



Atmosphere Monitoring

CAMS & C3S

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ECMWF



Copernicus EU



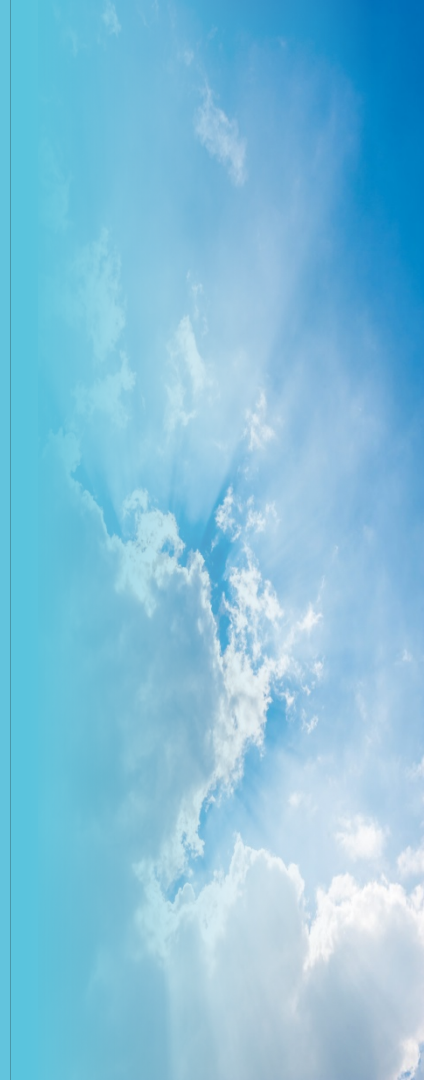
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Atmosphere
Monitoring

The EU Copernicus programme



Observations
feeding into
value-added
Services



Atmosphere



Climate



Land



Marine



Emergency



Security

Copernicus is the European Union's operational Earth Observation and Monitoring programme, looking at our planet and its environment for the ultimate benefit of all citizens.

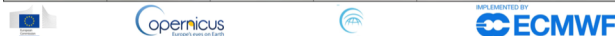
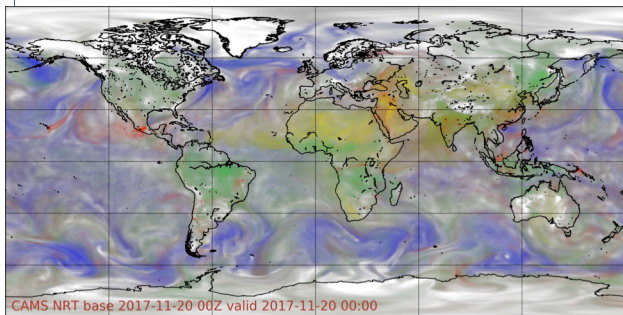
User-driven with free and unrestricted data access



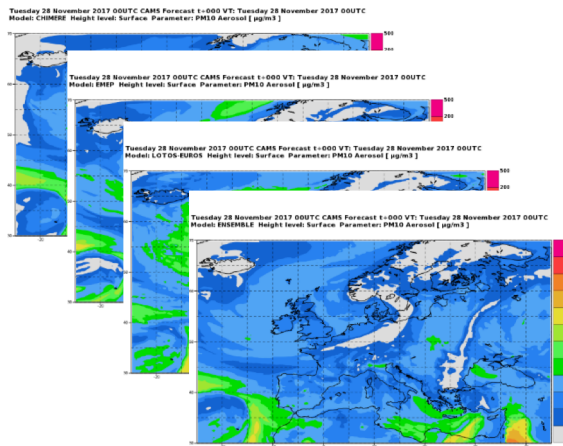


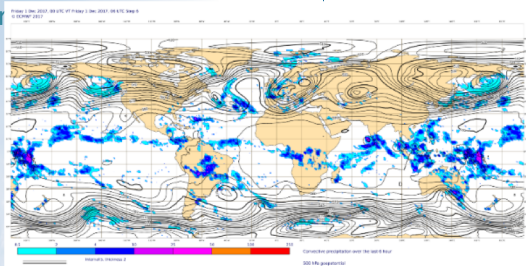
Copernicus Atmosphere Monitoring Service

