) (5)

Spatial coverage

- Global (8)
- Northern hemisphere (1)
- Southern hemisphere (1)

Temporal coverage

- Past (11)



Climate Change

Multi-system seasonal forecasts

Seasonal forecast monthly statistics on single levels from 2017 to present

Overview Download data Documentation

Seasonal forecasts provide a long-range outlook of changes in the Earth system over periods of a few weeks or months, as a result of predictable changes in some of the slow-varying components of the system. For example, ocean temperatures typically vary slowly, on timescales of weeks or months; as the ocean has an impact on the overlying atmosphere, the variability of its properties (e.g. temperature) can modify both local and remote atmospheric conditions. Such modifications of the 'usual' atmospheric conditions are the essence of all long-range (e.g. seasonal) forecasts. This is different from a weather forecast, which gives a lot more precise detail - both in time and space - of the evolution of the state of the atmosphere over a few days into the future. Beyond the chaotic nature of the atmosphere limits the possibility to predict precise changes at local scales. This is why long-range forecasts of atmospheric conditions have large uncertainties. To quantify such uncertain range forecasts use ensembles, and meaningful forecast products reflect a distributions of outcomes.



Given the complex, non-linear interactions between the individual components of the Earth system, the best long-range forecasting are climate models which include as many of the key components of the system and typically, such models include representations of the atmosphere, ocean and land surface. These models are with data describing the state of the system at the starting point of the forecast, and used to predict the evolution of the system in time. While uncertainties coming from imperfect knowledge of the initial conditions of the Earth system can be described with the use of ensembles, uncertainty arising from approximations in the models are very much dependent on the choice of model. A convenient way to quantify the effect of approximations is to combine outputs from several models, independently developed, initialised and operated.

To this effect, the C3S provides a **multi-system seasonal forecast service**, where data produced by state-of-the-art seasonal forecast systems developed, implemented and operated at forecast centres in several European countries are collected, processed and combined to enable user-relevant applications. The composition of the C3S seasonal forecast service is shown in the diagram below.

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Search results

Showing 1-6 of 6 results for Seasonal fo

Sort by

Relevancy

Title

Product type

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

Spatial coverage

- Global (6)

Temporal coverage

- Future (6)
- Past (6)

Seasonal forecast to present

Seasonal forecasts provide a long-range outlook of changes in the Earth system over periods of a few weeks or months, as a result of predictable changes in some of the slow-varying components of the s...

Seasonal forecast monthly statistics on pressure levels from 2017 to present

Seasonal forecasts provide a long-range outlook of changes in the Earth system over periods of a few weeks or months, as a result of predictable changes in some of the slow-varying components of the s...

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Seasonal forecasts provide a long-range outlook of changes in the Earth system over periods of a few weeks or months, as a result of predictable changes in some of the slow-varying components of the s...

Seasonal forecast monthly statistics on single levels from 2017 to present

Overview Download data Documentation

Originating centre

At least one selection must be made

- ECMWF UK Met Office Météo France

Select all

Variable

At least one selection must be made

- | | | |
|--|--|--|
| <input type="checkbox"/> 10m u-component of wind | <input type="checkbox"/> 10m v-component of wind | <input type="checkbox"/> 10m wind gust since previous post-processing |
| <input type="checkbox"/> 10m wind speed | <input type="checkbox"/> 2m dewpoint temperature | <input type="checkbox"/> 2m temperature |
| <input type="checkbox"/> East-west surface stress rate of accumulation | <input type="checkbox"/> Evaporation | <input type="checkbox"/> Maximum 2m temperature in the last 24 hours |
| <input type="checkbox"/> Mean sea level pressure | <input type="checkbox"/> Minimum 2m temperature in the last 24 hours | <input type="checkbox"/> North-south surface stress rate of accumulation |
| <input type="checkbox"/> Runoff | <input type="checkbox"/> Sea surface temperature | <input type="checkbox"/> Sea-ice cover |
| <input type="checkbox"/> Snow density | <input type="checkbox"/> Snow depth | <input type="checkbox"/> Snowfall |
| <input type="checkbox"/> Soil temperature level 1 | <input type="checkbox"/> Surface latent heat flux | <input type="checkbox"/> Surface sensible heat flux |
| <input type="checkbox"/> Surface solar radiation | <input type="checkbox"/> Surface solar radiation downwards | <input type="checkbox"/> Surface thermal radiation downwards |
| <input type="checkbox"/> Top solar radiation | <input type="checkbox"/> Top thermal radiation | <input type="checkbox"/> Total cloud cover |
| <input type="checkbox"/> Total precipitation | | |

