Atmosphere Monitoring

ECMWF-CAMS Products

Richard Engelen
ECMWF

Atmosphere Monitoring

Outline

Part I

- Brief History and Information for EU Copernicus programme
- Climate Change Service (C3S)
- Atmosphere Monitoring Service (CAMS)

Part II

- How do we produce our forecasts
- Modelling with focus on aerosol
- Satellite observations
- Data assimilation
- Reanalysis
- User interaction

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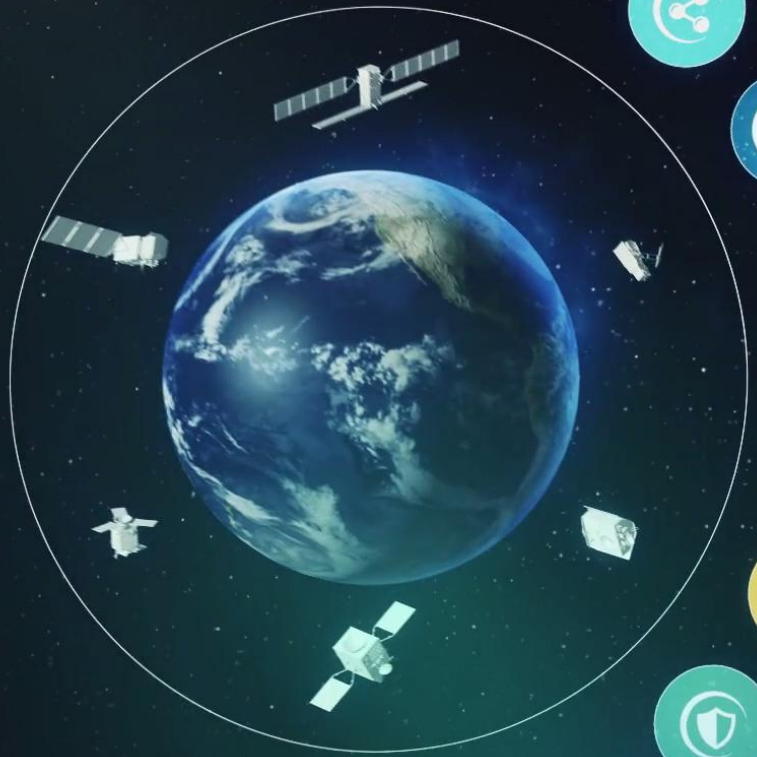


ATMOSPHERE MONITORING

MARINE ENVIRONMENT MONITORING

LAND MONITORING

CLIMATE CHANGE

EMERGENCY MANAGEMENT

SECURITY

Copernicus
Europe's eyes on Earth

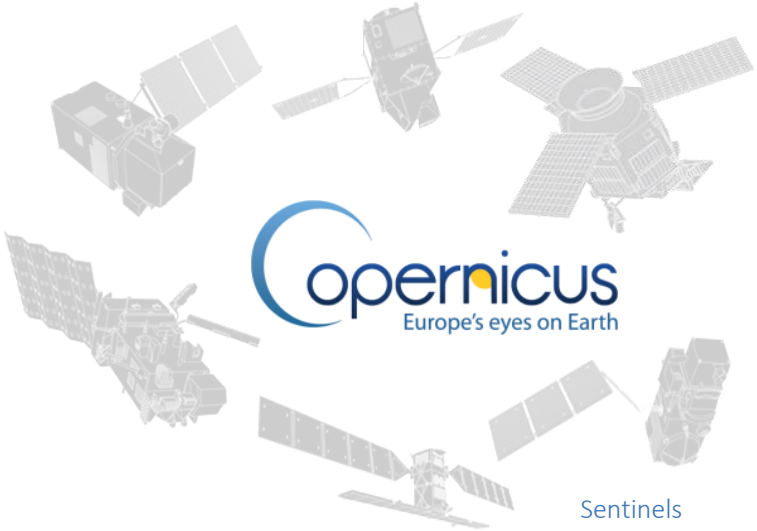
Atmosphere Monitoring

Copernicus

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

User-driven with free and unrestricted data access

Sustained and operational



Sentinels

Services

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Atmosphere Monitoring

A little bit of history

- **1998** Baveno Manifesto: birth of the Global Monitoring for Environment and Security programme
- **2008** GMES Forum in Lille launches first GMES services
- **2012** Name changed to the Copernicus programme
- **2014 – 2020** operational Copernicus services as part of the Multi-annual Financial Framework

GMES
Observing our planet for a safer world

Copernicus
Europe's eyes on Earth

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Climate Change

The Copernicus Climate Change Service (C3S)

Supporting scientists, policy makers and businesses by providing authoritative, quality-assured information about the past, current and future states of the climate in Europe and worldwide.

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Climate Change

The Copernicus Climate Change Service (C3S) mission

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

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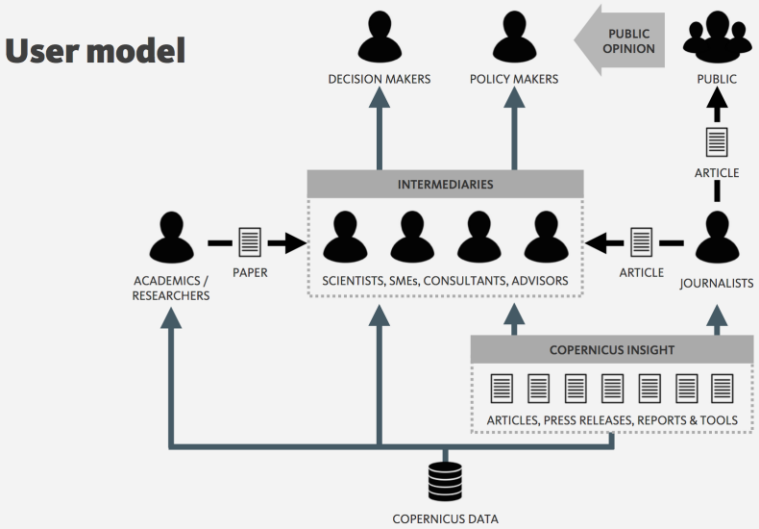
Who are the users and what do they want?



User needs	Scientists, academics, and researchers	SMEs and consultants	Policy advisors and influencers	Journalists
Find relevant data	x	x	x	
Content is reliable and trustworthy	x	x	x	x
Download data in appropriate form	x			
Download data they can use/need	x	x		
Know they can use data legally	x	x		
Keep up to date about tenders	x	x		
Get help with data	x	x		
Know about the programme (inc. longevity)		x		x
See Case studies of previous uses		x	x	
See high level overviews of information			x	
Keep up to date with relevant content			x	x
Find content appropriate to area of work			x	
Have a well structured explicit press area				x
Easy to access contact details				x
High quality assets				x

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Climate Change

A one-stop Climate Data Store

We are building a store.

We are putting products on the shelves.

Soon we will open the door to customers.

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Access to observations and climate reanalyses

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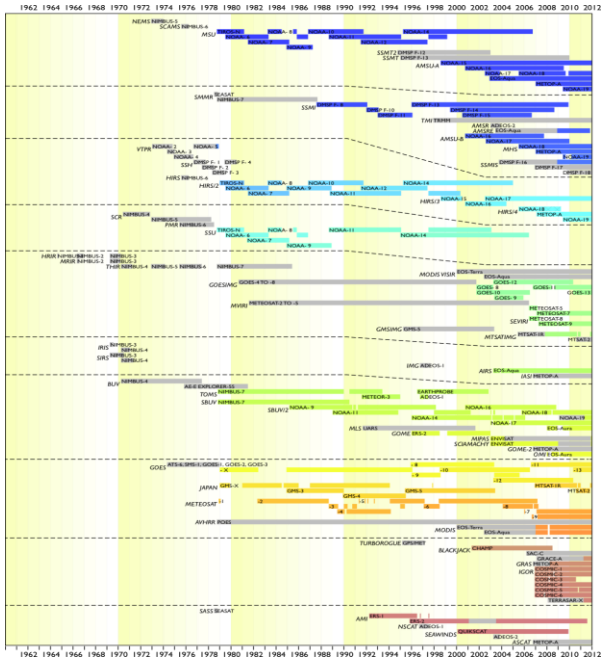
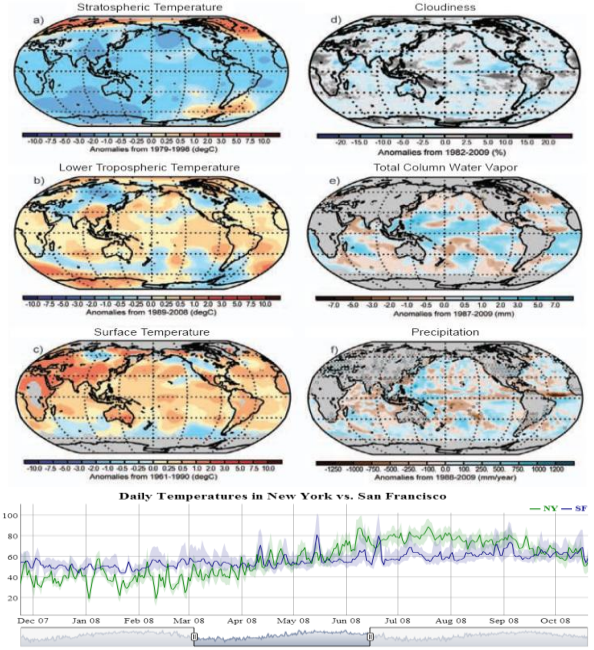


Earth system models



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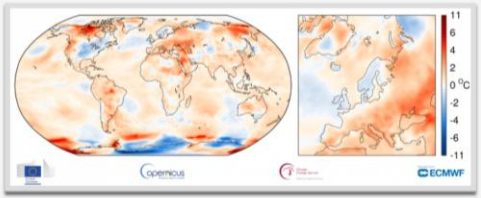
Monthly reports on the state of the climate

Climate Change

Surface air temperature for August 2017

home » resources » data analysis » average surface air temperature analysis » monthly maps » Surface Air Temperature For August 2017



Surface air temperature anomaly for August 2017 relative to the August average for the period 1981-2010. Source: ERA-Interim. (Credit: ECMWF Copernicus Climate Change Service)

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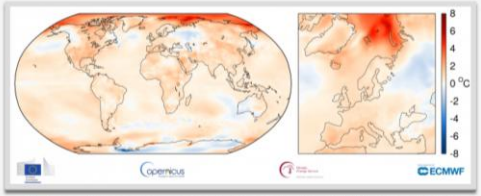
August 2017 was warmer than the 1981-2010 average over much of Europe. It was particularly warm over the south and east of the continent, where wildfires continued to trouble several countries and sustaining water supplies remained a challenge in places. Temperatures continued to be below average over the north-west.

Unusually warm summer conditions prevailed over the western USA and western and northern Canada, although central and eastern North America was not as warm as usual for August. Temperatures were much above average over parts of the Middle East and eastern Siberia. Most other continental areas were also warmer than average. Temperatures were well below average over much of Antarctica, although pronounced warm anomalies occurred where the surrounding winter sea-ice cover was lower than usual.



Surface air temperature anomaly for September 2016 to August 2017 relative to the average for 1981-2010. Source: ERA-Interim. (Credit: ECMWF Copernicus Climate Change Service)

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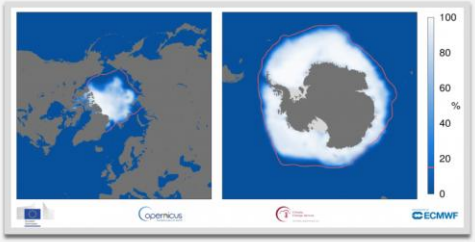
Average temperatures for the twelve-month period from September 2016 to August 2017 were:

- most above the 1981-2010 average in the Arctic;
- much above average offshore of West Antarctica, over much of North America, and over south-western Europe, the Middle East, north-western and central Africa, and eastern and southern Asia;
- higher than average over most other areas of land and ocean;
- lower than average over only a few oceanic and land areas.

Sea-ice cover for August 2017



Sea-ice cover for August 2017. The pink line denotes the climatological ice edge for August for the period 1981-2010. Source: ERA-Interim. (Credit: ECMWF Copernicus Climate Change Service)

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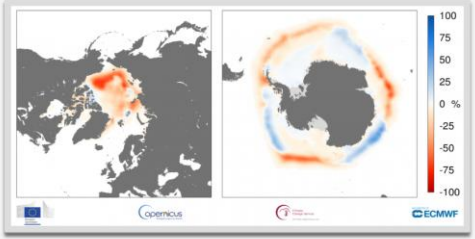
Sea-ice was much less widespread in August 2017 than in the average for August from 1981 to 2010.

Arctic sea-ice was either absent or at a lower concentration than normal almost everywhere. Ice cover was especially below average in a region extending outwards into the Arctic Ocean from the Beaufort Sea and the East Siberian Sea.

Antarctic sea-ice cover was also lower than average overall. It extended less to the north than is normal for August in all but one sector, although concentrations close to the northern limit of sea-ice were also higher than average in two other sectors.



Sea-ice cover anomaly for August 2017 relative to the August average for the period 1981-2010. Source: ERA-Interim. (Credit: ECMWF Copernicus Climate Change Service)

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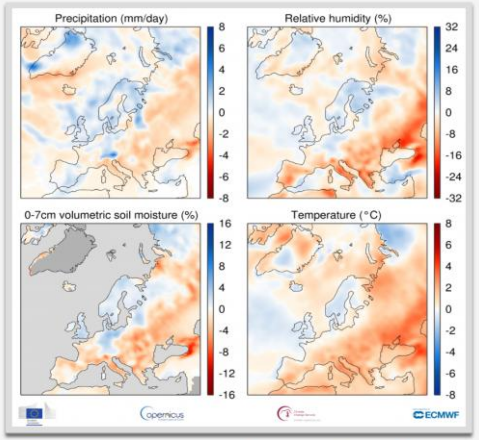
Precipitation, relative humidity and soil moisture for August 2017

The surface hydrological variables are more difficult to observe and analyse than surface temperature. The surface hydrological variables page explains more about the reliability of the data and information presented here, including comparisons with alternative datasets. The data on soil moisture is currently of qualitative rather than quantitative value. This summary is intended to provide European and near-global views of conditions for the month. Specific information for many countries can be found on the websites of their weather or climate services.



