



Climate Change

# C3S and the Atmospheric Composition ECVs

M. Van Roozendael (BIRA-IASB)

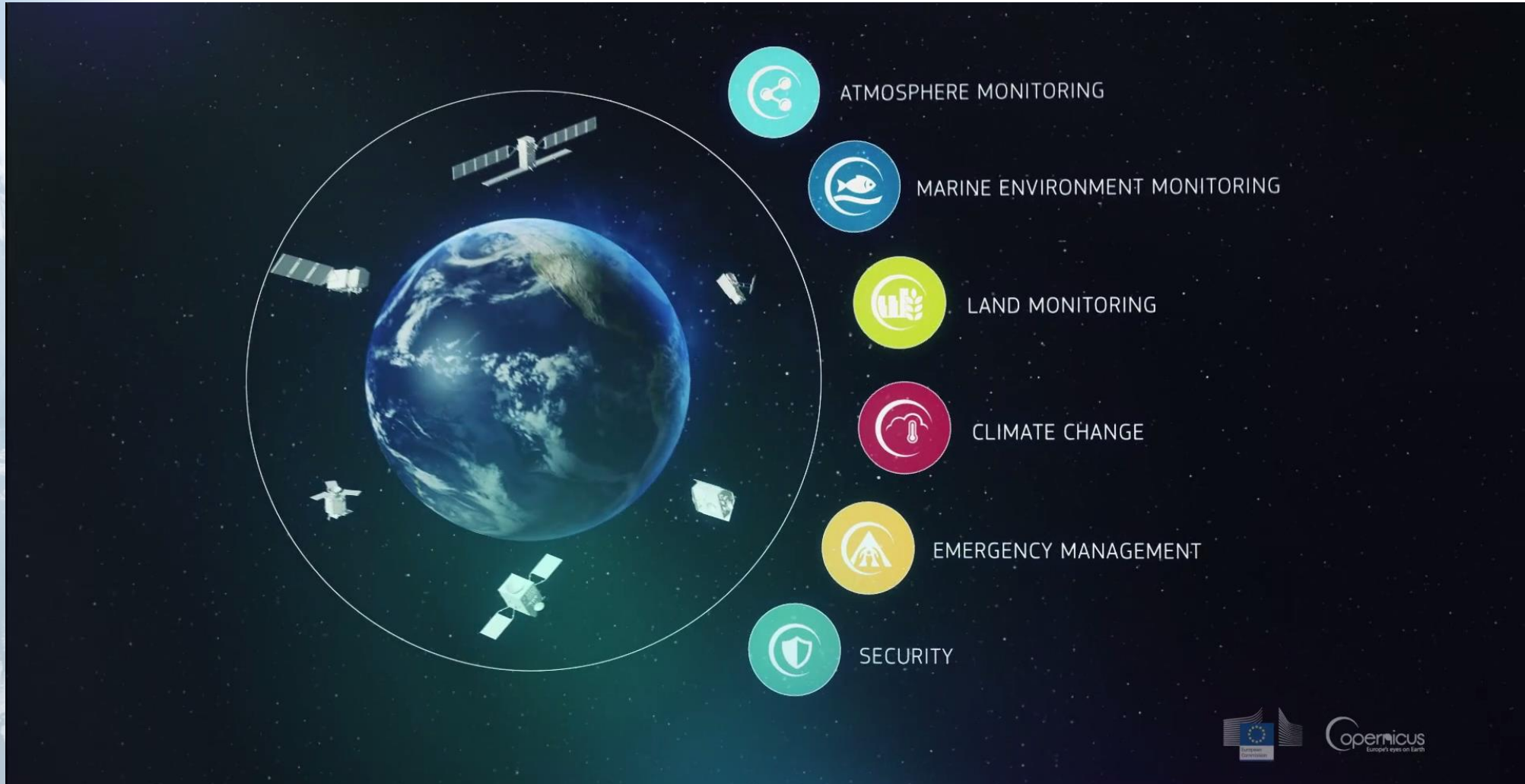
D. Schepers, J. Munoz Sabater (ECMWF)





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# Copernicus: Earth observations and information services



To support European adaptation and mitigation policies by:

- Building on existing capabilities and infrastructures
- Providing consistent and authoritative information about climate
- Stimulating the market for climate services in Europe





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# Components of C3S

## Climate Data Store

Essential Climate Variables (ECVs) for atmosphere, ocean, land and Climate Indicators:

- Observed, reanalysed and simulated
- In support of adaptation & mitigation policies at global and European level
- On a distributed system, single access portal
- Toolbox

## Sectoral Information System



- Ensures C3S delivers state-of-the-art climate information to end-users
- 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

## Outreach Dissemination

- Web content provision & management
- Public outreach
- Coordination with national outreach efforts
- Liaison with public authorities
- Events (conferences, seminars...)
- Training and education service

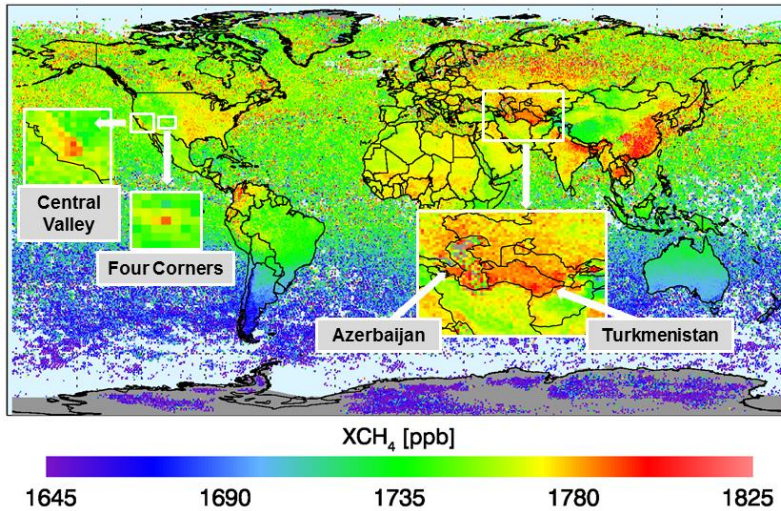




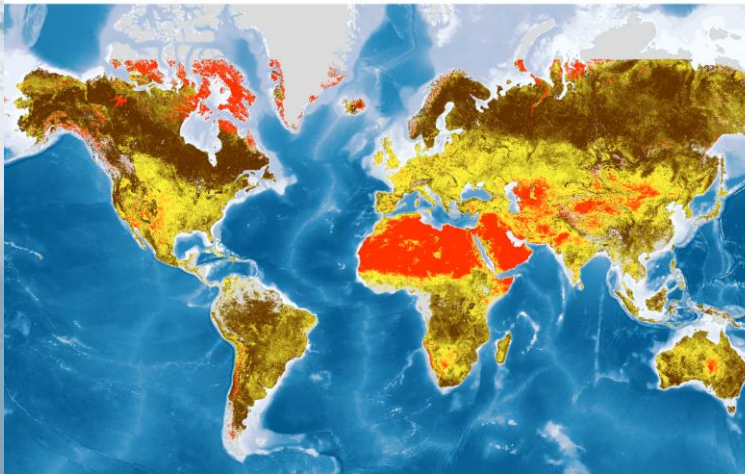
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# Access to observations and climate reanalyses