Atmosphere Monitoring

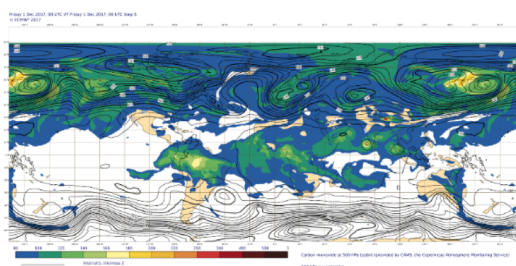


Transforming satellite observations into user-driven services.

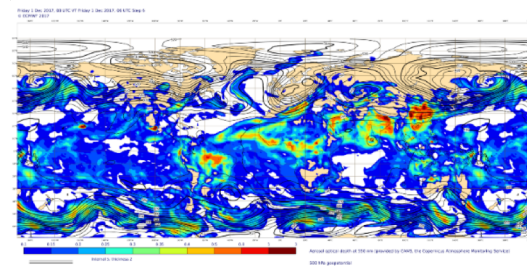




Carbon monoxide



Aerosol



ECMWF's NWP forecasting system (IFS) has been extended with atmospheric composition variables and relevant observations. Full tropospheric chemistry (CB05 scheme), simplified stratospheric chemistry (Cariolle scheme), bulk aerosol scheme and greenhouse gases are part of the IFS.

Species	Instruments
O ₃	OMI, SBUV, GOME-2, MLS, OMPS, S5p
CO	IASI, MOPITT, S5p
NO ₂	OMI, GOME-2, S5p
SO ₂	OMI, GOME-2, S5p
Aerosol	MODIS, PMAp, VIIRS, S3
CO ₂	GOSAT, OCO-2
CH ₄	GOSAT, IASI, S5p

The CAMS forecasting system uses standard 4D-Var with a 12-hour data assimilation window and with static background errors based on NMC and EDA statistics.

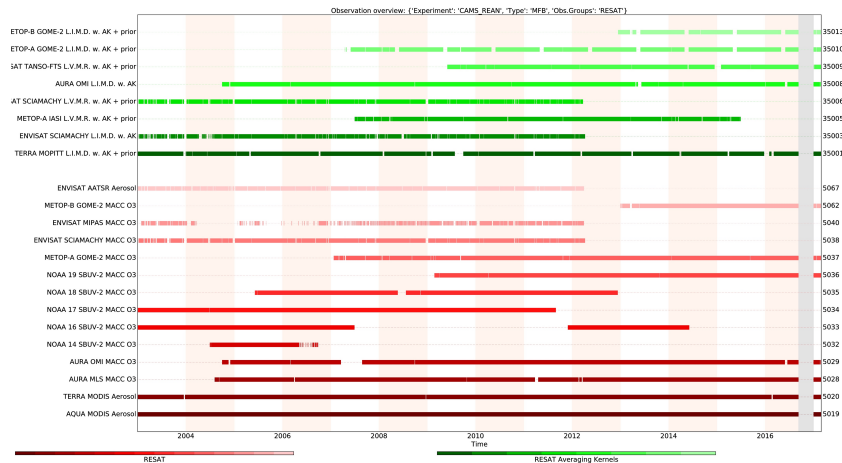
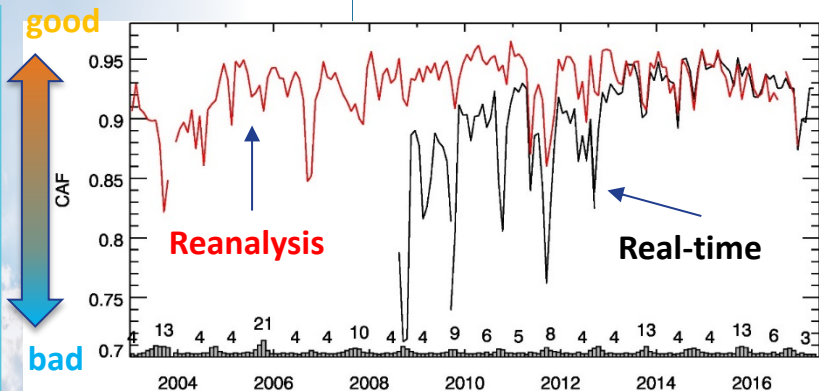
Observations of atmospheric composition are used on top of all the meteorological observations.