Anomalies in precipitation, the relative humidity of surface air, the volumetric moisture content of the top 7 cm of soil and surface air temperature for August 2017 with respect to August averages for the period 1981-2010. The darker grey shading denotes where soil moisture is not shown due to ice cover or climatologically low precipitation. Source: ERA-Interim. (Credit: ECMWF Copernicus Climate Change Service)

Download the original image

August 2017 was in general drier than the 1981-2010 average over south-western and central Europe, in terms of surface atmospheric relative humidity and the moisture content of the soil. Temperatures were also well above average over this part of the continent. The distribution of precipitation was more mixed. Rainfall totals were particularly high over the Alps, where relative humidity and soil moisture were above average. The month was also generally wetter than normal over northern Europe, in terms of precipitation, relative humidity and soil moisture. It was cooler than normal over part of this region.

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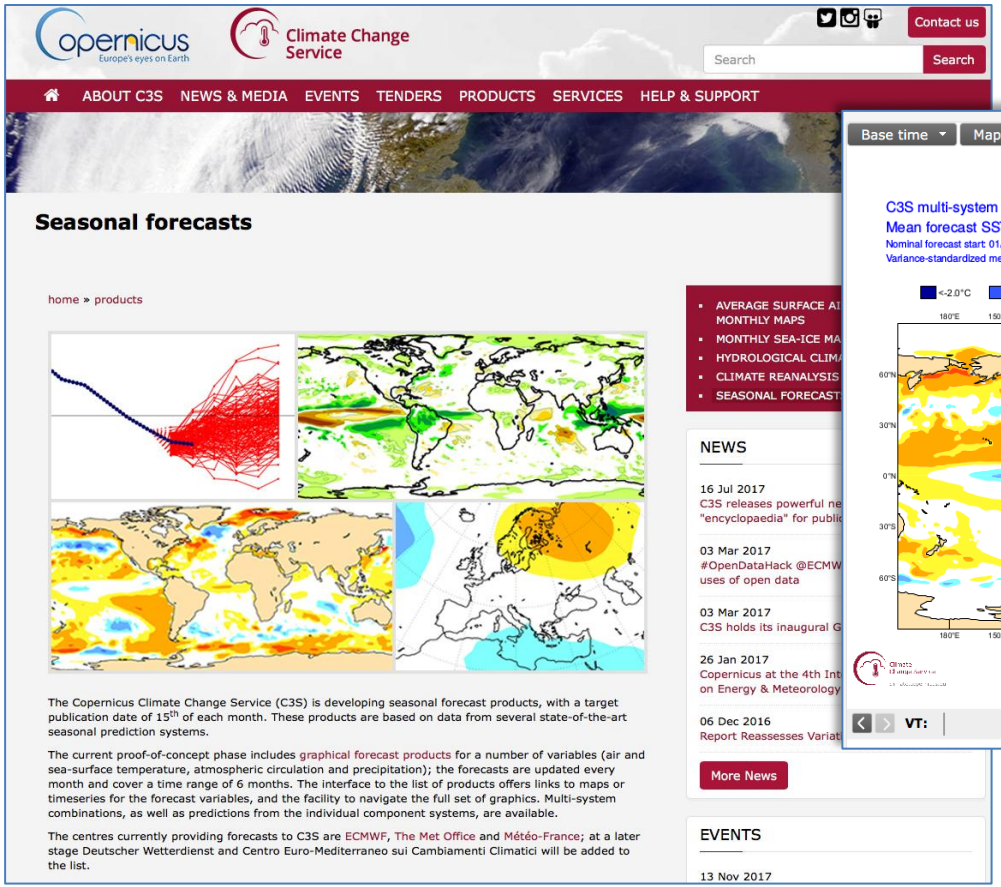
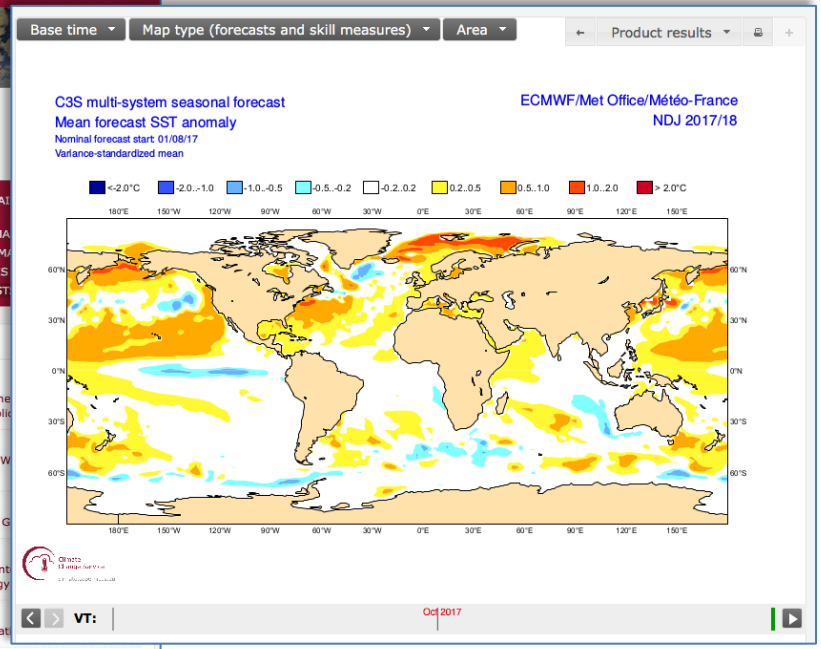
Access to seasonal forecast data and products





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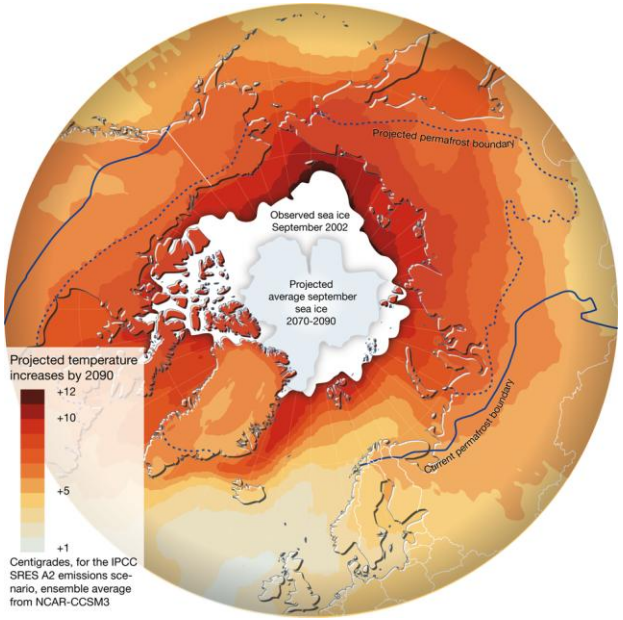
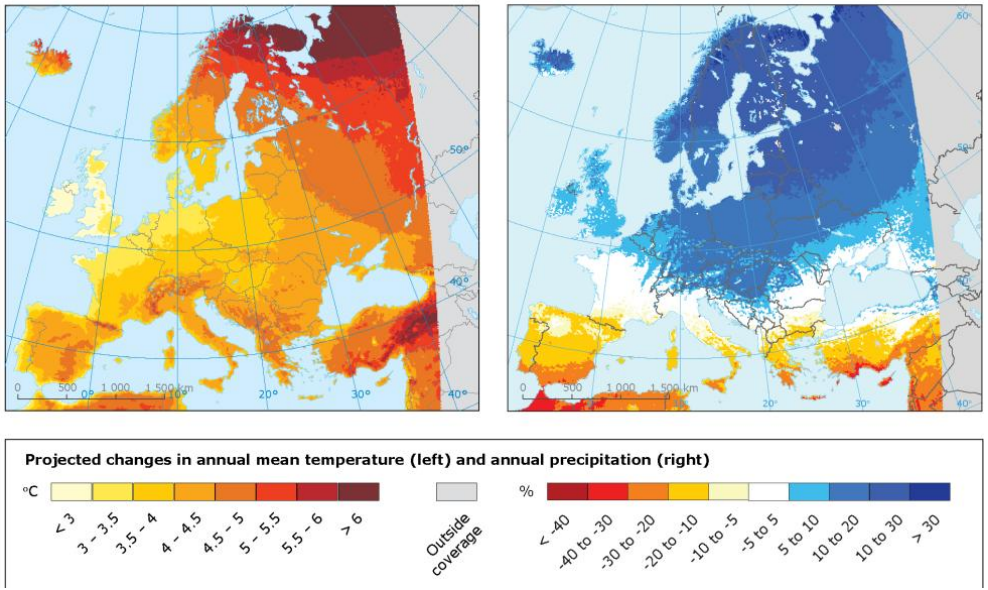
Access to climate model simulations

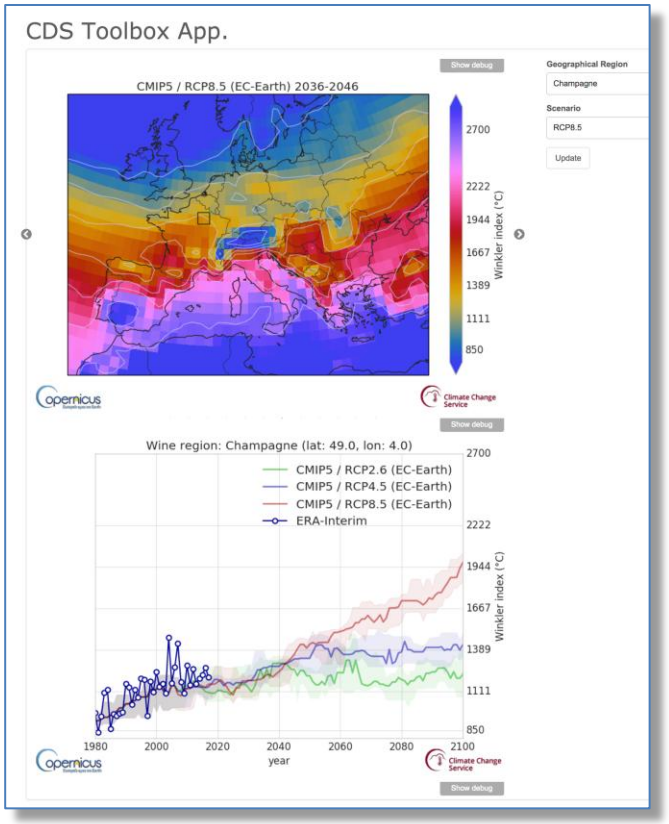
Climate Change

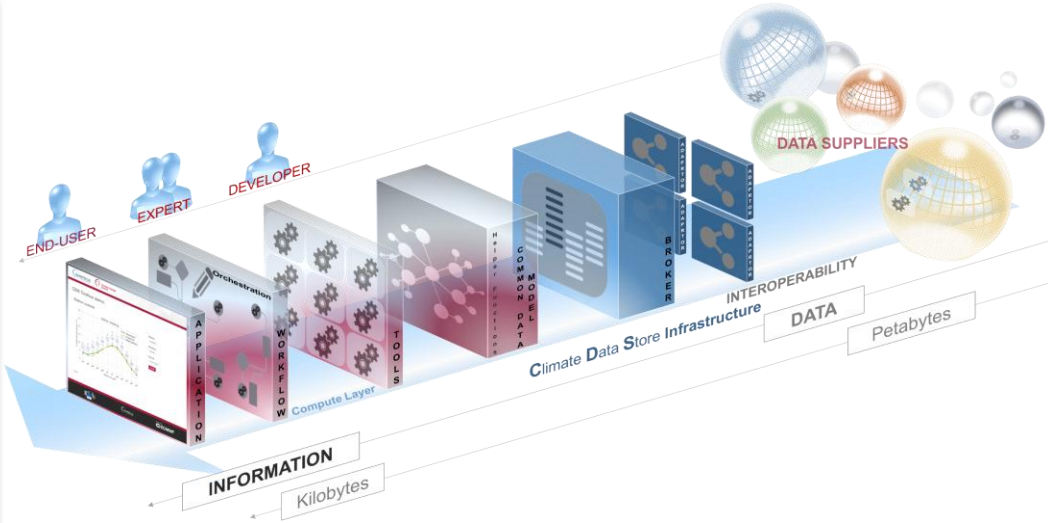




Access to tools, workflows and applications

Climate Change





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Sectoral indicators and tools to support adaptation

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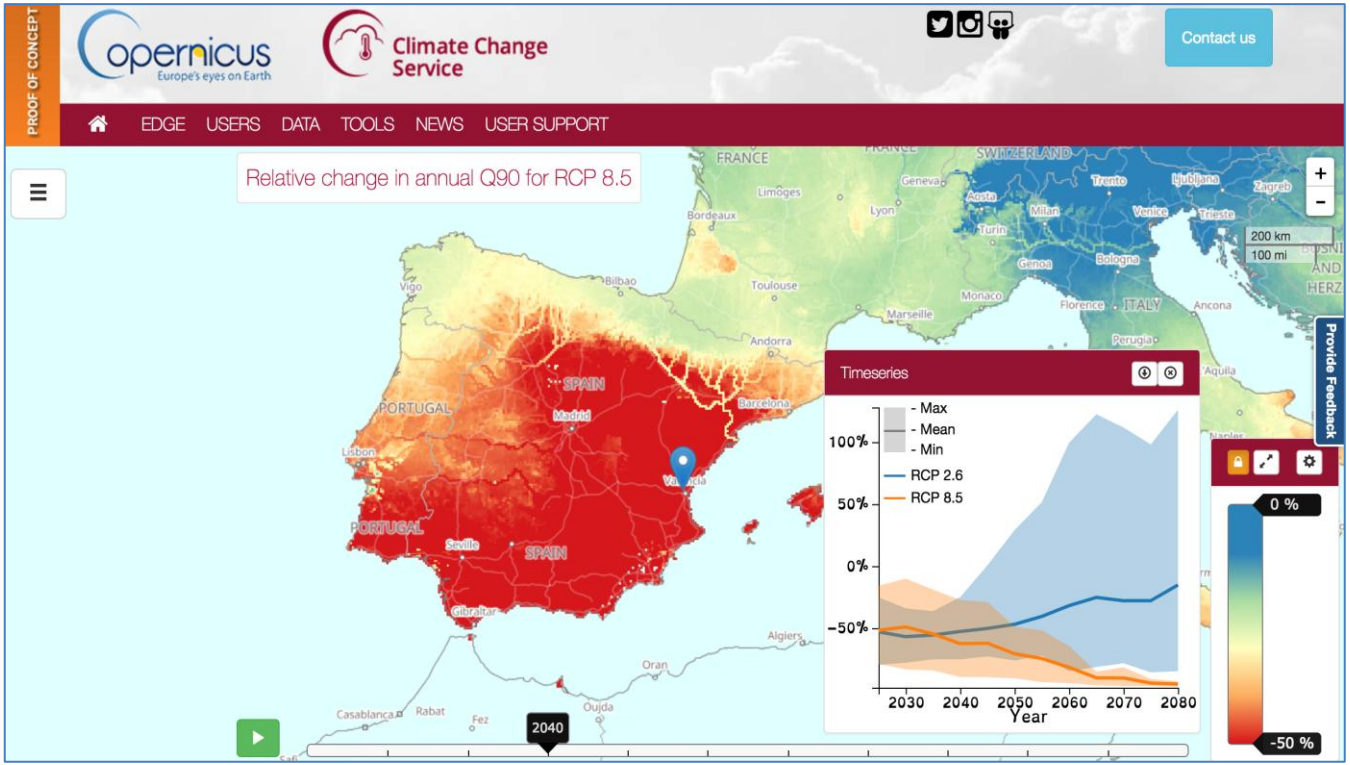