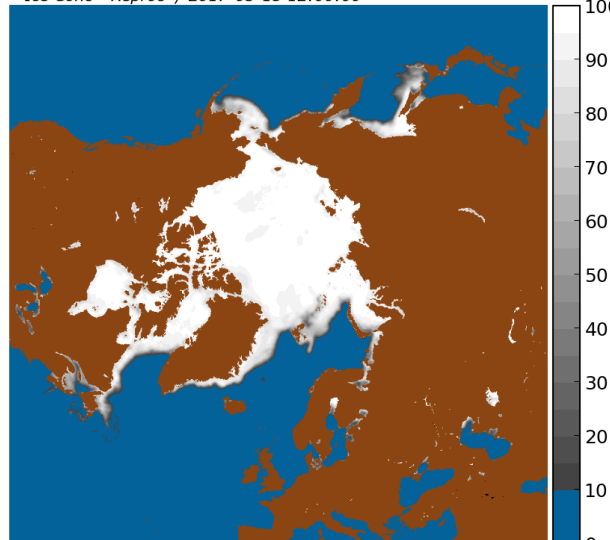
Methane SCIAMACHY/ENVISAT WFMD



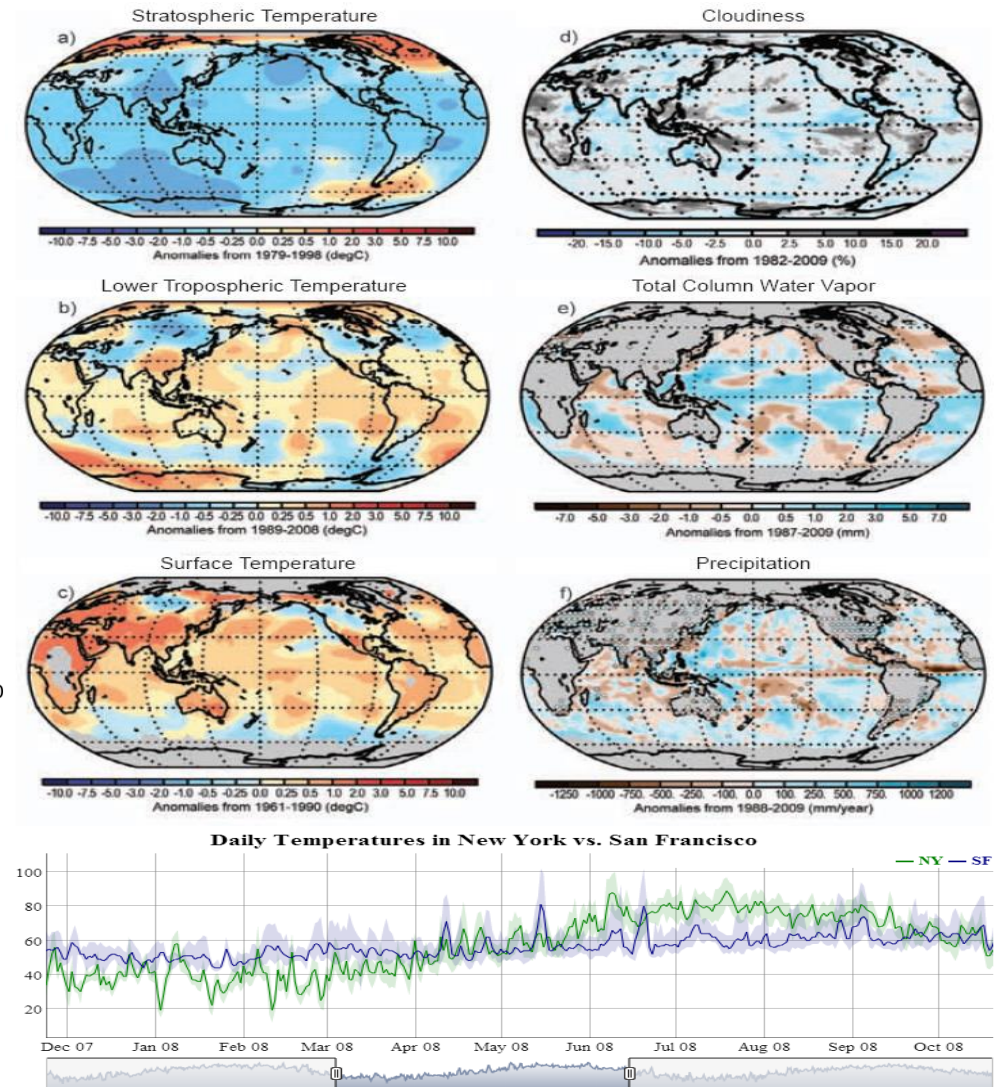
Albedo, Hemispherical



Ice Conc - Reproc / 2017-03-15 12:00:00



Copyright (2017) EUMETSAT












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# Access to seasonal forecast data and products





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ABOUT C3S

NEWS & MEDIA

EVENTS

TENDERS

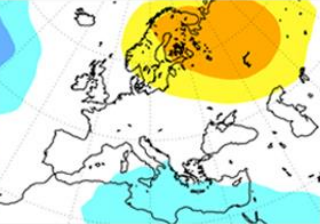
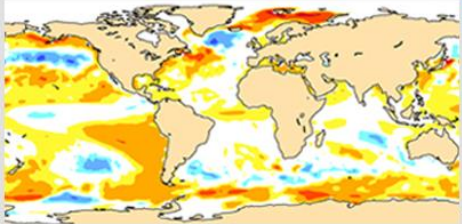
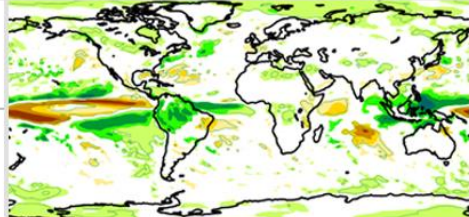
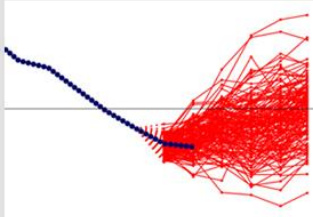
PRODUCTS