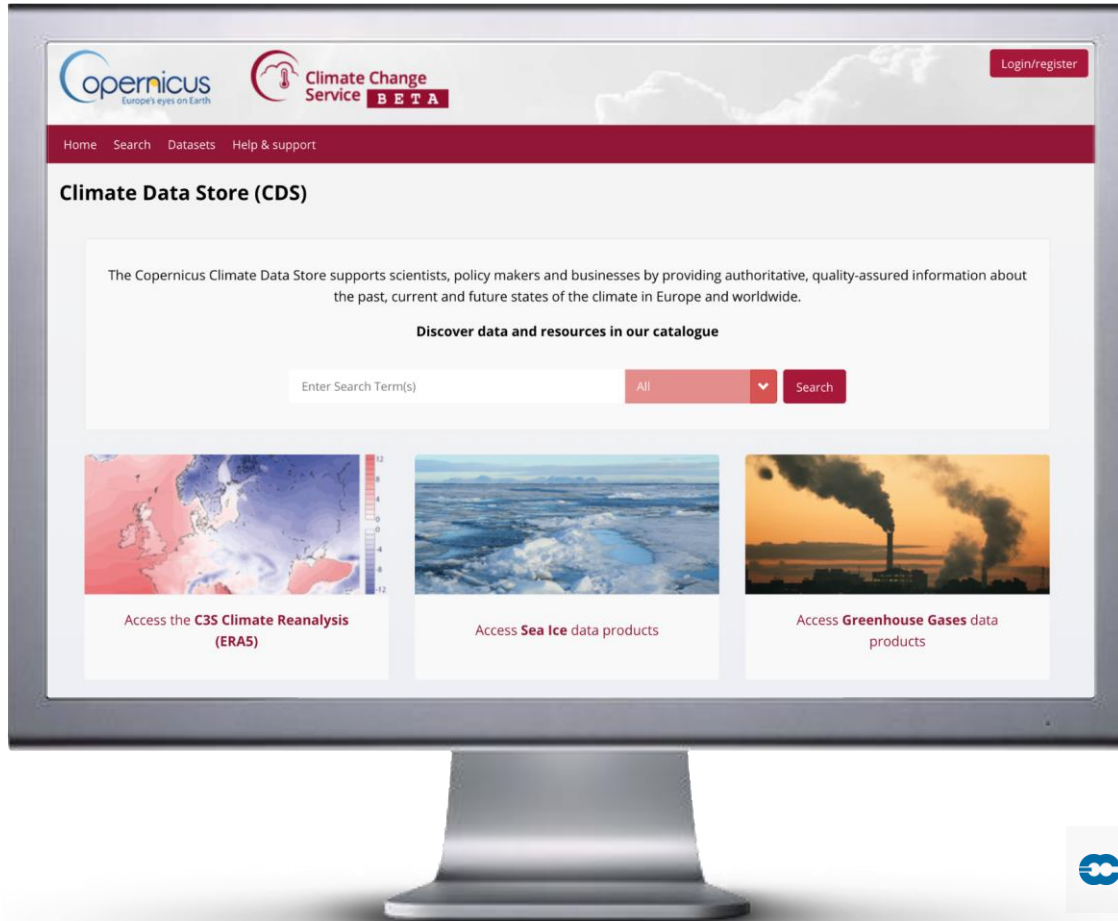
Select all

Product type

At least one selection must be made

- Ensemble

Climate Data Store – CDS



The CDS contains **observations**, global and regional **climate reanalyses**, global and regional **climate projections** and **seasonal forecasts**. It also contains generic and **sectoral climate indicators**.

The CDS is designed as a **distributed system**, providing improved access to **existing datasets** through a **unified web interface**

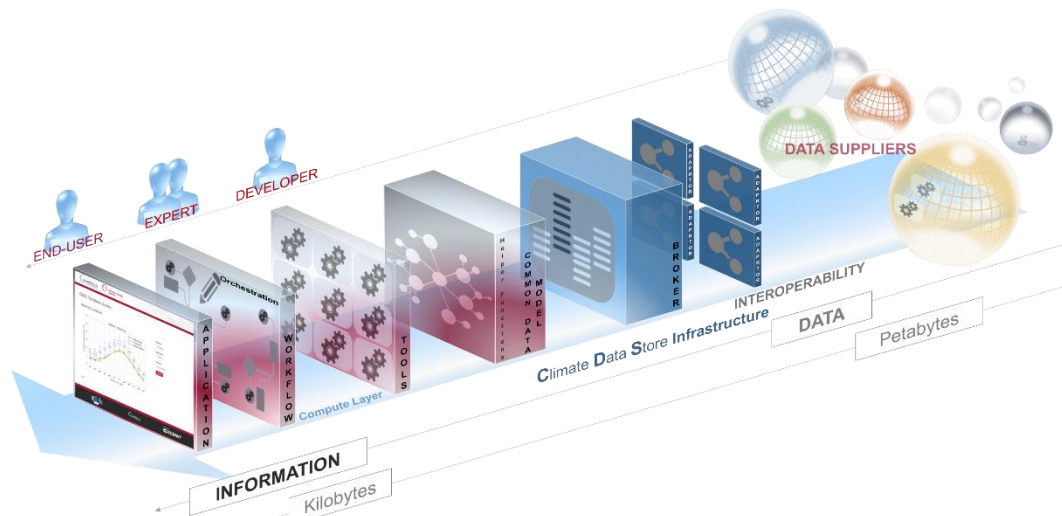
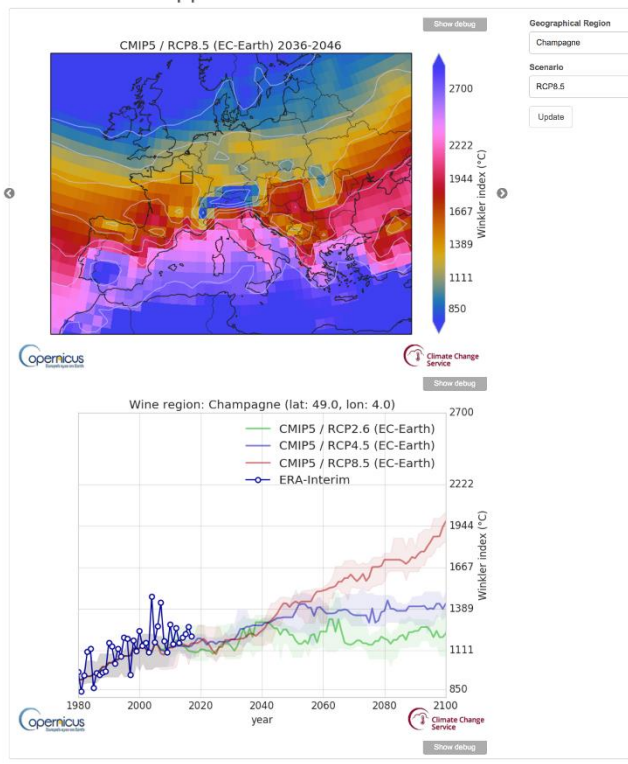


Climate
Change

C3S infrastructure

CDS concept: Access to tools, workflows and applications

CDS Toolbox App.