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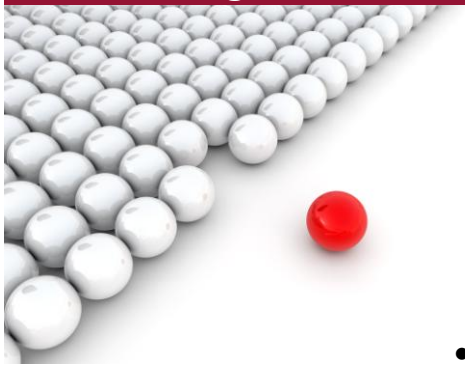
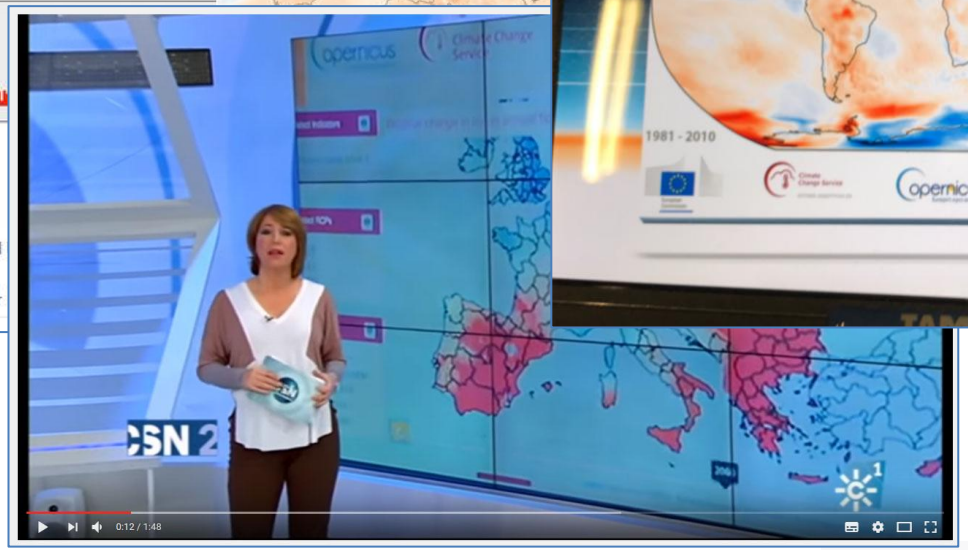
Challenges in communication



- Communicating climate science
- New kid on the block
- Unfamiliar territory for ECMWF

Successes in communication

Climate Change



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Why we do it

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Atmosphere Monitoring

Copernicus Atmosphere Monitoring Service



Providing policy makers, businesses, scientists and citizens alike with reliable information about atmospheric composition.



Building up knowledge and boosting informed decision-making on topics such as air quality, health, solar energy, weather and climate.

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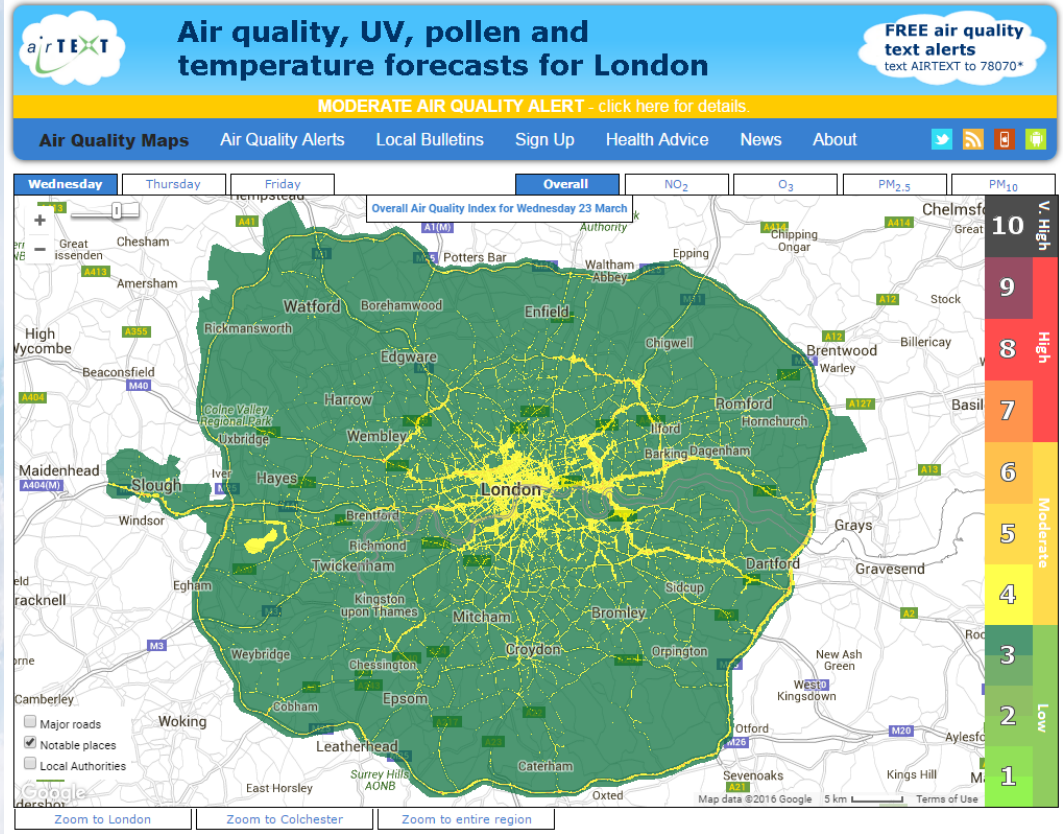
Atmosphere Monitoring

Existing services: *air*TEXT



airTEXT

Free air pollution, UV, pollen and temperature forecasts for Greater London and the South East.

Currently provides free air quality alerts to more than 15,000 subscribers.

Local forecast models need information on how much pollution flows into and out of the domain to provide an accurate service.

CERC

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European Commission

Existing services: SunSmart

Atmosphere Monitoring

The SunSmart phone app offers users daily alerts on ultraviolet (UV) radiation peaks and current readings wherever they are in Australia.

It can also provide alerts to users on how much and when they need to reapply sunscreen depending on their coverage and skin type.

Interpolated observations provide information for today.

Using forecasts of UV, SunSmart can provide warnings in advance.

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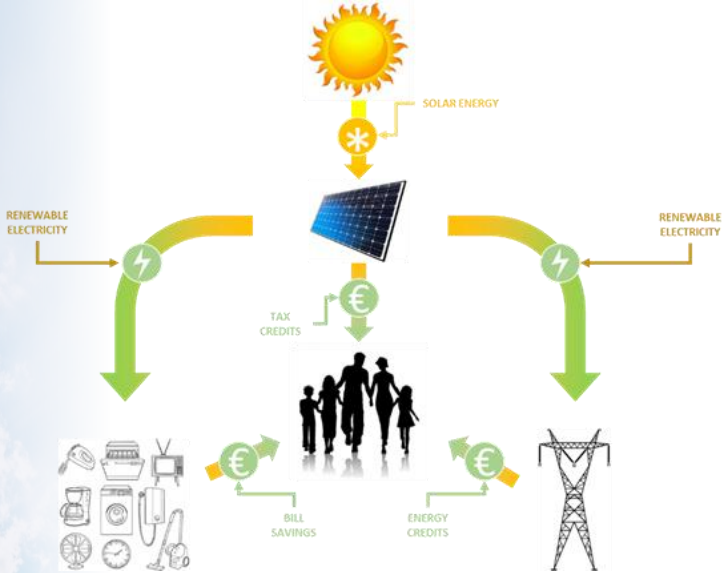
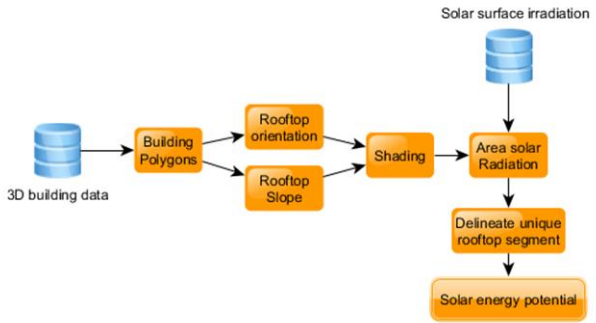
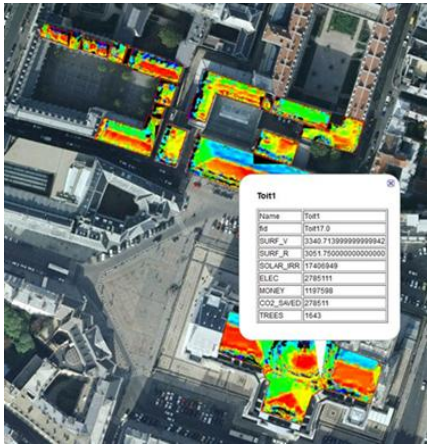
Atmosphere Monitoring

Existing services: CitySol





CitySol (Noveltis) provides a web-based decision support system for the development of rooftop photovoltaic solar panels. Location-specific solar input would need surface observations over along period of time.



Using satellite/model-based solar radiation time series would make the application much easier to deploy.

How can CAMS help?

Atmosphere Monitoring Service

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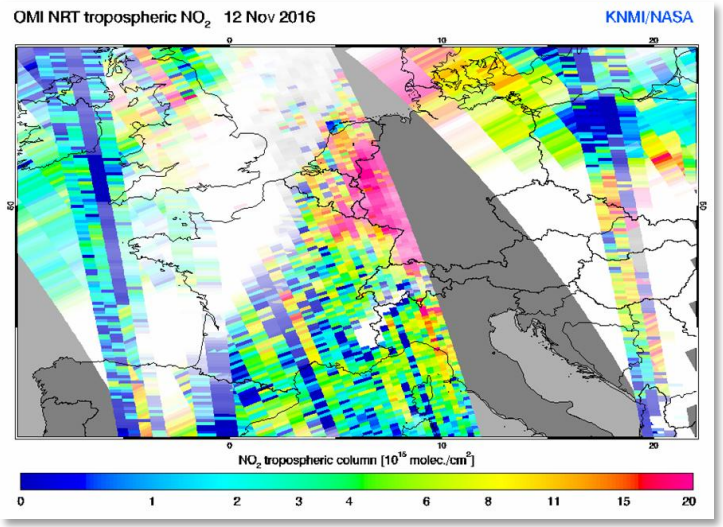
Atmosphere Monitoring

CAMS: Adding value to observations

European Environment Agency

In-situ observations



Satellite observations

CAMS adds value to today's observations, providing consistent information anywhere in Europe (and the rest of the world).

CAMS forecasts allow you to anticipate the situation of tomorrow.