SERVICES

HELP & SUPPORT

## Seasonal forecasts

home » products



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

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

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

AVERAGE SURFACE AIR MONTHLY MAPS

MONTHLY SEA-ICE MAPS

HYDROLOGICAL CLIMATE

CLIMATE REANALYSIS

SEASONAL FORECASTS

### NEWS

16 Jul 2017  
C3S releases powerful new "encyclopaedia" for public

03 Mar 2017  
#OpenDataHack @ECMWF uses of open data

03 Mar 2017  
C3S holds its inaugural G

26 Jan 2017  
Copernicus at the 4th Int on Energy & Meteorology

06 Dec 2016  
Report Reassesses Variat

More News

### EVENTS

13 Nov 2017

Base time

Map type (forecasts and skill measures)

Area

Product results

C3S multi-system seasonal forecast

Mean forecast SST anomaly

Nominal forecast start: 01/08/17

Variance-standardized mean

ECMWF/Met Office/Météo-France

NDJ 2017/18

<-2.0°C

-2.0..-1.0

-1.0..-0.5

-0.5..-0.2

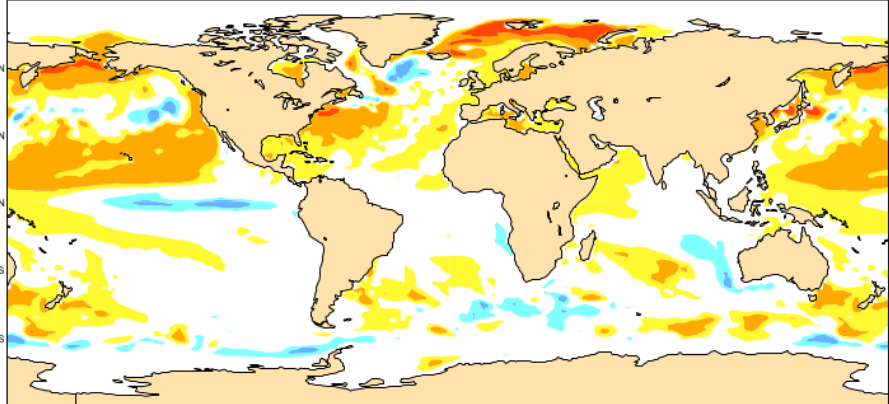
-0.2..0.2

0.2..0.5

0.5..1.0

1.0..2.0

> 2.0°C



Oct 2017

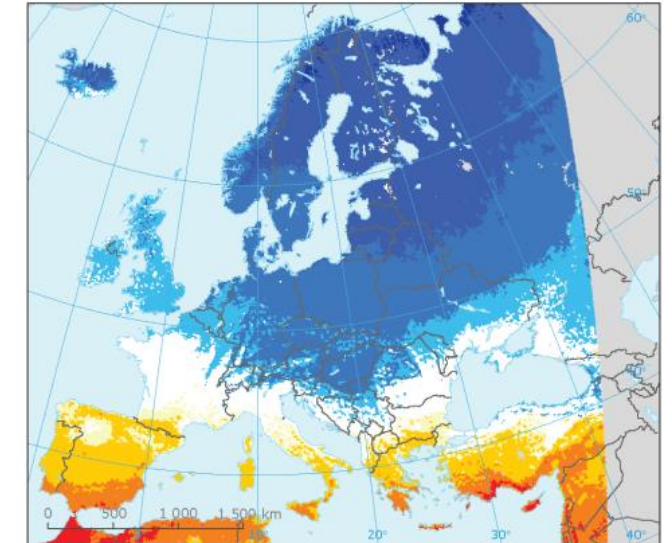
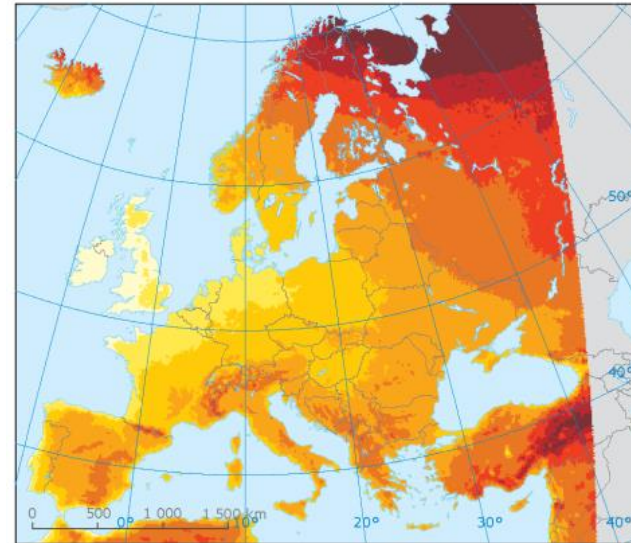
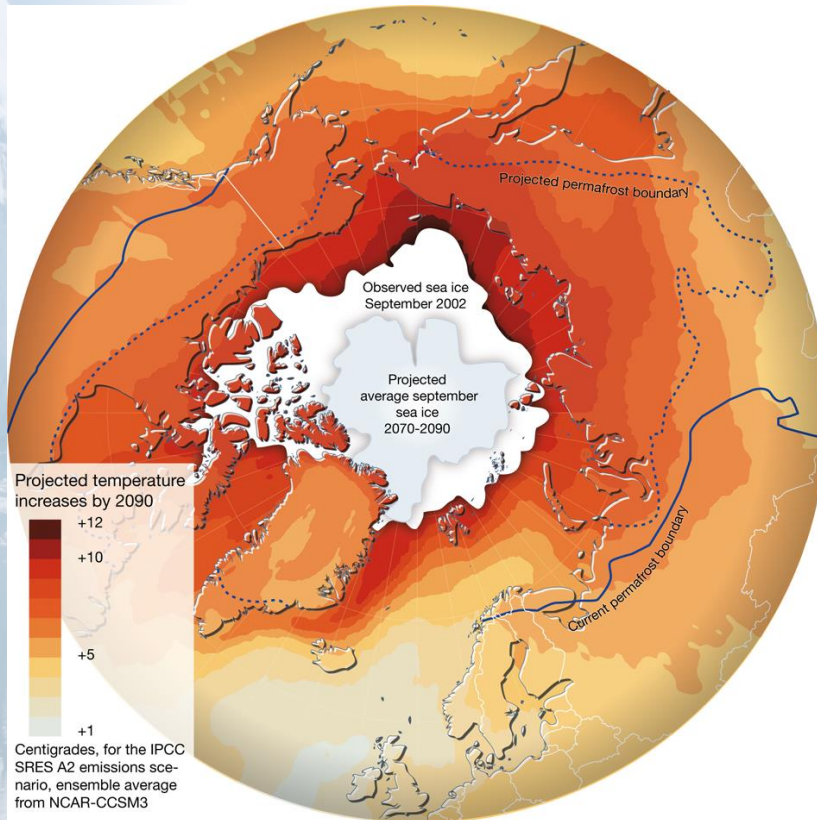
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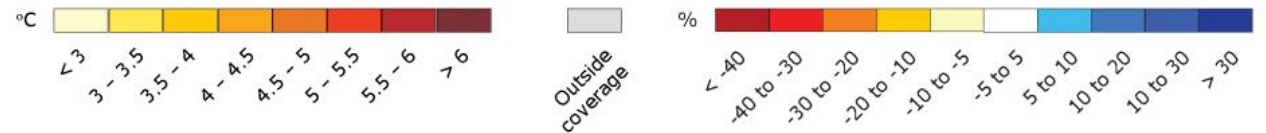


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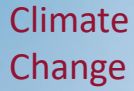
# Access to climate model simulations



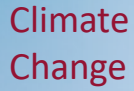
Projected changes in annual mean temperature (left) and annual precipitation (right)







# Climate Change







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# Climate Data Store: Content



## Scientific basis:

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



Action engaged



In preparation  
(PIN or ITT out)