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

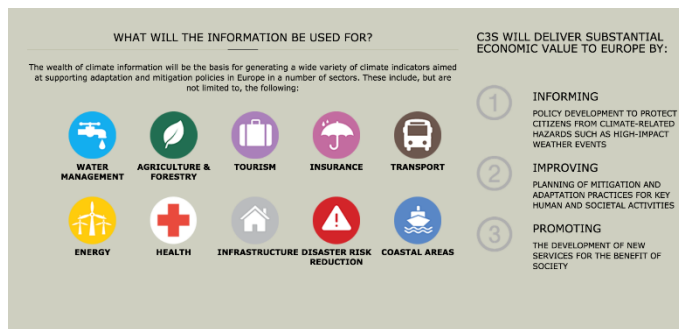


Climate
Change

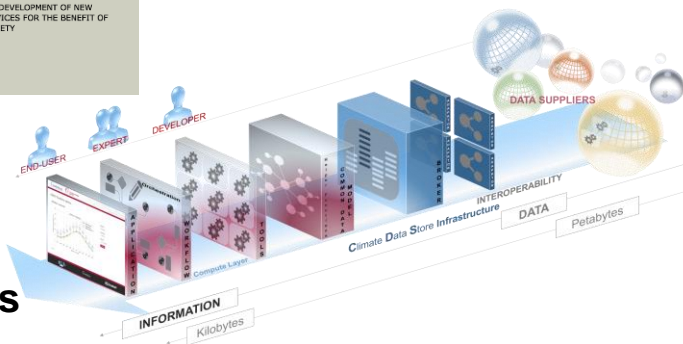
SECTORAL INFORMATION SYSTEM

Proof-of-concepts of climate services:

Demonstration of the **value chain** with several end-to-end **demonstrators**



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** and **indicators**, **good practices**, **tools** and by supporting compelling **use cases**.



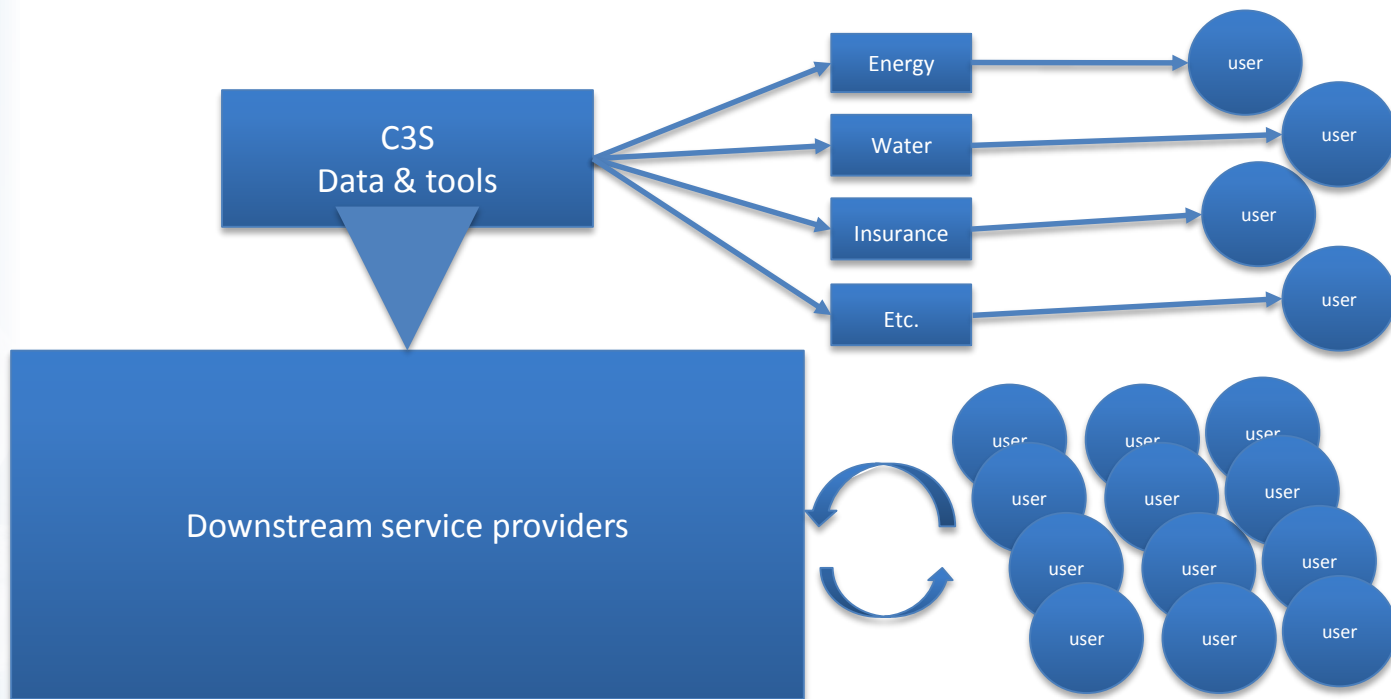
Further down the line, Copernicus **DIAS** will provide free access to **all Copernicus data and information** in the cloud, plus a development environment for users to develop and market their own **cloud-based applications**/front offices (under cloud computing commercial terms). Other EO missions data are also expected to be available.