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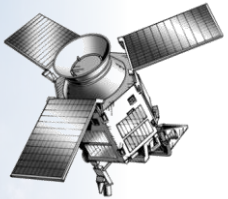
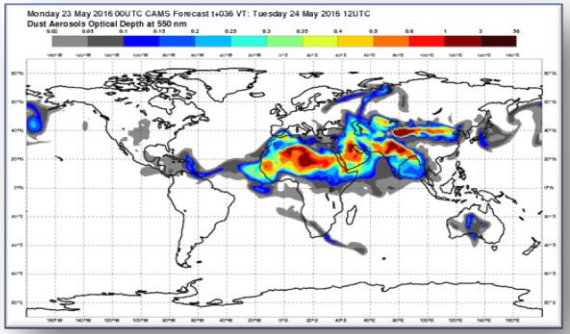
CAMS Service Chain

Atmosphere Monitoring

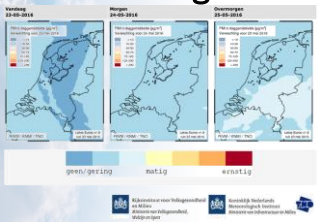
Space Agencies

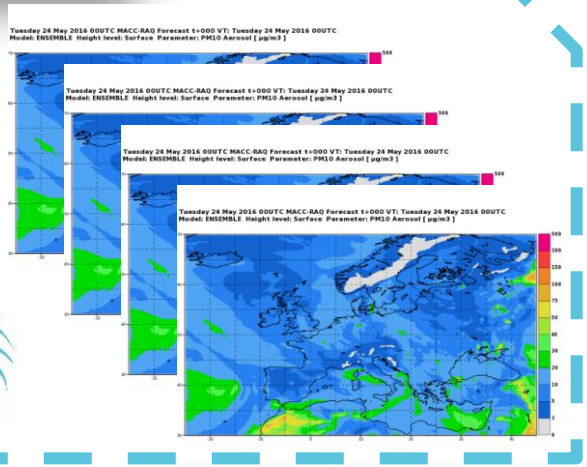




In-situ observations

National agencies





SMEs

Citizens

Scientists

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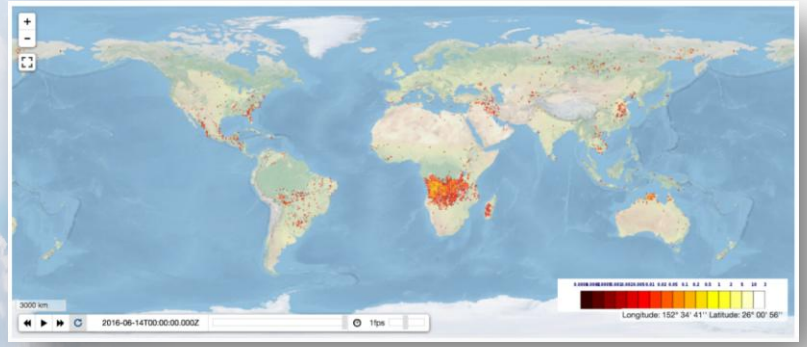
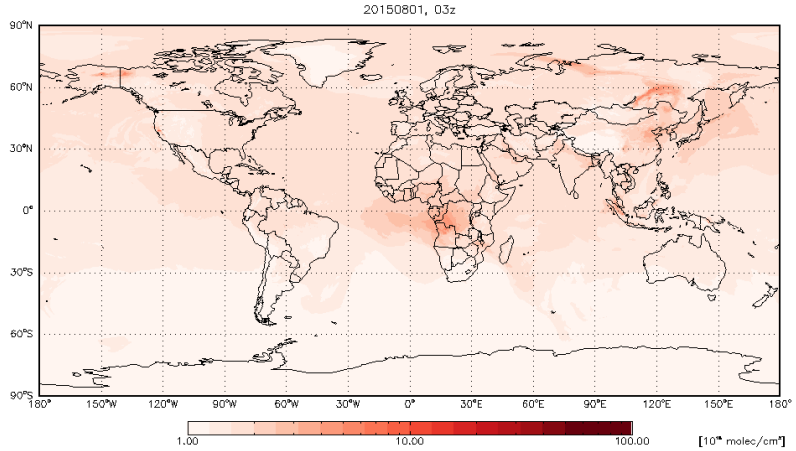
User question: long-range transport

Newspaper: Will the smoke from wildfires in Indonesia affect air quality in our country later this week?



CAMS satellite-based Fire emissions (GFAS)

- daily estimates
- Aerosols, chemical species and greenhouse gases



CAMS global forecasts

- twice-daily 5-day forecasts
- Aerosols, 13 chemical pollutants, CO_2 & CH_4
- 40 km spatial resolution

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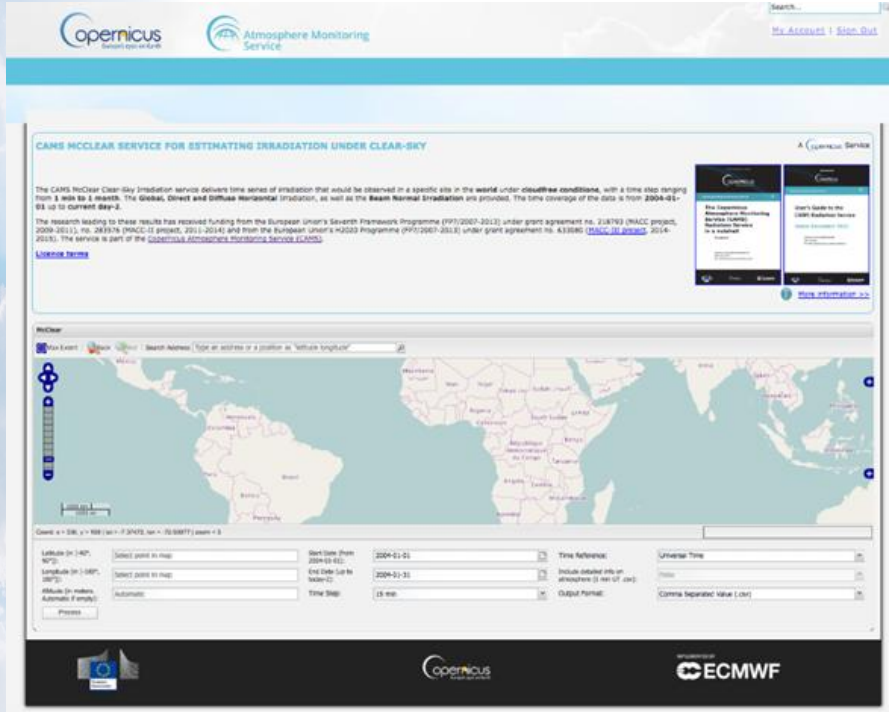
User question: solar energy

Energy firm: What is a cost-effective place to build our solar power plant?



CAMS solar radiation

- 2004 – current
- 1-minute resolution
- Clear-sky and total sky global, direct and diffuse radiation at surface

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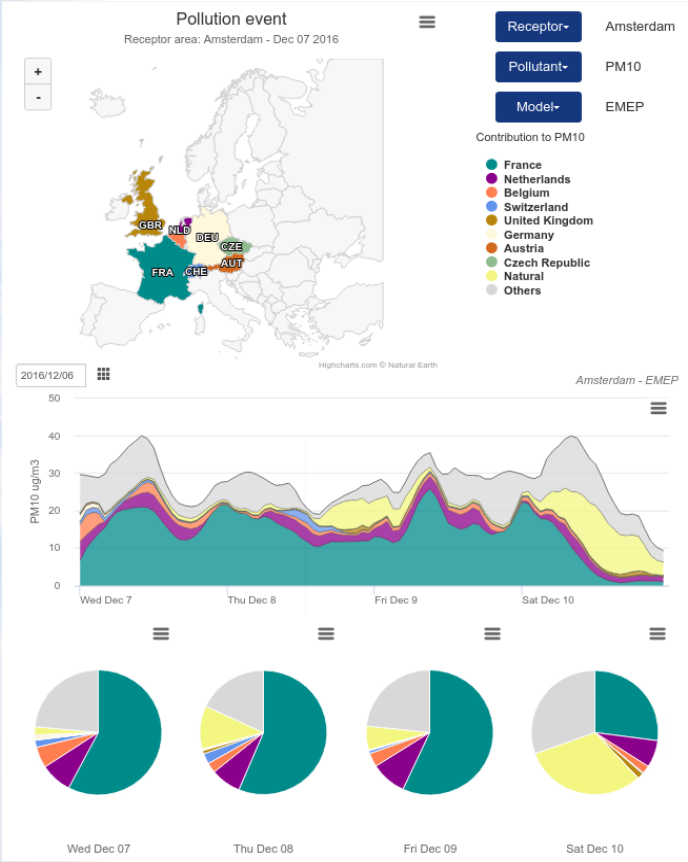
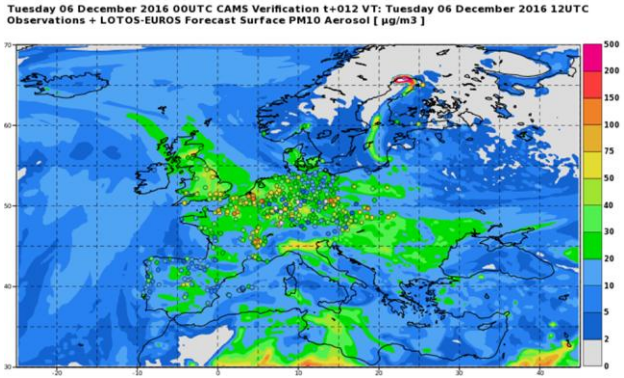
User question: understanding episodes

National Environment Agency: Where did PM_{10} come from during the latest pollution event?





CAMS policy tools

- Source-receptor calculations and emission scenarios
- Daily and on-demand
- Main regulatory pollutants
- 10 km spatial resolution

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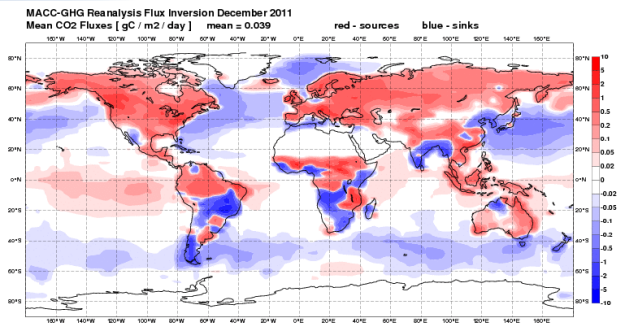
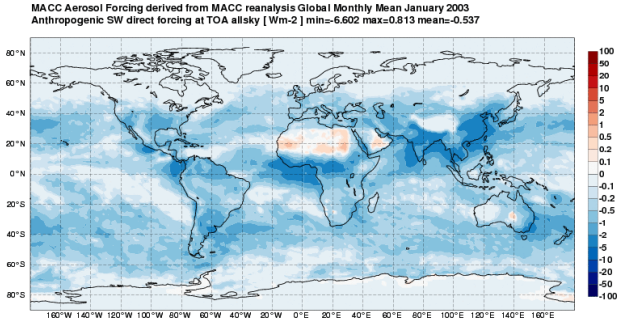
User question: climate change

Scientist: what has been the impact of greenhouse gases and aerosol on the Earth's climate over the last few decades?





CAMS greenhouse gas flux estimates

- CO_2, CH_4 and N_2O
- Decadal time series

CAMS radiative forcing

- Direct and indirect radiative forcing of aerosol and greenhouse gases
- Decadal time series

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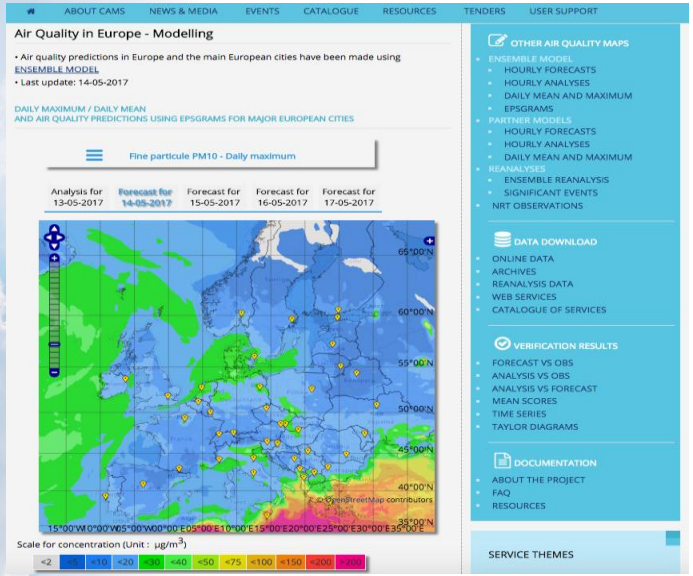
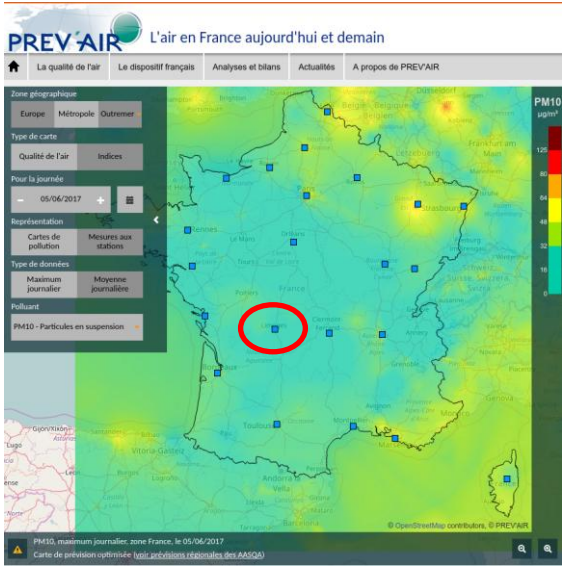
User question: what's the forecast?

Atmosphere Monitoring

French citizen: What will be the air quality in Limoges tomorrow?



CAMS provides background air quality forecast maps, but more importantly boundary conditions for national forecast models.