Not started

## Observations

Global estimates  
of ECVs from  
satellite and in-  
situ observations

Reprocessed  
CDRs, reference  
observations

Support for data rescue,  
climate data collections

## Reanalyses

Global atmosphere,  
ocean, land

Regional  
reanalyses for  
Europe and  
Arctic

Coupled climate  
reanalysis for  
100 years

## Model data

Multi-model seasonal  
forecast products

Access to CMIP  
data and  
products, global  
and regional

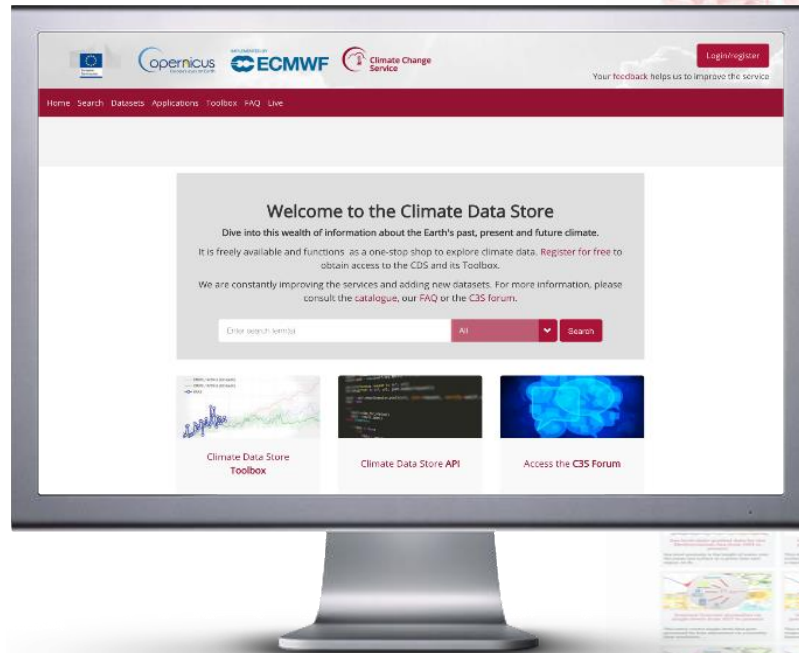
Reference set of  
climate projections  
for Europe

Climate Indicators



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# 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*





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## Current EO activities in C3S

C3S_311a	Data rescue activities	Lot1: Coordination of data rescue activities	Started 2017Q2/ End 2021Q2
		Lot2: Harmonised access to Global Data Archives	Started 2017Q2 / End 2021Q2
		Lot3: Harmonised access to data from reference networks	Started 2017Q2 / End 2021Q2
C3S_311c		Lot1: Satellite data rescue, mainly prior to 1978	Started 2018Q4 / End 2021Q2
		Lot2 : Upper-air data rescue	Started 2018Q4 / End 2021Q2
C3S_311b	Reprocessing	Reprocess of EUMETSAT L1 satellite data	Started 2016Q3 / End 2021Q2

### Gridded datasets

C3S_311a	Lot4: High-resolution ECV products for Europe	Based on E-OBS	Started 2017Q2 / End 2021Q2
C3S_312b	ECV products from satellite observations → 22 ECVs organized in 5 Lots	Lot1: Atmospheric Physics	Started 2018Q3 Will end 2021Q2
		Lot2: Atmospheric Composition	
		Lot3: Ocean	
		Lot4: Hydrology & Cryosphere	
		Lot5: Land Biophysics	



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# ECVs evolution in C3S (satellite data)

			C3S_312a				
				C3S_312b			
		GCOS	2017	2018	2019	2020	2021
Atmospheric physics							
	Precipitation	4.3.5		Lot 1			
	Surface Radiation Budget	4.3.6					
	Water Vapour	4.5.3					
	Cloud Properties	4.5.4					
	Earth Radiation Budget	4.5.5					
Atmospheric composition							
	Carbon Dioxide	4.7.1	Lot 6	Lot 2			
	Methane	4.7.2	Lot 6				
	Ozone	4.7.4	Lot 4				
	Aerosol	4.7.5	Lot 5				
Ocean							
	Sea Surface Temperature	5.3.1	Lot 3	Lot 3			
	Sea Level	5.3.3	Lot 2				
	Sea ice	5.3.5	Lot 1				
	Ocean Colour	5.3.7					
Land hydrology & cryosphere							
	Lakes	6.3.4		Lot 4			
	Glaciers	6.3.6	Lot 8				
	Ice sheets and ice shelves	6.3.7					
	Soil moisture	6.3.16	Lot 7				
Land biosphere							
	Albedo	6.3.9	Lot 9	Lot 5			
	Land Cover	6.3.10					
	Fraction of Absorbed Photosyntheti	6.3.11	Lot 9				
	Leaf Area Index	6.3.12	Lot 9				
	Fire	6.3.15					
			2017	2018	2019	2020	2021