5 DIASs under development (4 by ESA, 1 by ECMWF/EUM/MO)



Climate
Change

C3S: Enabler for downstream exploitation

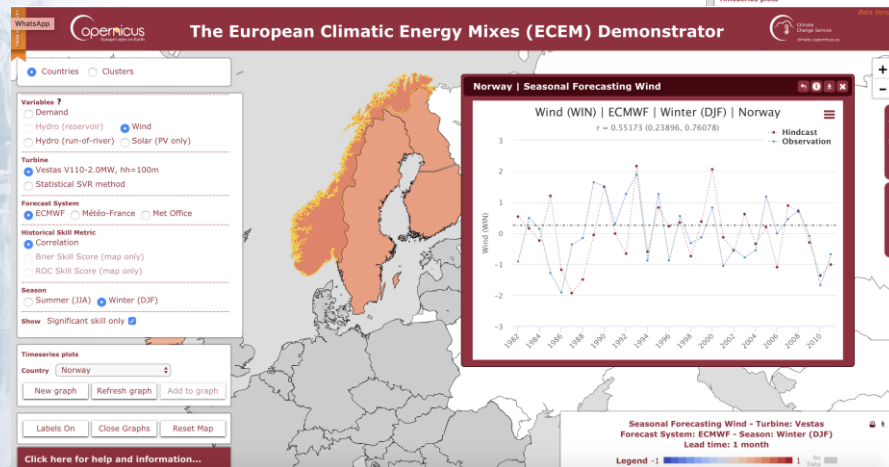




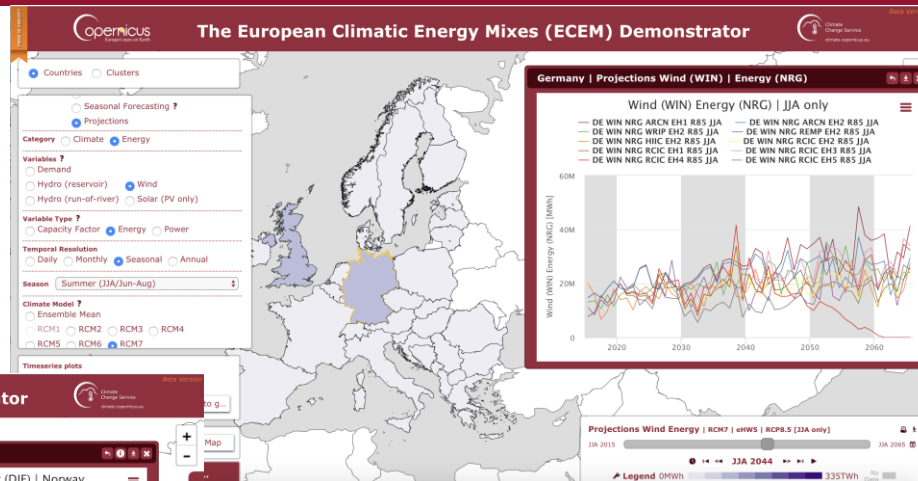
Climate Change

Energy

Integrating climate and energy scenarios to learn how well prepared our infrastructure is to cope with the climate of the future. Will the renewable dominated energy mix of the future be able to cope with the expected change in the energy demand profile?



Contract led by UEA



Using a combination of historical data, reanalysis, seasonal predictions and climate projections the SIS contracts have demonstrated how it will be possible to address some of these questions through the CDS.

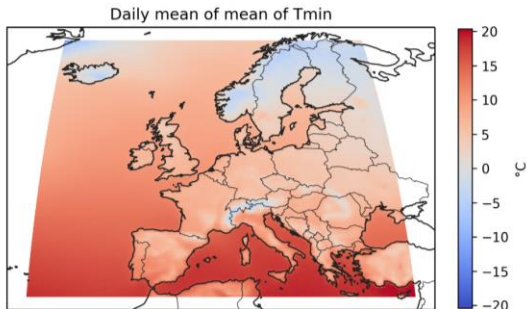


Climate
Change

Health exposure demonstrator

Secure | https://cds.climate.copernicus.eu/apps/355/heat_exposure?sdk_version=2.8.1

Heat_exposure



Variable

Tmin

City

Rome

Statistic

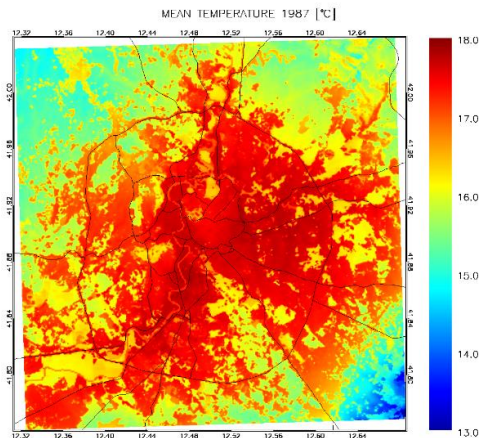
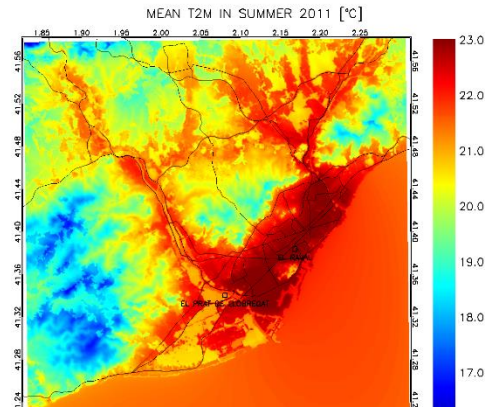
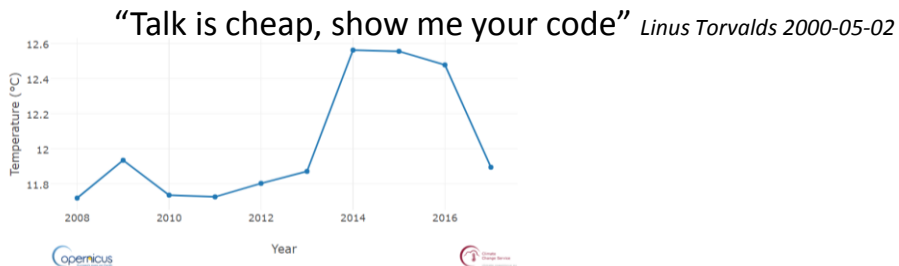
Mean

Period

Annual



Timeseries of mean of Tmin for Rome



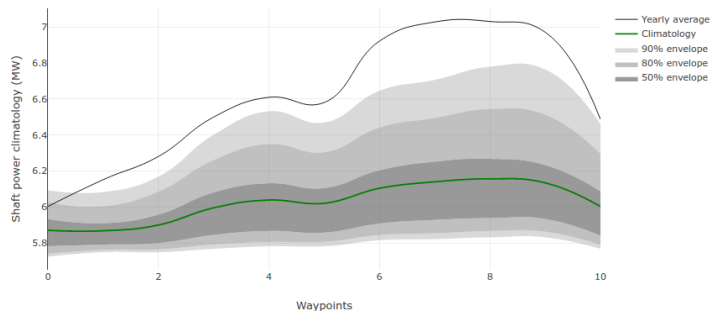


Climate Change

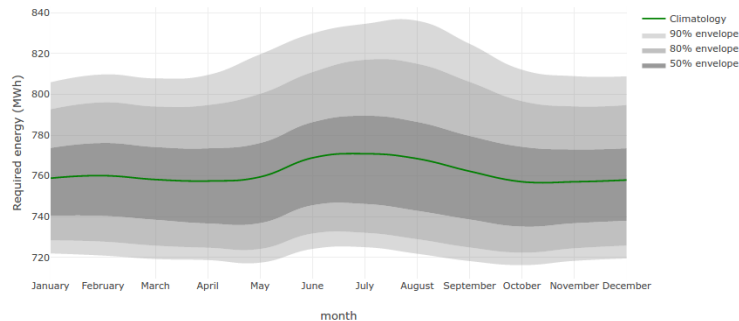
Climate indicators related to Shipping

Which part of the route/season is most likely to lead to overconsumption ?