CAMS regional forecasts

- Daily 4-day forecast using forecast model ensemble
- 10 chemical pollutants + pollen
- 10 km spatial resolution

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CAMS Portfolio

Atmosphere Monitoring

Portfolio	Product groups
A. Regional products	European AQ NRT analyses
	European AQ NRT forecasts
	European AQ interim reanalyses
	European AQ reanalyses
B. Global products (troposphere and stratosphere)	Global atmospheric composition NRT analyses
	Global atmospheric composition NRT forecasts
	Global atmospheric composition reanalyses
C. Supplementary products	Policy support products
	Solar radiation
	Greenhouse gas fluxes
	Climate forcings
D. Emissions products	Anthropogenic emissions
	Fire emissions

CAMS delivers the portfolio of products outlined in the Delegation Agreement with the EC

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Accessing the Products

Atmosphere Monitoring

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- [ ] Regional forecasts
- [ ] Climate forcings
- [ ] Anthropogenic emissions
- [ ] Solar radiation
- [ ] Greenhouse gas fluxes
- [ ] Fire emissions
- [ ] Policy support

PARAMETER FAMILY

- [ ] Aerosol
- [ ] Greenhouse gas
- [x] Reactive gas
- [ ] Radiation
- [ ] Fire

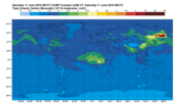
PARAMETER

- [ ] Sulfates concentration
- [ ] Organic carbon concentration
- [ ] Black carbon concentration
- [ ] Sea-salt concentration
- [ ] Dust concentration
- [ ] PM10

CURRENT FILTERS:

× Product family: Global forecasts × Pa

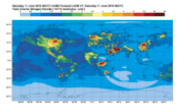
Total results: 5



Global for chemical monoxide

This service prov chemical species observations

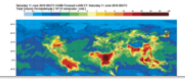
Parameter: Car



Global for chemical dioxide

This service prov chemical species observations

Parameter: Nitr

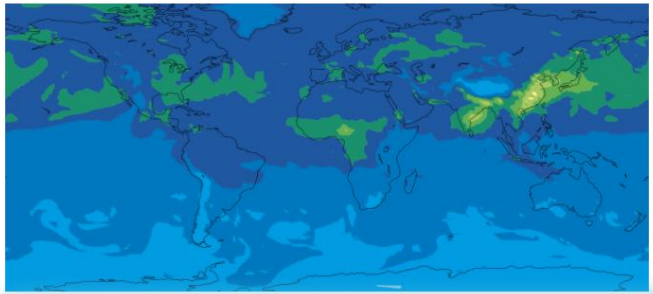


Global forecasts of assimilated chemical species - formaldehyde

More details

Global forecasts of chemical species - carbon monoxide

Back to index



This service provides daily forecasts up to 5 days of chemical species

Theme: Air quality and atmospheric composition
Product family: Global forecasts
Parameter: Carbon monoxide
Geographical area: (-180, 180, -90, 90)
Time coverage:
Metadata: XML

Data download | Verification results | Validation reports | Plots | Documentation | Contact us

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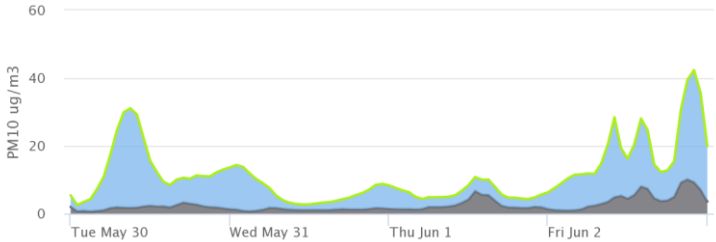
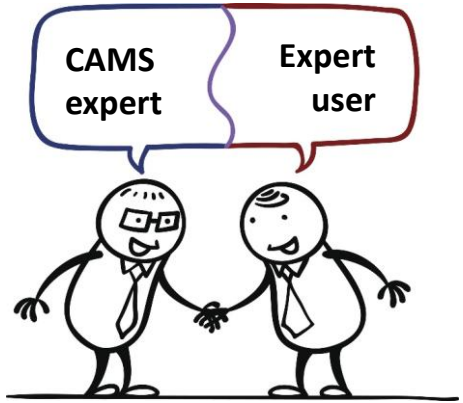
Using CAMS data

Atmosphere Monitoring



CAMS forecast charts and policy tools



Downstream applications

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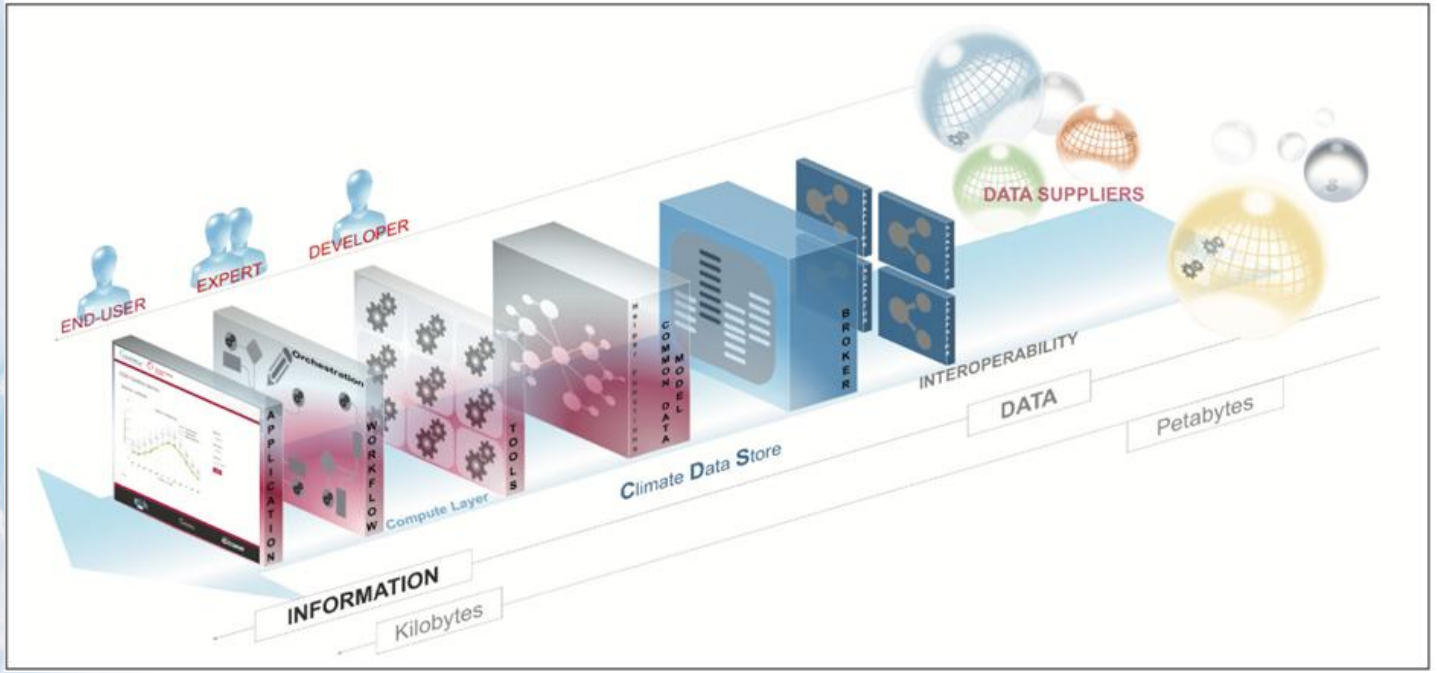
Looking forward: Data Platforms



C3S and CAMS are putting in place a distributed data platform with consistent workflow and tools for all products.

Together with EUMETSAT and the Marine Service this will be expanded to also include access to other Copernicus data and provide cloud computing facilities.

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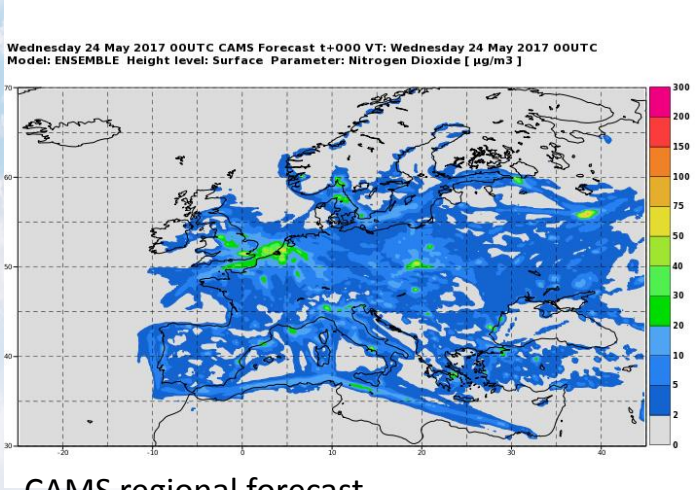
Use Case: AirText

AirText (CERC) uses daily air quality forecasts from the CAMS regional model ensemble to provide the boundary conditions for their local air quality forecast model.

This ensures better local forecasts and also allows them to market their service in other cities in Europe.



CAMS regional forecast

AirText London warnings

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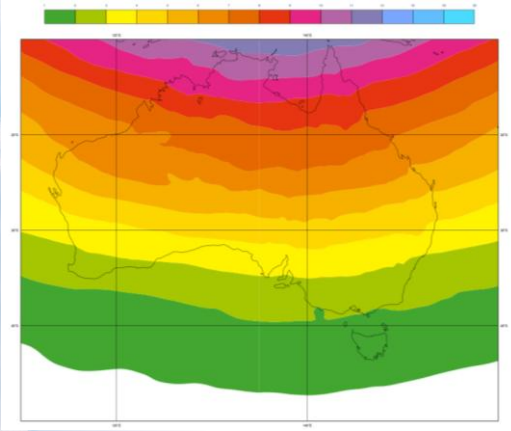
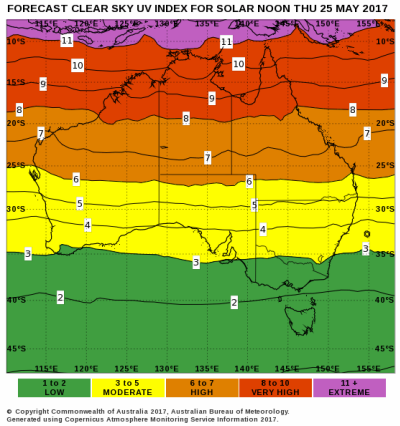
Use Case: SunSmart

In Collaboration with the Australian Bureau of Meteorology, SunSmart uses CAMS UV-Index forecasts every day to feed their smartphone App with the required information, providing an improved service to their customers.



CAMS UV forecast



Bureau of Meteorology

Cancer Council Victoria

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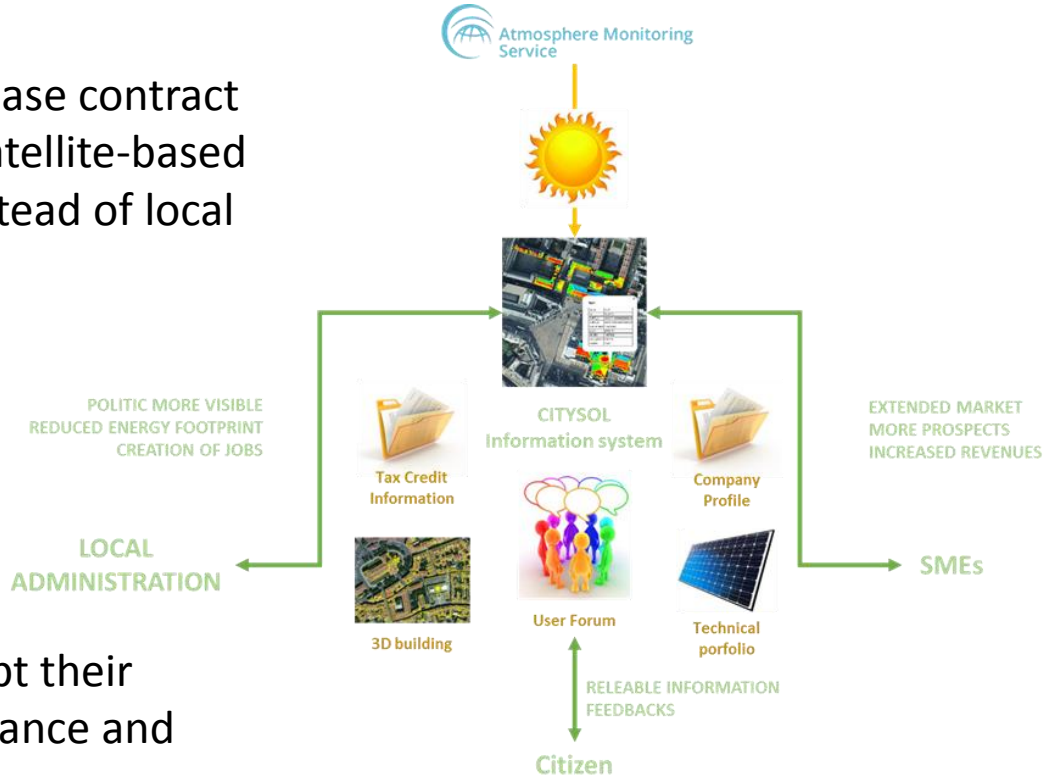
Atmosphere Monitoring

Use Case: CitySol

Noveltis is using a CAMS Use Case contract to adapt their system to use satellite-based solar radiation information instead of local measurements.

This allows them to easily adapt their service for different cities in France and potentially the rest of Europe.



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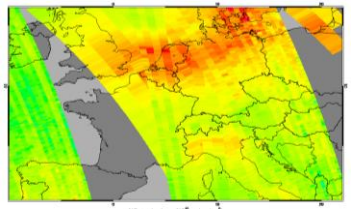
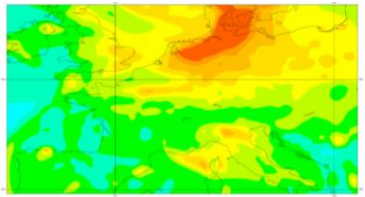
To summarize

Atmosphere Monitoring Service

atmosphere.copernicus.eu





User-driven

Free and unrestricted data access

Making observations more meaningful to you

Provide information for past, present and future

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Atmosphere Monitoring

Part II

How we combine observations and models to provide accurate forecasts: data assimilation.