The new CAMS reanalysis

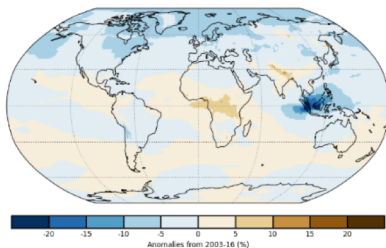
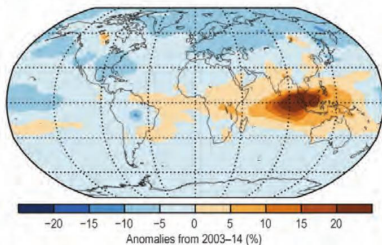
Atmosphere
Monitoring

O3 score at Neumayer station



2015 CO anomaly [%] 2016

(ac) Carbon Monoxide



Re-processing many satellite data sets for 2003 – 2017 providing consistent time series.

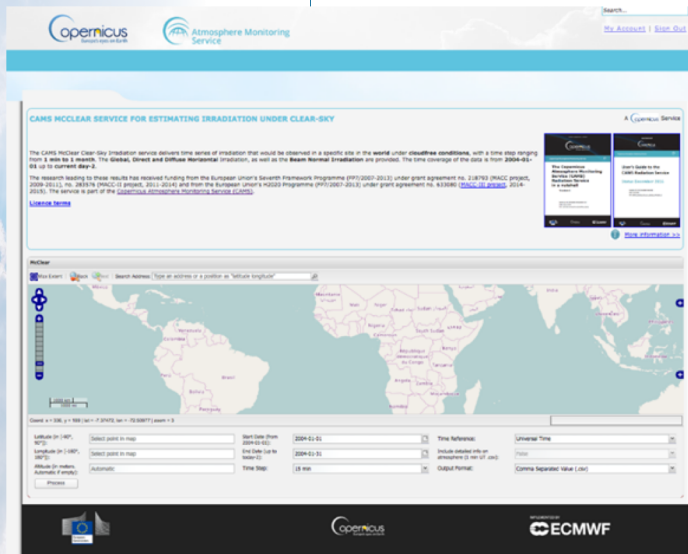
A. Inness



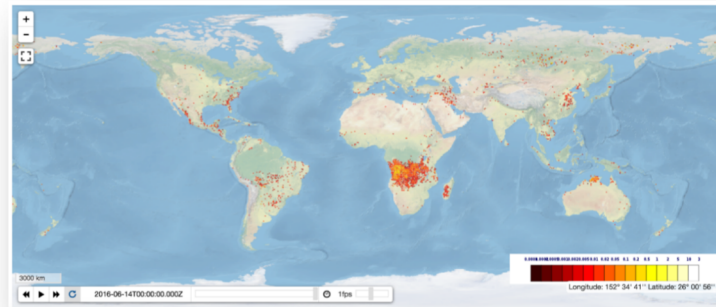
Satellite-based CAMS services

Atmosphere
Monitoring

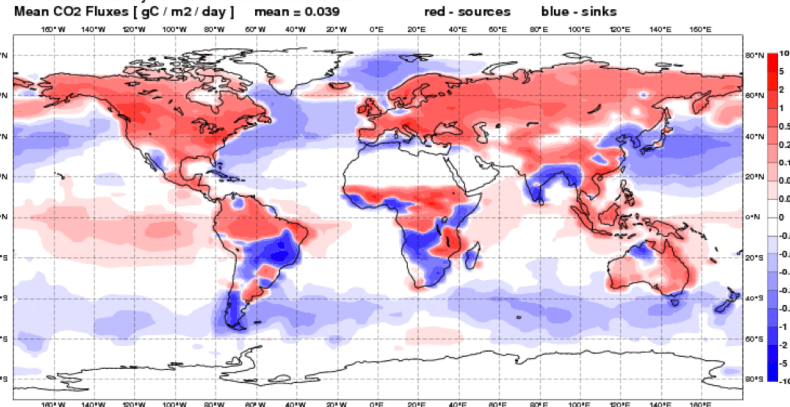
Global Fire Assimilation System (GFAS)



Solar radiation



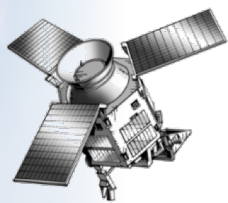
MACC-GHG Reanalysis Flux Inversion December 2011



GHG fluxes



How does CAMS implement new observations?



L1b data

Retrieval teams

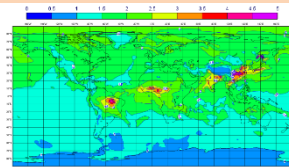
L2 data

CAMS analysis and
monitoring tools

Statistics and plots

Downstream services and users

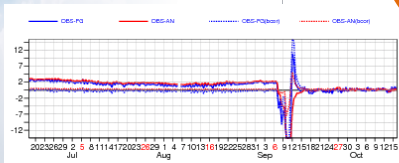
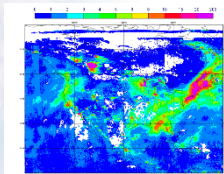
CAMS analyses and forecasts



NRT assimilation

Assimilation tests

Feedback



Good data





Climate
Change

Goals for the Climate Change Service

To support European adaptation and mitigation policies by:

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





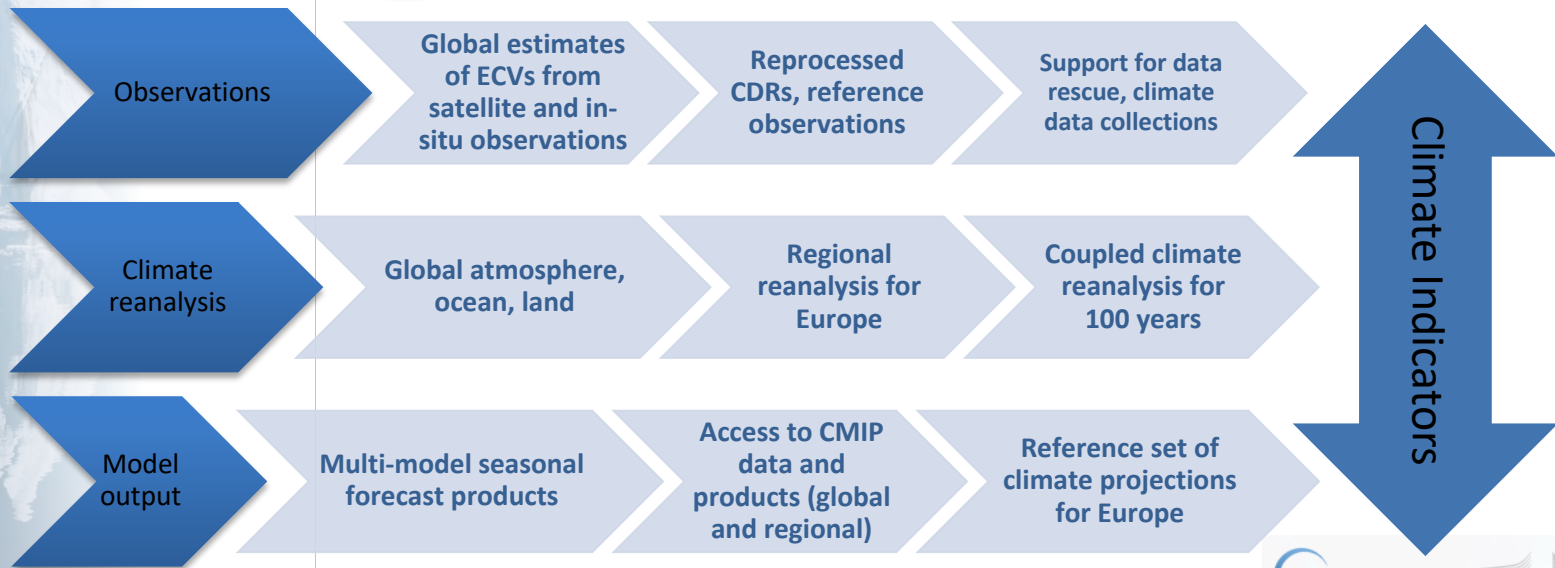
Climate
Change

C3S portfolio



Scientific basis:

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





Climate
Change

Earth Observation based ECVs in C3S

		C3S_312a		C3S_312b			
		GCOS	2017	2018	2019	2020	2021
Atmospheric physics							
	Precipitation	4.3.5					
	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				
	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				
	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					
	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				
	Land Cover	6.3.10					
	Fraction of Absorbed Photosynthetically Active Radiation	6.3.11	Lot 9				