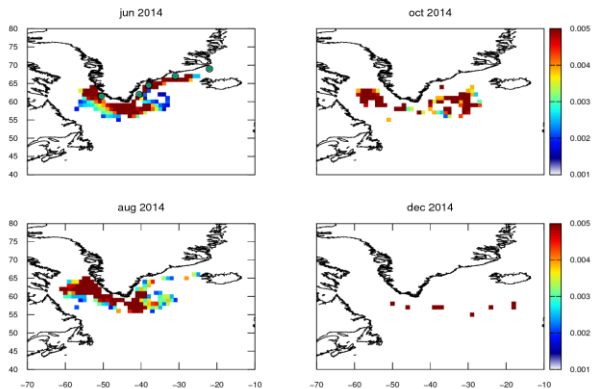
Shaft power climatology in July



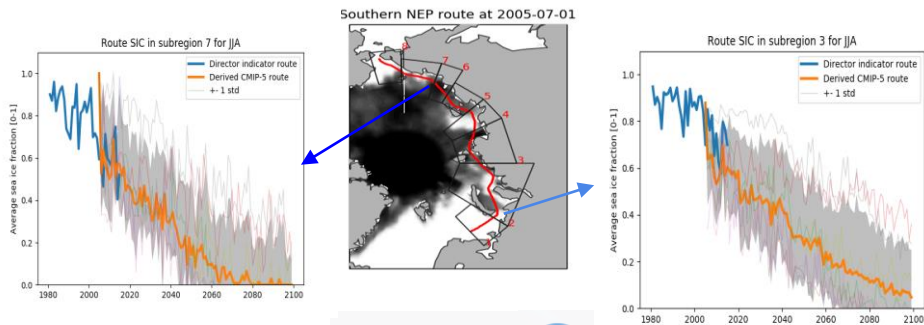
Yearly climatology of required energy



Where/when will I find icebergs ?



When will the Arctic route become commercially viable?





Climate Change

Evaluation and Quality Control (EQC)

A suitable EQC framework has been developed for quality assurance of CDS datasets

Key feature: Quality Assurance R

Sea ice monthly and daily gridded data from 197

Overview Download data Documentatio **Quality**

This dataset provides daily values for sea ice **concentration**, sea ice **edge** and sea ice **type** and monthly values for sea ice **thickness**. These four variables are important markers for climate change studies since sea ice greatly influences the surface albedo and aa exchanges of energy, moisture and carbon. The sea-ice distribution, including polynyas and margins, also has an important infl on marine ecosystems. Changes in the distribution of sea ice affect these ecosystems and a number of activities such as shippingistic and tourist operations.

Ice Conc - Reprod



Copyright

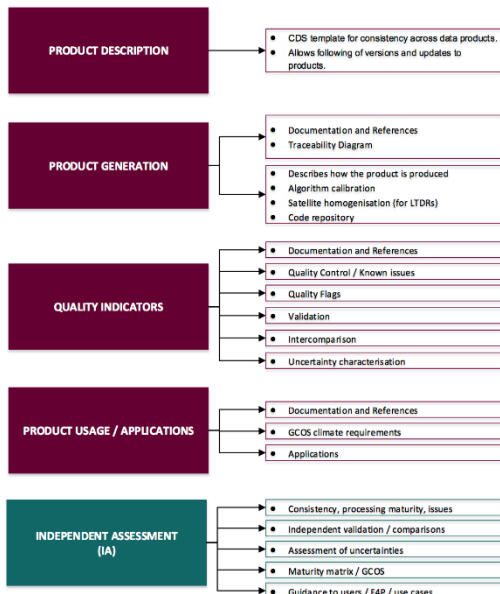
Sea ice edge, sea ice concentration and sea ice type were computed from satellite passive microwave brightness temperatures from the series of SMMR, SSM/I and SSMIS sensors. Sea ice thickness were computed from Ku-Band radar altimeter measurements collecting the Envisat and CryoSat-2 satellite missions. Ice thicknesses from Envisat satellite (October 2002 to October 2010) have less coverage and higher tainty than (November 2010 - March 2015), however the combined dataset provides a valuable variability.

From 1978 up to April 2015 the data records provided by this dataset have continuity to detect climate variability and change. From April 2015 onwards, same algorithms and processing environment but consistency and continuity have not been maintained.

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

DATA DESCRIPTION

Horizontal coverage	Sea ice concentration and edge: global ocean split in Northern and Southern hemisphere (Lambert EASE/EASE2 projection). Sea ice thickness and type: northern hemisphere (Lambert EASE2 projection).
---------------------	--



Quality of data:

- assessments
- user guidance
- gaps and limitations

Quality of tools:

- fitness for purpose
- best practices

Quality of service:

- speed, responsiveness
- system availability, ...



Climate
Change

Monthly climate bulletins

Implemented by ECMWF as part of The Copernicus Programme

Climate Change Service

News Events Press Tenders Help & Support

ABOUT US WHAT WE DO DATA QSEARCH

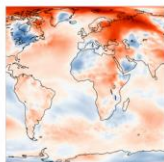
WHAT WE DO ► CLIMATE BULLETIN

Climate bulletins

Through our monthly maps, we present the current condition of the climate using key climate change indicators. We also provide analysis of the maps and guidance on how they are produced.

HIGHLIGHTS OF THE LATEST MONTHLY SUMMARIES MONTHLY CLIMATE UPDATE FEATURED STORY MONTHLY SUMMARIES

Monthly summaries



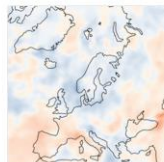
Surface air temperature

This series of monthly maps and charts, generated from ERA-interim data, covers



Sea ice

We produce sea-ice maps every month. Based on ERA-interim reanalysis data, these provide near real-time



Hydrological variables

This series of monthly maps and charts, based on ERA-interim data, covers several



Surface in-situ monitoring for Europe

Monthly and yearly State-of-the-European-climate reports provided

Monthly climate update

15TH OCTOBER 2018

In Europe, it was the warmest September on record. Portugal and western Spain were particularly warm.