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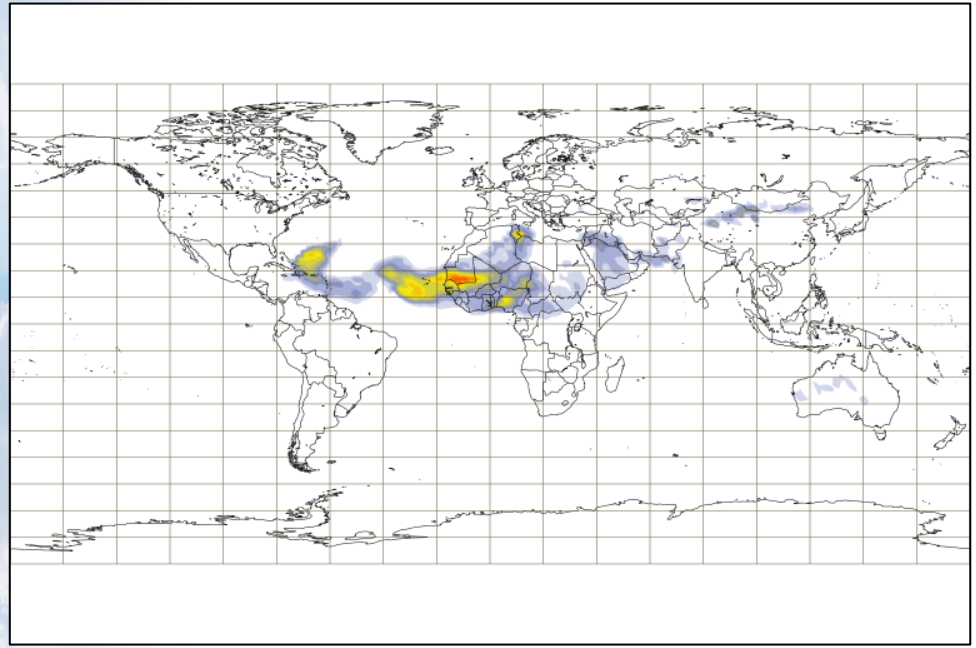
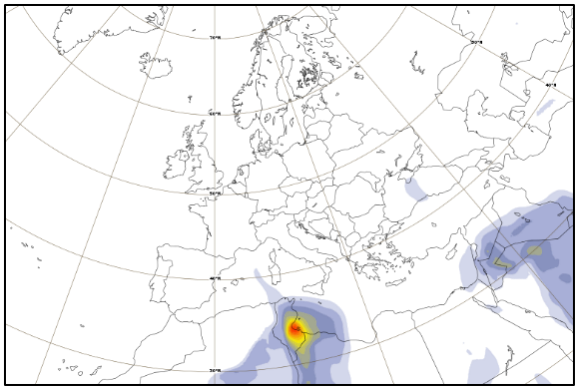
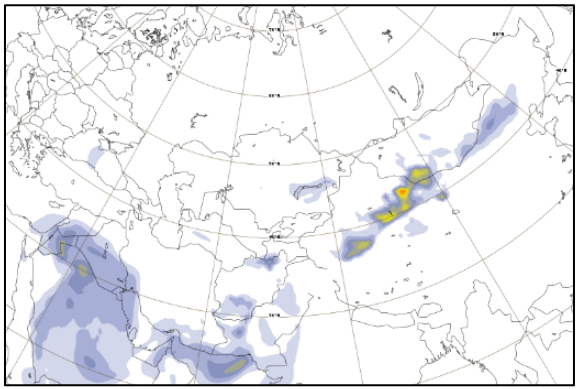
Atmosphere Monitoring

Twice-daily forecasts from global system

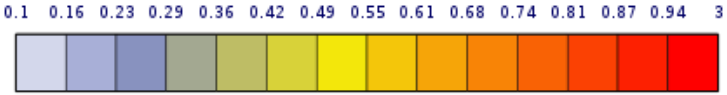
5-day forecasts @ 40 km resolution







DOD



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From global to regional

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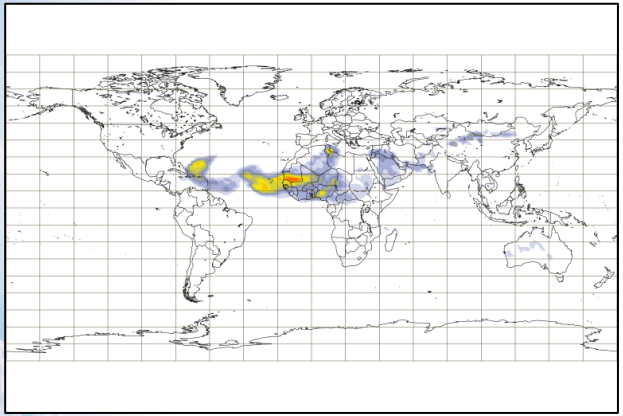
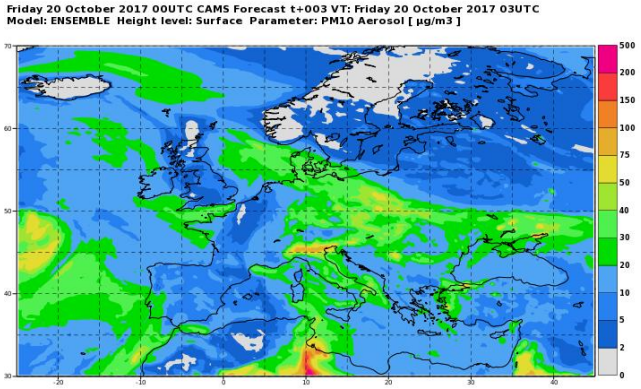
40 km



10 km



The CAMS global system provides boundary conditions for the daily CAMS regional ensemble forecasts.

Boundary conditions are also available for CAMS users running regional models for other domains.

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Global production

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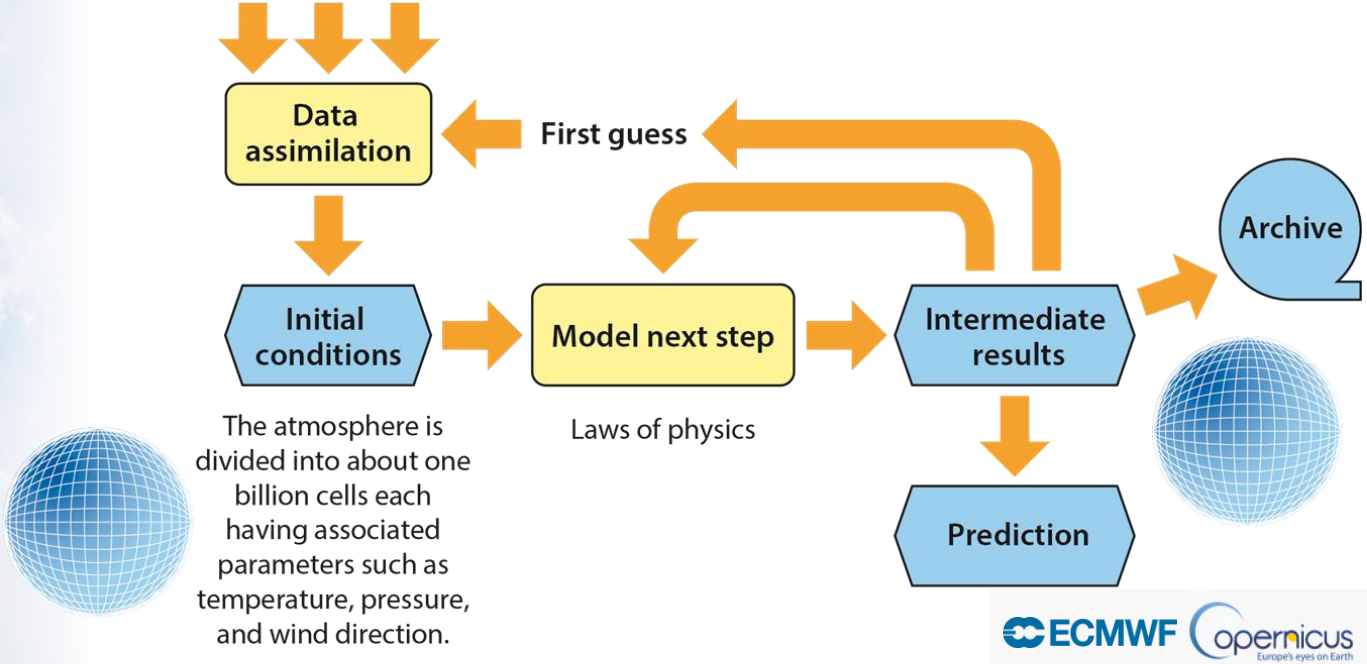
Approximately 20 million observations

Every 12 hours, observations are acquired, pre-processed, quality controlled, and assimilated.

Every 12 hours a global 5-day forecast is produced, checked and disseminated.



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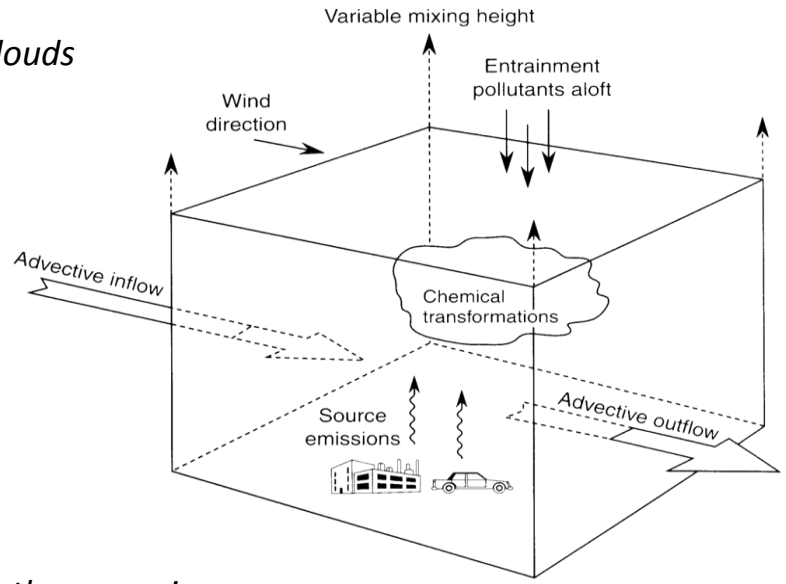
Atmospheric composition modelling

Atmosphere Monitoring

Turbulent mixing and convection

Advection

Radiation and clouds



Wet deposition

Sedimentation

Homogeneous and heterogeneous chemistry, including photochemistry

Biogenic and anthropogenic emissions

Aerosol processes

Dry deposition

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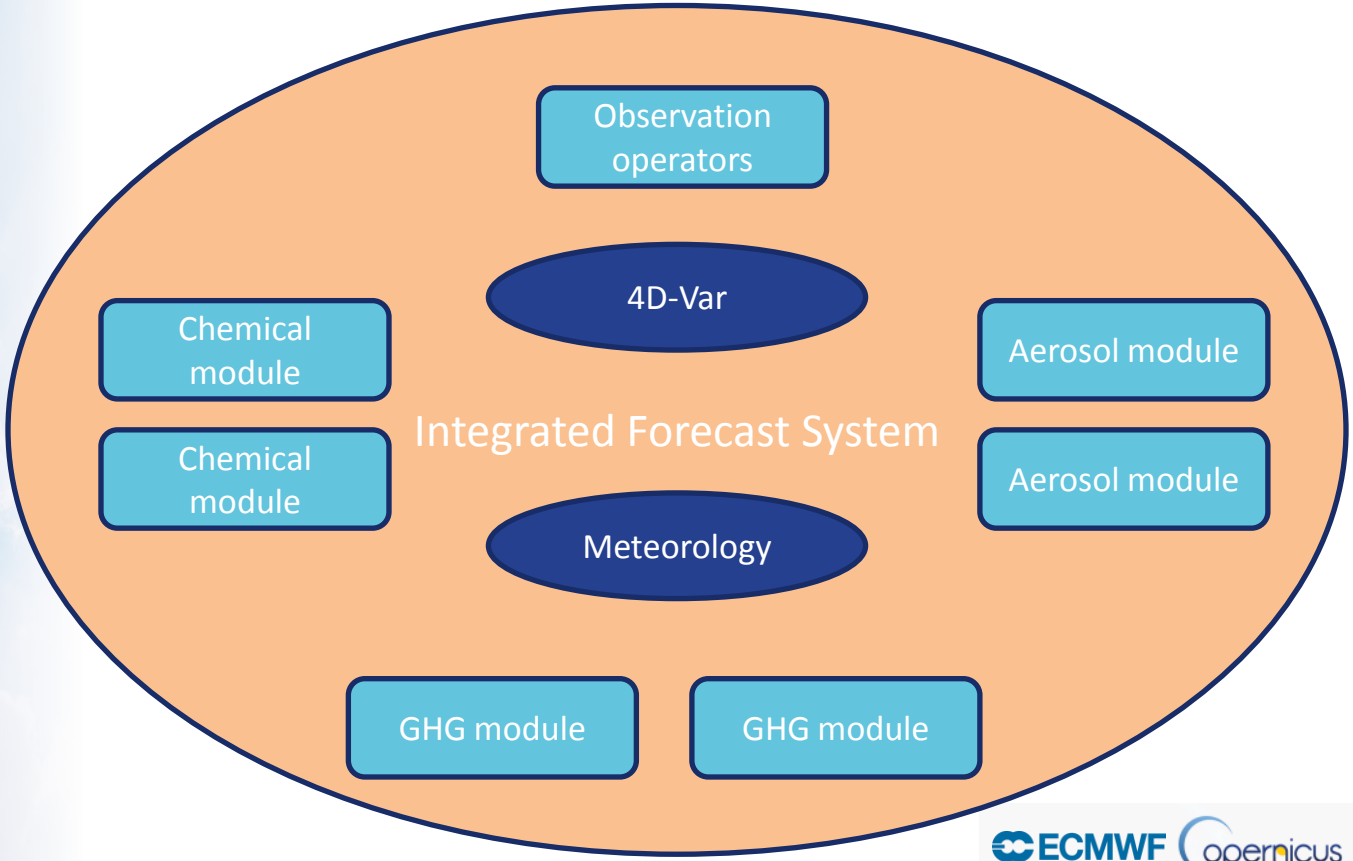
Atmosphere Monitoring

Global system – ECMWF's IFS



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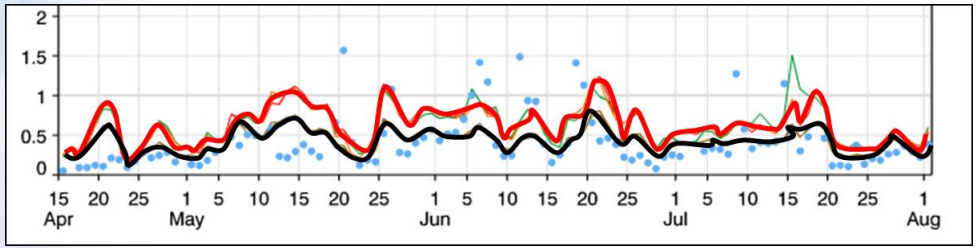
Atmosphere Monitoring

Under the aerosol hood

Dust emissions are based on the bare soil fraction, soil moisture content, wind speed above a threshold and a regionally-defined constant source potential (Morcrette et al. (2009), Ginoux et al. (2001)).

Online dry deposition velocities for all aerosol species as a function of particle size, surface friction, roughness length and soil type, following Zhang et al (2001).

Data assimilation uses observations from MODIS and PMAp to constrain total Aerosol Optical Depth. This means that speciation and size distribution are provided by model.