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

Coordination with ESA-CCI and other  
national projects

Coordination with ESA-CCI

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

Coordination with ESA-CCI, CGL,  
LSA-SAF







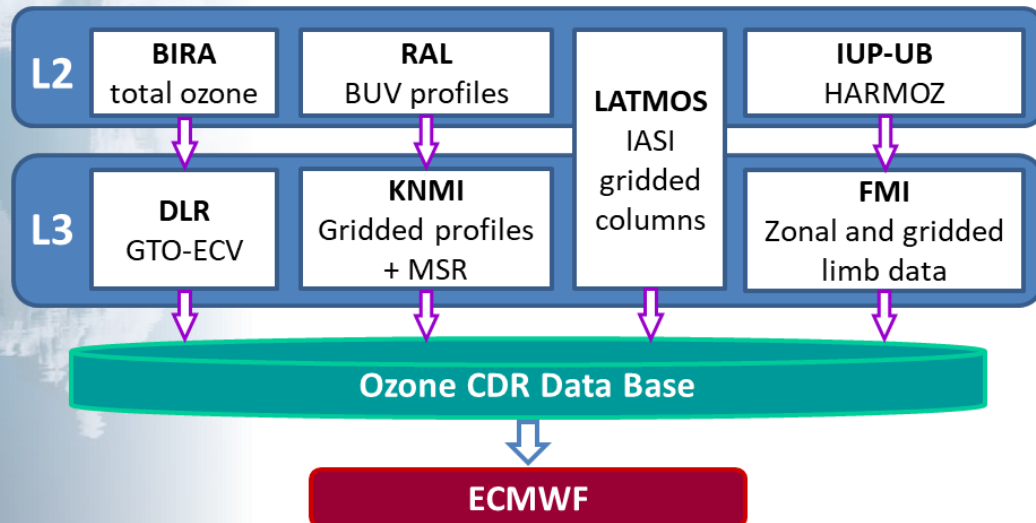
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# C3S\_312b\_Lot2 ozone data production

## Main platforms and sensors

Agency	Satellite platform	Sensor	Time period																			
			96	97	98	99	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
ESA	ERS-2	GOME																				
		SCIAMACHY																				
		GOMOS																				
		MIPAS																				
EUMETSAT	METOP-A	GOME2-A																				
		IASI-A																				
	METOP-B	GOME2-B																				
		IASI-B																				
SNSB CSA	ODIN	OSIRIS																				
		SMR																				
CSA	SCISAT	ACE																				
NASA	ERBS	SAGE-2	84																			
	UARS	HALOE	91																			
	TIMED	SABER																				
	AURA	MLS/OMI																				

## The distributed ozone production system



## Ozone data products

25 ozone data products from various satellites and sensors, including:

- O<sub>3</sub> total column
- O<sub>3</sub> tropospheric column
- O<sub>3</sub> vertical profile (nadir)
- O<sub>3</sub> vertical profile (limb)

**C3S\_312b\_Lot2**  
(aerosol/GHG/ozone)



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# Integration in the CDS

## Harmonized view & downloading sites

### Ocean colour daily data from 1997 to present derived from satellite observations

[Overview](#) [Download data](#) [Documentation](#)

This dataset provides global daily estimates of ocean surface **chlorophyll-a concentration** and **remote sensing reflectance** derived from multiple satellite sensors. These two products are part of the broader discipline of ocean colour remote sensing, which analyses ocean surface radiances measured from space to derive information about the optical properties and constituents of the upper ocean. This information plays an essential role in our ability to monitor the health and productivity of marine ecosystems, assess the role of the oceans in the global carbon cycle, and quantify the impacts of climate change. Satellite remote sensing is the only method for regular monitoring of the ocean biology on a global scale.