Iceland, Ireland and Scotland saw generally cooler than average temperatures.

Japan was hit by two devastating storms, Jebi and Trami following rains, landslides, floods and record-breaking heat this year.

Strong tropical cyclone Mangkhut caused at least 134 fatalities in the Philippines, Hong Kong and China.



Featured story

29TH OCTOBER 2018



A stormy September

One of the **warmest summers on record** has come to an end with a September full of storms. Modelling of historic storms can help us prepare for such events. We use two of the recent storms to demonstrate the improvements we have made with the release of our new **dataset**.

[Read more](#)

➤ climate.copernicus.eu/climate-bulletins





Climate Change

Contributing to EEA, GCOS and the WMO

WORLD METEOROLOGICAL ORGANIZATION
Weather · Climate · Water

Our mandate · Programmes · Projects · Resources · Media · Events · About us · Extranet

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

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

Global and European temperature

Indicator Assessment — Prod-ID: 190-4-en Alpha known as: CS3 012, CLM 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).

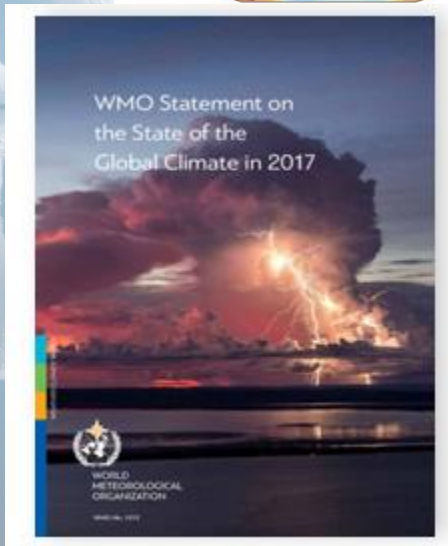


Photo: — Programmes — Global Climate Observing System — Global Climate Indicators

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: gcios@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-GlobTemp (NOAA); and JRA-55 (JMA). Credit: Copernicus Climate Change Service/ECMWF

60-month average global temperature

Change during industrial era

1800 1850 1900 1950 2000 2020

13.0 14.5 16.0 17.5 19.0 20.5 22.0

0.0 0.5 1.0 1.5

ERA-Interim GISTEMP HadCRUT4 NOAA-GlobTemp JRA-55

ECMWF Copernicus

series 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 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 spread across north-eastern Europe and Scandinavia in winter and southern Europe in summer. The number of days exceeding the 90th percentile threshold of a baseline period) have doubled between 1960 and 2017 (Fig. 1.10). 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 century. In southern Europe, they are projected to be particularly strong.

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

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

1850 1900 1950 2000 2017

0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5 9.0 9.5 10.0 10.5 11.0 11.5 12.0 12.5 13.0 13.5 14.0 14.5 15.0 15.5 16.0 16.5 17.0 17.5 18.0 18.5 19.0 19.5 20.0 20.5 21.0 21.5 22.0 22.5 23.0 23.5 24.0 24.5 25.0 25.5 26.0 26.5 27.0 27.5 28.0 28.5 29.0 29.5 30.0 30.5 31.0 31.5 32.0 32.5 33.0 33.5 34.0 34.5 35.0 35.5 36.0 36.5 37.0 37.5 38.0 38.5 39.0 39.5 40.0 40.5 41.0 41.5 42.0 42.5 43.0 43.5 44.0 44.5 45.0 45.5 46.0 46.5 47.0 47.5 48.0 48.5 49.0 49.5 50.0 50.5 51.0 51.5 52.0 52.5 53.0 53.5 54.0 54.5 55.0 55.5 56.0 56.5 57.0 57.5 58.0 58.5 59.0 59.5 60.0 60.5 61.0 61.5 62.0 62.5 63.0 63.5 64.0 64.5 65.0 65.5 66.0 66.5 67.0 67.5 68.0 68.5 69.0 69.5 70.0 70.5 71.0 71.5 72.0 72.5 73.0 73.5 74.0 74.5 75.0 75.5 76.0 76.5 77.0 77.5 78.0 78.5 79.0 79.5 80.0 80.5 81.0 81.5 82.0 82.5 83.0 83.5 84.0 84.5 85.0 85.5 86.0 86.5 87.0 87.5 88.0 88.5 89.0 89.5 90.0 90.5 91.0 91.5 92.0 92.5 93.0 93.5 94.0 94.5 95.0 95.5 96.0 96.5 97.0 97.5 98.0 98.5 99.0 99.5 100.0

ECMWF Copernicus European Commission

C3S: Operational production of climate indicators



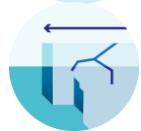
Surface temperature



Greenhouse gases



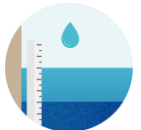
Rain



Sea Ice



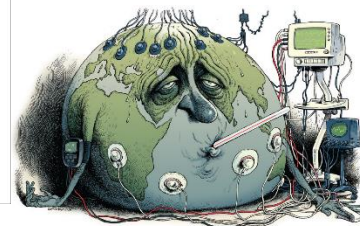
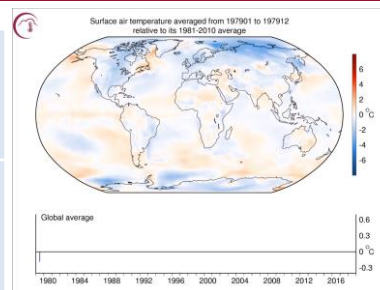
Glaciers



Sea Level



Soil Moisture



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



<https://climate.copernicus.eu/CopernicusESC>



Climate

C3S and UNFCCC Sustainable Development Goals

C3S contribution to SDGs

C3S contribution to SDGs

2 ZERO HUNGER

C3S SIS addresses agriculture, and some of the global services will focus on food security

3 GOOD HEALTH AND WELL-BEING

C3S SIS addresses health, providing relevant climate change indicators

6 CLEAN WATER AND SANITATION

Two Proof-of-concept SIS projects in C3S dedicated to water management. A urban PoC SIS is also addressing this SDG at city level. Operationalisation underway

7 AFFORDABLE AND CLEAN ENERGY

Two proof-of-concept SIS projects in C3S dedicated to the Energy Sector. Reanalyses (produced by C3S) are also highly relevant.