Total AOD at the Tamanrasset (Algeria) AERONET station

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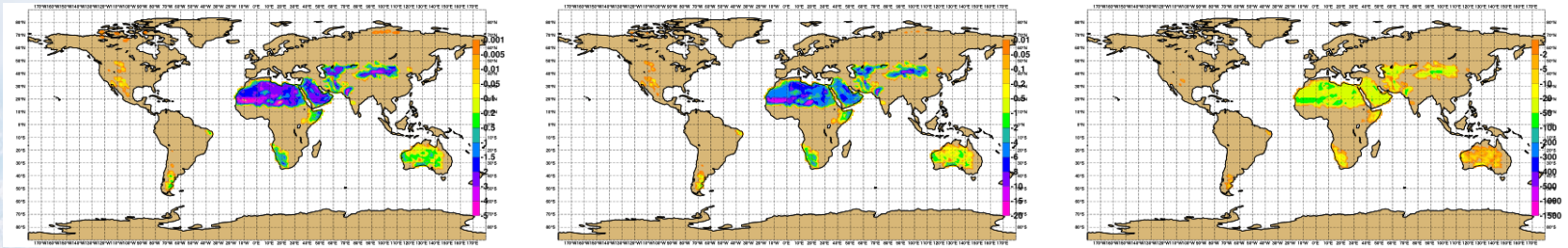
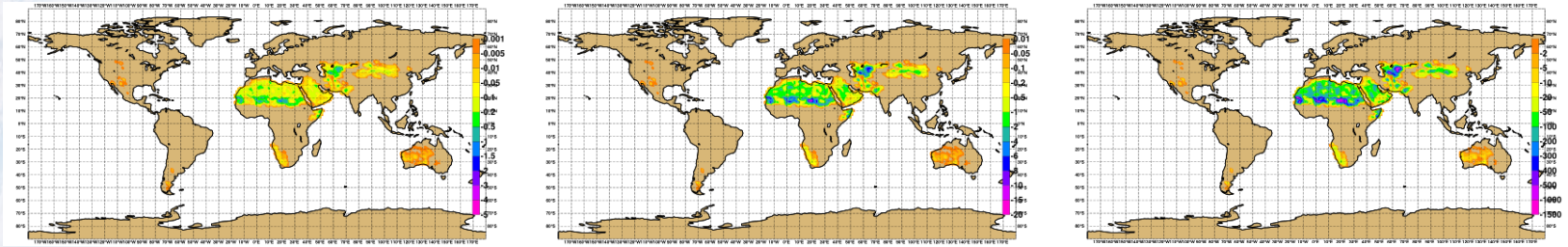
On-going aerosol developments

A new dust emission scheme is adapted from Nabat et al. (2012, ACP), which itself uses the work of Zakey et al. (2006, 2008), based on Marticorena and Bergametti (1995).

Old



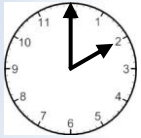
New



Redistribution of aerosol over size bins.

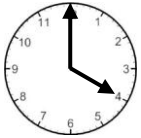
Atmosphere Monitoring

Operational timeliness



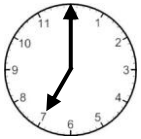
Space

GOME-2 observes the atmosphere



AC-SAF/EUMETSAT

Retrieves O_3, NO_2 & SO_2 concentrations



ECMWF

Global data assimilation and forecast for the next 5 days

7 regional centres

Regional air quality forecast

Meteo-France

Model ensemble processing

Anywhere

Daily AQ forecast for Europe for the next 4 days

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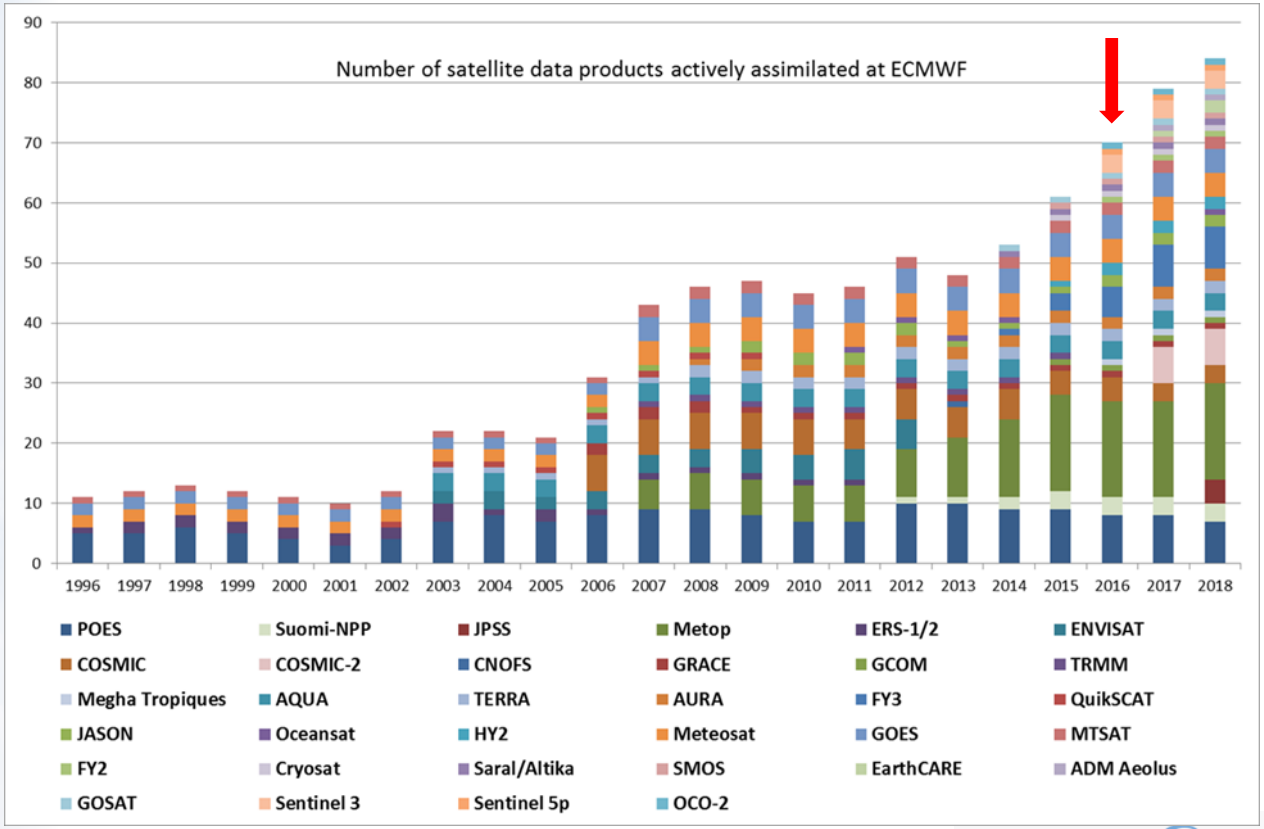
Atmosphere Monitoring

Satellite data used



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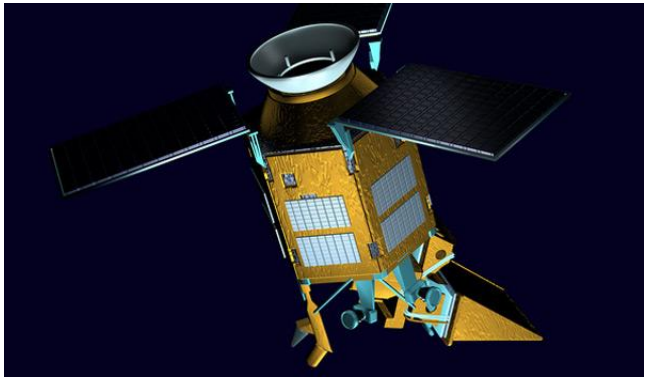
Atmosphere Monitoring

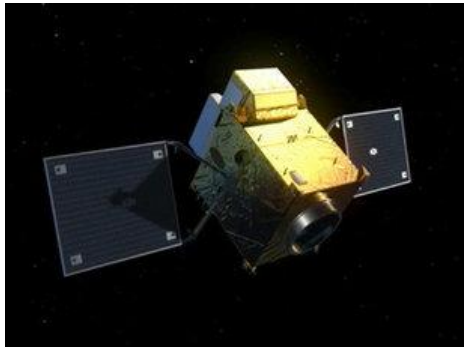
European stage

IASI & GOME-2 (and PMAp)



Sentinel-5p

Sentinel-5



Sentinel-4

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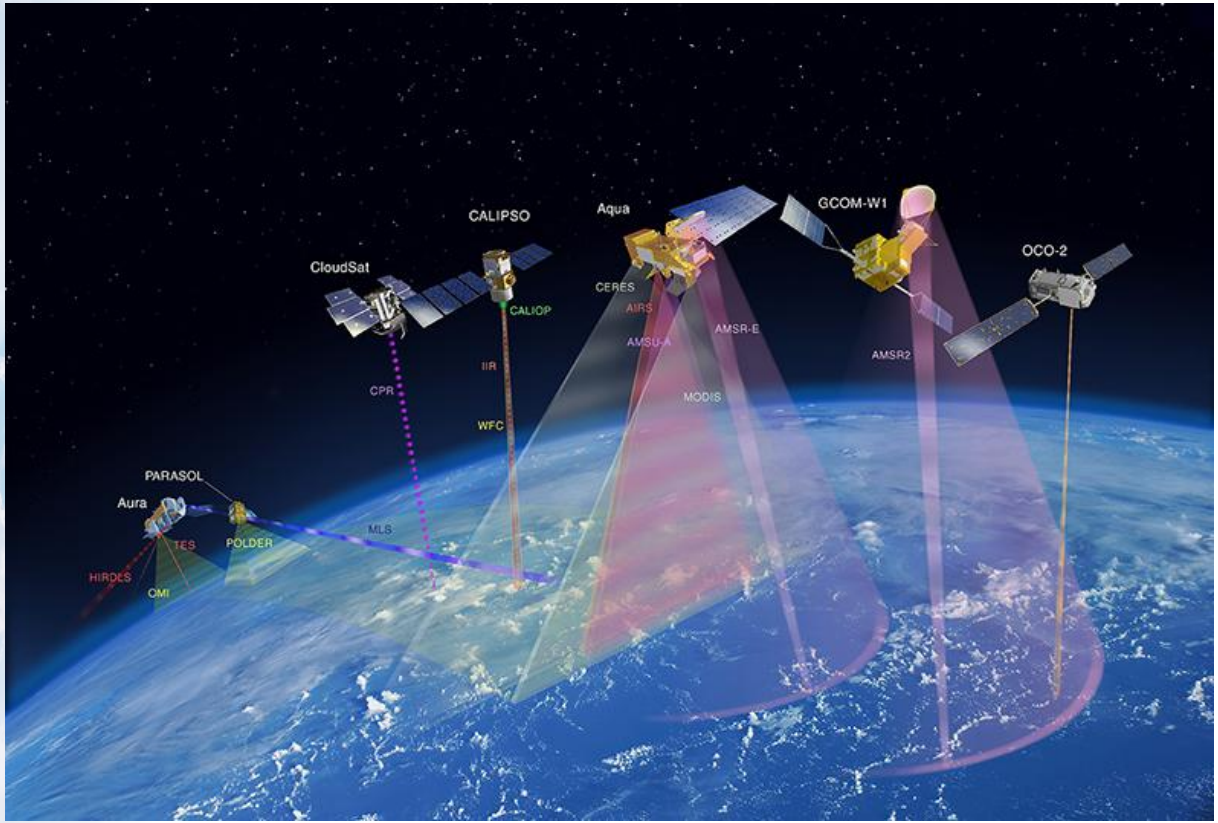
Which instruments do we use?



The A-train

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Atmosphere Monitoring

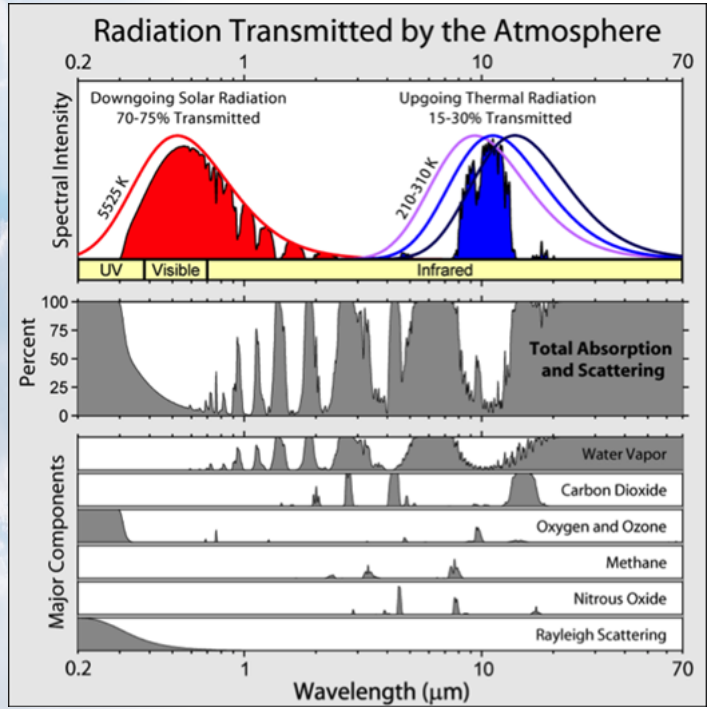
Current satellite data usage

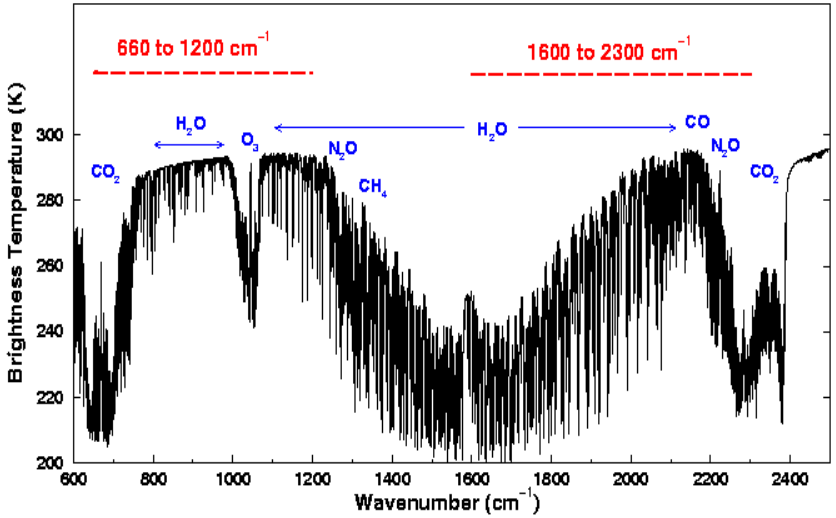
Species	Instruments
Global system	
O_3	**OMI**, **SBUV**, **GOME-2**, **MLS**, **OMPS**, S5p
CO	**IASI**, **MOPITT**, S5p
NO_2	**OMI**, GOME-2, S5p
SO_2	**OMI**, **GOME-2**, S5p
Aerosol	**MODIS**, **PMAp**, VIIRS, S3
CO_2	**GOSAT**, OCO-2
CH_4	**GOSAT**, **IASI**, S5p
GFAS fire emissions	**MODIS**, GOES, SEVIRI, VIIRS, S3

Atmosphere Monitoring

What we actually observe from satellites

There is a wealth of information available in the observed radiances.