Remote-sensing reflectance (or Rrs) is defined as the ratio of water-leaving radiance to downwelling irradiance and serves as the main input to algorithms used to derive other ocean colour products. Chlorophyll-a (Chl-a) is the main photosynthetic pigment found in phytoplankton, which form the base of the marine food-web and are responsible for approximately half of global photosynthesis. Chl-a can be estimated from Rrs data using different algorithms (see details in the Documentation). Here, we provide a blended Chl-a estimate from multiple algorithms, where blending is based on the suitability of each candidate algorithm to the optical typology of a given pixel. This approach provides the best estimates of global Chl-a across a range of water types.

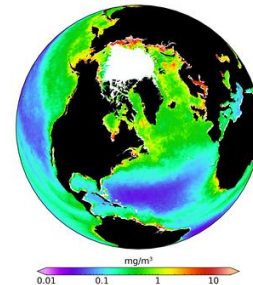
The files from this dataset contain global daily composites of merged sensor (SeaWiFS, MERIS, MODIS Aqua, VIIRS) products. Note that Rrs and Chl-a data are only available over cloud- and ice-free areas. As a result, more complete spatial coverage (as shown in the map in the upper-right corner) can be achieved by aggregating data over longer time periods.

This dataset is produced using the processing chain software developed by the Ocean Colour component of the European Space Agency Climate Change Initiative project (ESA OC-CCI).

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

DATA DESCRIPTION	
Data type	Grid (latitude-longitude and sinusoidal grids)
Horizontal coverage	Global
Horizontal resolution	Sinusoidal equal-area grid: 4km x 4km Regular latitude-longitude grid: 0.042° x 0.042° (4km x 4km at the Equator)
Temporal coverage	From September 1997 to present
Temporal resolution	Daily

2018 annual mean chlorophyll-a concentration



#### Contact

[copernicus-support@ecmwf.int](mailto:copernicus-support@ecmwf.int)

#### Licence

Licence to Use Copernicus Products

ESA CCI Essential Climate Variable products' licence

#### Publication date

2019-11-21

### Ocean colour daily data from 1997 to present derived from satellite observations

[Overview](#) [Download data](#) [Documentation](#)

#### Variable ?

At least one selection must be made

☐ Remote sensing reflectance

☐ Mass concentration of chlorophyll-a

#### Projection

At least one selection must be made

☐ Sinusoidal grid

☐ Regular latitude-longitude grid

[Select all](#)

#### Year

At least one selection must be made

☐ 1997  
☐ 2003  
☐ 2009  
☐ 2015

☐ 1998  
☐ 2004  
☐ 2010  
☐ 2016

☐ 1999  
☐ 2005  
☐ 2011  
☐ 2017

☐ 2000  
☐ 2006  
☐ 2012  
☐ 2018

☐ 2001  
☐ 2007  
☐ 2013  
☐ 2019

☐ 2002  
☐ 2008  
☐ 2014

[Select all](#)

#### Format ?

☒ Zip file (.zip)

☐ Compressed tar file (.tar.gz)

[Clear all](#)

[Show API request](#)

[Show Toolbox request](#)

[Please check mandatory fields](#)

## Other characteristics

- Information landing page for the main data providers
- Data licenses
- Comprehensive set of documentation for each dataset version







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# Way Forward

## **Increase ECV portfolio from the current 22 up to 35 ECVs (\*)**

- Potential ECVs for next phase: river discharge, permafrost, LST, snow, upper-air temperature, surface ocean currents, etc.

## **Progressive transition towards the use of Sentinel data by current ECV products**

- 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**

- Introduction of use cases applications
- Quality Assurance tab for each ECV
- Cross-signposting of ECV products with other data suppliers
- Increased collaboration with ESA-CCI and EUMETSAT SAF programmes, as well as with the other Copernicus Services to maximize the catalogue of data services provision

(\*) budget-permitting



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# Way Forward

## Requirements for future ECVs:

- be suitable for use as CDRs, i.e. be of sufficient length, consistency, homogeneity and continuity to represent past climate variability and change;
- have global or near-global coverage;
- be derived from observations only (satellite and/or in situ);
- provide the best achievable spatial coverage and resolution given available observations;
- provide the best achievable length of record and frequency of output given available observations;
- be frequently updated to incorporate newly available input observations (ICDRs);
- be periodically reprocessed using improved algorithms and/or newly available input data;
- include meaningful estimates of uncertainty, in terms of accuracy and precision;
- include metadata on data provenance to ensure full traceability of information;
- be delivered using data formats, metadata and pre-defined protocols;
- be fully documented
- be backed up with specialised user support