8 DECENT WORK AND ECONOMIC GROWTH

C3S activities contribute indirectly to this SDG insofar that the energy climate impact indicators (see goal 7) are relevant.

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

C3S is working closely with the standardisation community (via DG-CLIMA) on developing climate change information required for the writing of standards in infrastructure and transport.

11 SUSTAINABLE CITIES AND COMMUNITIES

C3S SIS related to urban aspects of climate change, as well as health and infrastructure aspects, contribute indirectly to this SDG. Reanalysis products too.

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

C3S SIS products and indicators on water management are directly relevant for this goal.

13 CLIMATE ACTION

ECV products, including from reanalysis, CDRs, seasonal forecasts and climate scenarios, directly relevant for adaptation. The SIS also delivers relevant indicators in support of adaptation. Cooperation: EEA Climate ADAPT

14 LIFE BELOW WATER

Some of the ECV products generated by C3S (including reanalysis ORAS5) are ocean relevant. This is done in coordination with CMEMS.

15 LIFE ON LAND

Biodiversity is a future sectoral application of C3S. Relevant products will contribute to this goal. ECV products on soil moisture, forestry, lakes, also contribute to this goal.



Climate
Change

C3S user learning services

Focus on the use of the Climate Data Store to address climate change adaptation challenges

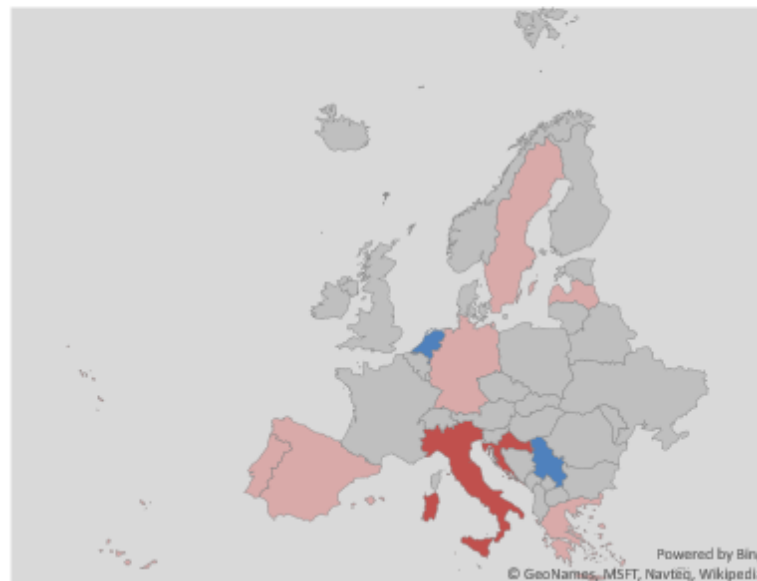
Key elements:

- Blended training
- Online training resources freely available anywhere and anytime
- Personalized learning
- 3 main target audiences
- In-country training events in local language in more than 30 EU countries
- Train the trainers to widen the reach of the training and increase the impact

➤ uls.climate.copernicus.eu

Train the trainer events

- completed (2018)
- planned (2018)
- tentative (2019)

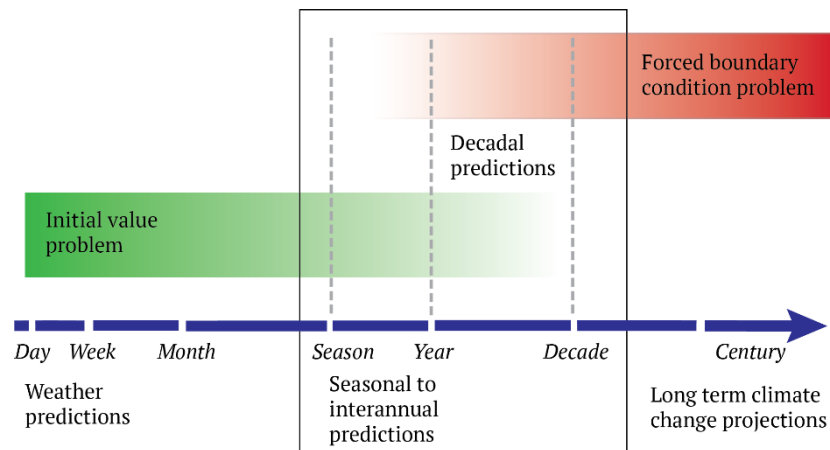




Climate
Change

What's next: Decadal Component

- **Rationale:**
 - Current user requirements surveys and discussions with C3S stakeholders clearly indicate the need for information at decadal timescales.
 - Current gap in the Service
- **Process:**
 - Workshop (early 2019) involving key stakeholders, the scientific and user community
 - Take stock of the existing state-of-play
 - (WMO operational initiative, C3S climate projections roadmap recommendations, projects e.g. EUCP, etc.)
 - Assess the level of maturity of decadal prediction (including verification) science.
 - Agree and design a prototype decadal component before the end of the current Delegation Agreement



Credit: WCRP

Reference:

- C3S User Requirement study (<https://climate.copernicus.eu/secteur>)
- <https://www.sciencedirect.com/science/article/pii/S2405880717300018>
- [European Roadmap for Climate Services](#)



Climate
Change

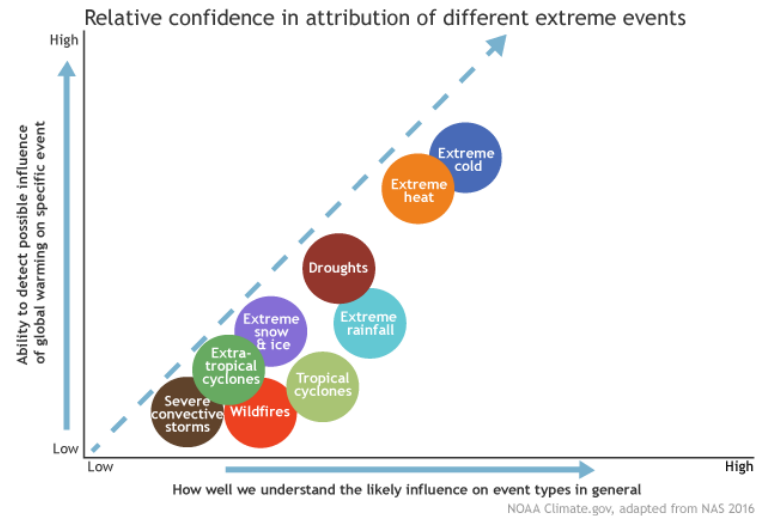
What's next: Attribution component

Rationale:

- High interest from the society (media, policy makers, planners)
- Event attribution studies aim at providing a rigorous scientific approach to determine to what extent weather-related risks have changed due to human influences on climate.