	Leaf Area Index	6.3.12	Lot 9				
	Fire	6.3.15					
			2017	2018	2019	2020	2021

Heritage/coordination:

- ESA CCI(+)
- EUMETSAT SAFs
- Other Copernicus Services
- etc..

- Multiple datasets
- Provision of uncertainty estimates
- Focus on stability and consistency
- ..



Climate
Change

Reanalyses

ERA5 global reanalysis:

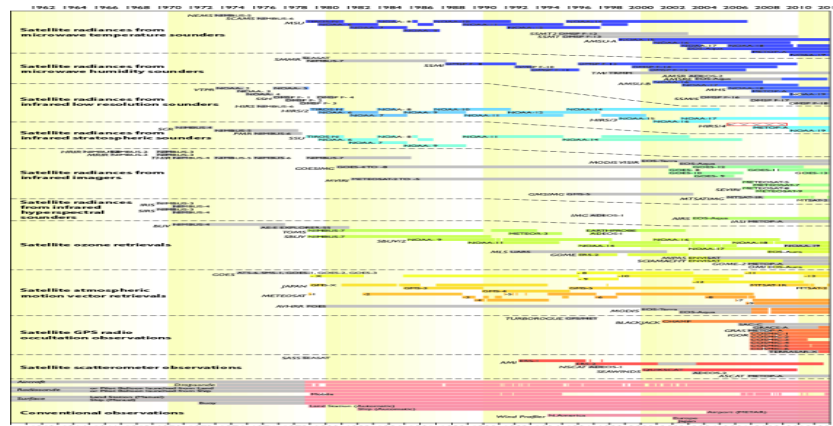
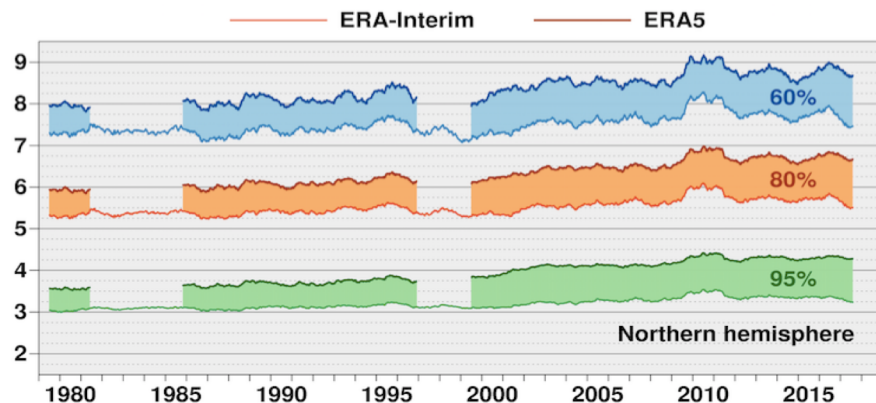
- Atmosphere/land/wave parameters
- 31 km global resolution, 137 levels
- Hourly output from 1979 onward
- Will be extended back to 1950s
- Based on IFS Cy41r2 (March 2016)
- Using improved input observations
- Ensemble data assimilation
- Providing uncertainty estimates
- First release of 2008-2017 dataset
- Full release Q3 2018