Process:

- Brainstorming with key stakeholders to revisit the “attribution science” state of play (Prague workshop, 10-11 October 2017)
- Ongoing study to define a publishable protocol for operational attribution, together with requirements on data and tools
- Validation of this protocol by the scientific community
- commission a "prototype" Attribution service element towards a possible operational Attribution component for C3S next generation.



Reference:

- C3S Technical Annex (page 34)
- C3S precursor project EUCLEIA <https://eucleia.eu>



Copernicus

What's next: Broad international agenda

- “Transforming our world: the 2030 Agenda for Sustainable Development” - 17 **Sustainable Development Goals** with 169 associated targets
- Sendai Framework for **Disaster Risk Reduction** 2015–2030 with seven global targets
- **Paris Agreement** adopted by conference of parties to United Nations Framework Convention on Climate Change (COP-21)
- The **New Urban Agenda** adopted at Habitat III



Credit: WMO





Copernicus

Establishment of User Needs / Requirements for Copernicus evolution

- The EC conducted in 2016-17 a wide initiative to identify long term, “user-driven” requirements for evolution of Copernicus services and space segment => user consultations, workshops, etc.
- Copernicus will continue to be a public service, driven by the needs of policy and public administrations, and fostering economic development in Europe
- Stability of the programme and long term commitment
 - (Enhanced) continuity of current data and services;
 - Continuity of full, open and free data policy
- Emerging needs
 - Climate change and sustainable development;
 - Monitoring CO2 and other greenhouse gas emissions;
 - Land use and forestry;
 - Changes in the Arctic;
 - Security and Defence: Improving the EU's capacity (border control, maritime surveillance);

30 November 2017



Copernicus

Space Segment, observation requirements preliminary conclusions

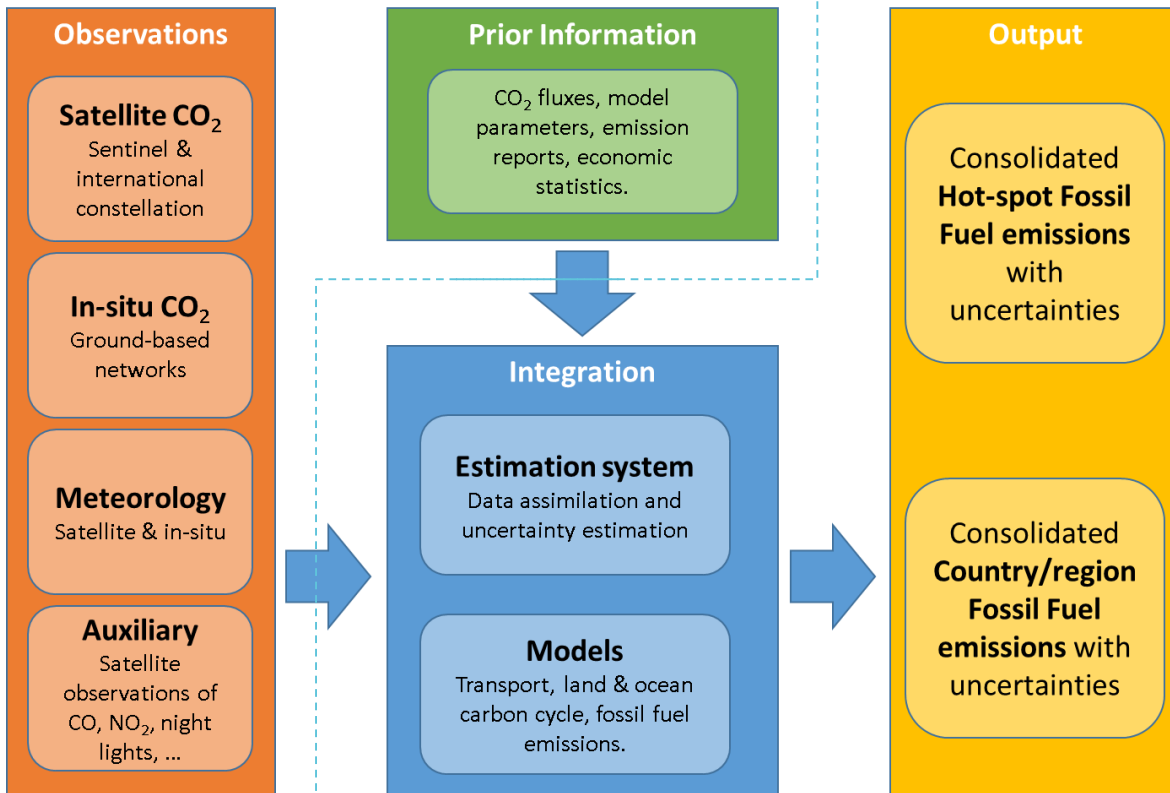
- **The (enhanced) continuity of existing observation capacity is the overarching priority;**
- **Conclusions on major gaps :**
 - CO2 measurements to estimate anthropogenic emissions (highest priority)
 - High-Resolution Thermal observations
 - SAR L-band observations
 - Monitoring of sea ice and ice sheets in the polar region (various measurements and instruments)
 - Hyper-spectral measurements
- Very **ambitious plans** being put forward by the EC/ESA for the future generation of Copernicus satellites (Sentinels 1 to 6 deployment completion, Next Gen S1 to S6, and further missions)

30 November 2017



Copernicus

CO₂ ANTHROPOGENIC EMISSION MONITORING SYSTEM



Approach based on CAMS and C3S, with 3 complementary components:

- ECMWF/IFS @5-10km, 100+ satellite data streams
- Regional zooms @1-2km
- Hot spots



Implemented by ECMWF as part of The Copernicus Programme

**Climate
Change Service**

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