Regional reanalysis:

- European + Arctic domains
- Higher spatial resolution

EUMETSAT
reprocessing
activity

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



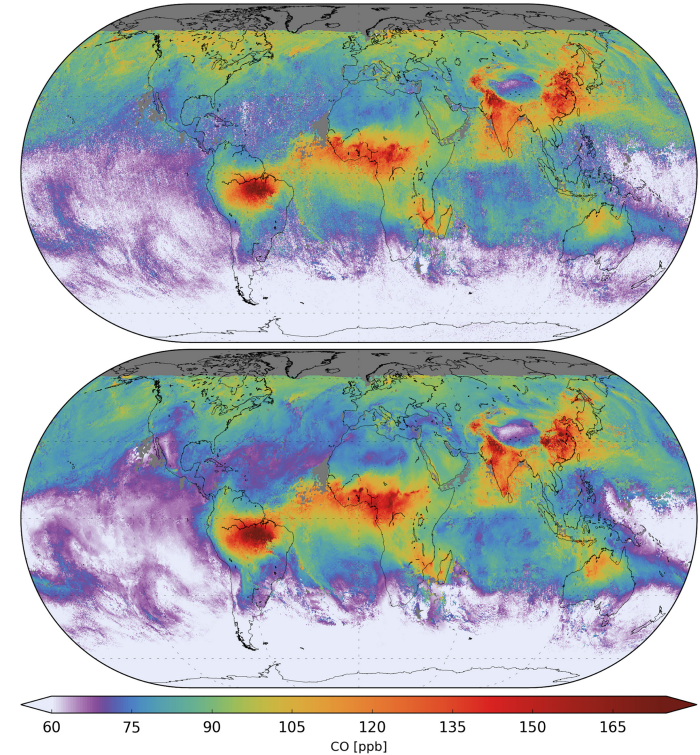


CAMS & C3S use many satellite data streams in NRT, delayed-mode and reanalysis.

Continuous work is on-going to bring in more satellite data sets.

We interact with space agencies, data providers, other operational centres and the science community to deliver our services.

CEOS activities are obviously very much appreciated; coordination ensures better use of resources and ensuring user needs are met.



<http://atmosphere.copernicus.eu>

The screenshot shows the website's header with the Copernicus logo and 'Atmosphere Monitoring Service' text. A navigation menu includes 'ABOUT CAMS', 'NEWS & MEDIA', 'EVENTS', 'CATALOGUE', 'RESOURCES', 'TENDERS', and 'USER SUPPORT'. The main content area features a large satellite image of Earth. Below this, there are three columns: 'IN FOCUS' with a 'CAMS General Assembly' article, 'CATALOGUE' with a 'EUROPEAN AIR QUALITY' map, and 'NEWS' with articles about carbon emissions and wildfire season. A search bar is located in the top right corner.

Twitter

The screenshot shows a Twitter profile for 'Copernicus ECMWF' with 95 tweets. Two tweets are visible: one mentioning a blog post about peatland fires and another about tracking Asia's haze. The interface includes navigation buttons for 'Tweets', 'Media', and 'Favourites', and a bottom navigation bar with icons for Home, Notifications, Messages, and Me.

Newsletter

The screenshot shows an email newsletter header with the Copernicus logo and 'Copernicus Atmosphere Monitoring Service' text. The main content includes a satellite image of the Earth with the Sentinel-3 satellite in orbit, a paragraph explaining the newsletter's purpose, and a section for the '1st CAMS General Assembly' with details on dates, location, and agenda items.

Thank you!



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