Many trace gases can be measured in the UV-VIS, infrared, and microwave parts of the spectrum.

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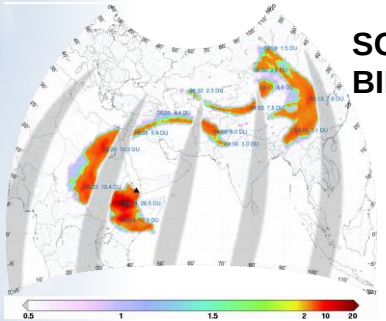
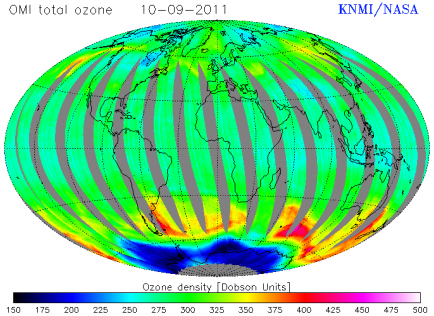
Some examples

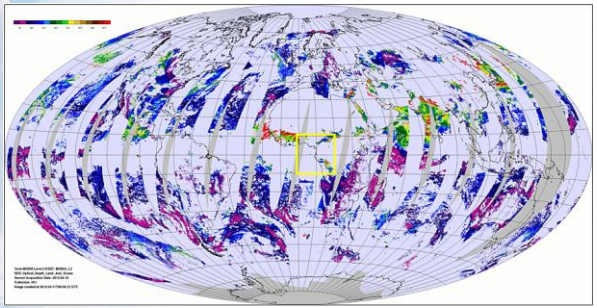


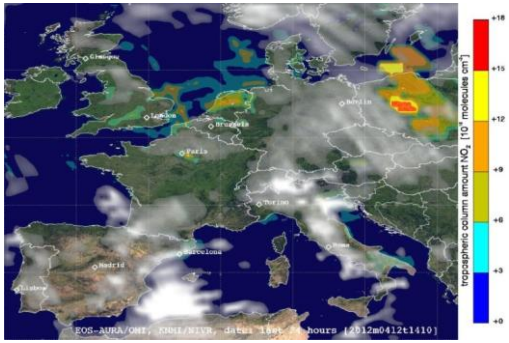
SO_2, GOME-2, SACS, BIRA/DLR/EUMETSAT



O_3, OMI, KNMI/NASA

Aerosol Optical Depth, MODIS, NASA





NO_2, OMI, KNMI/NASA

Atmospheric composition observations traditionally come from UV/VIS measurements. This limits the coverage to day-time only. Infrared/microwave are now adding more and more to this spectrum of observations (MOPITT, AIRS, IASI, MLS, MIPAS …)

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Data assimilation

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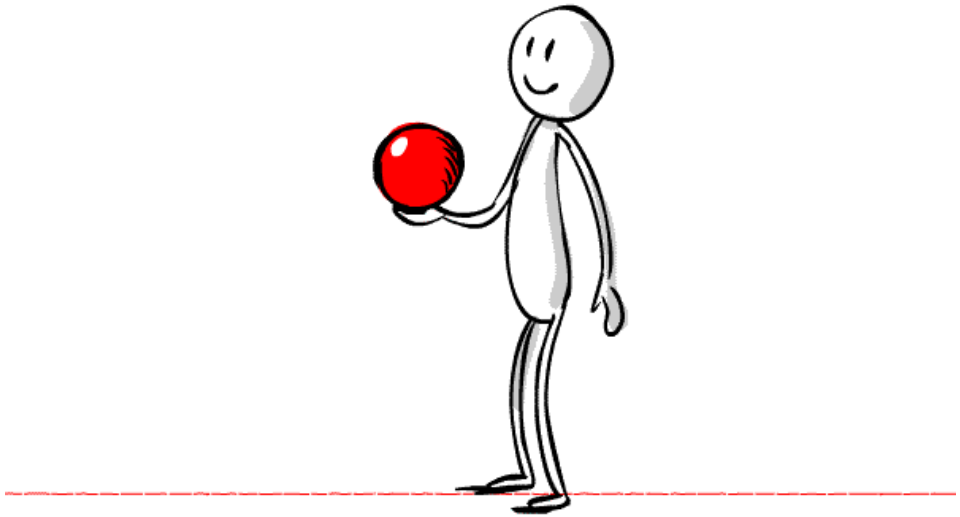

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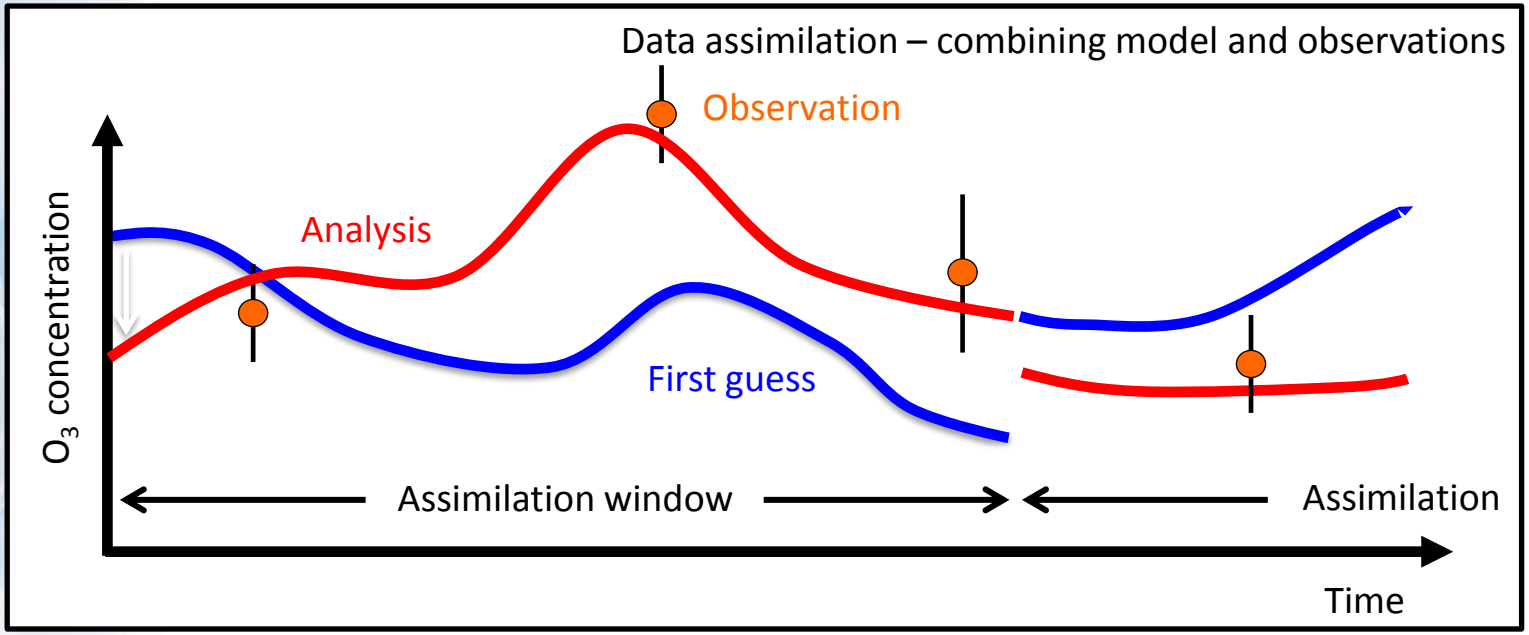
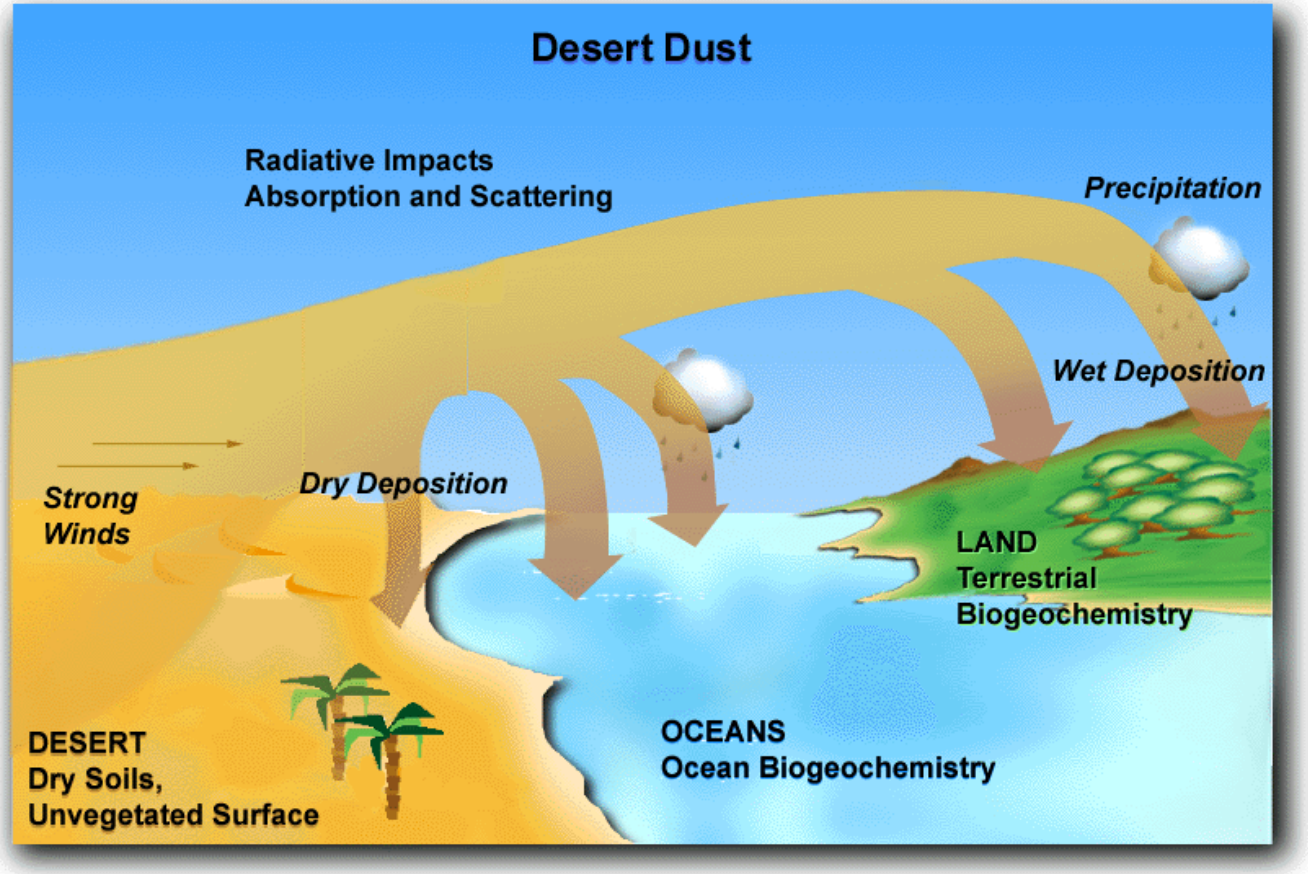
Data assimilation



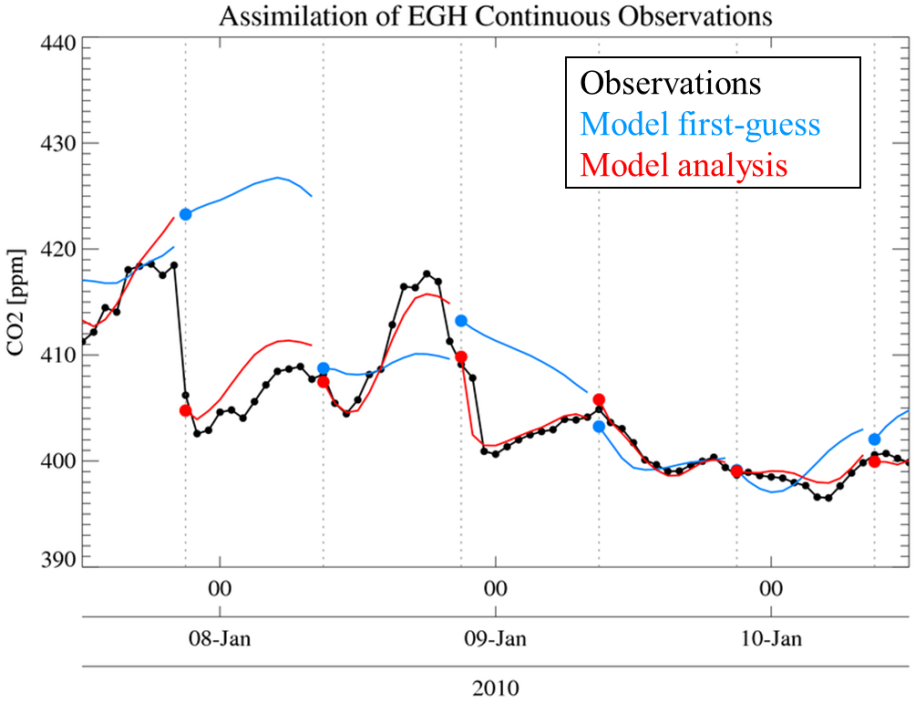
Atmosphere Monitoring

Dust as an example



Boundary condition problem – CO2

Atmosphere Monitoring



For atmospheric composition, the boundary conditions are very important (surface fluxes, emissions,…).

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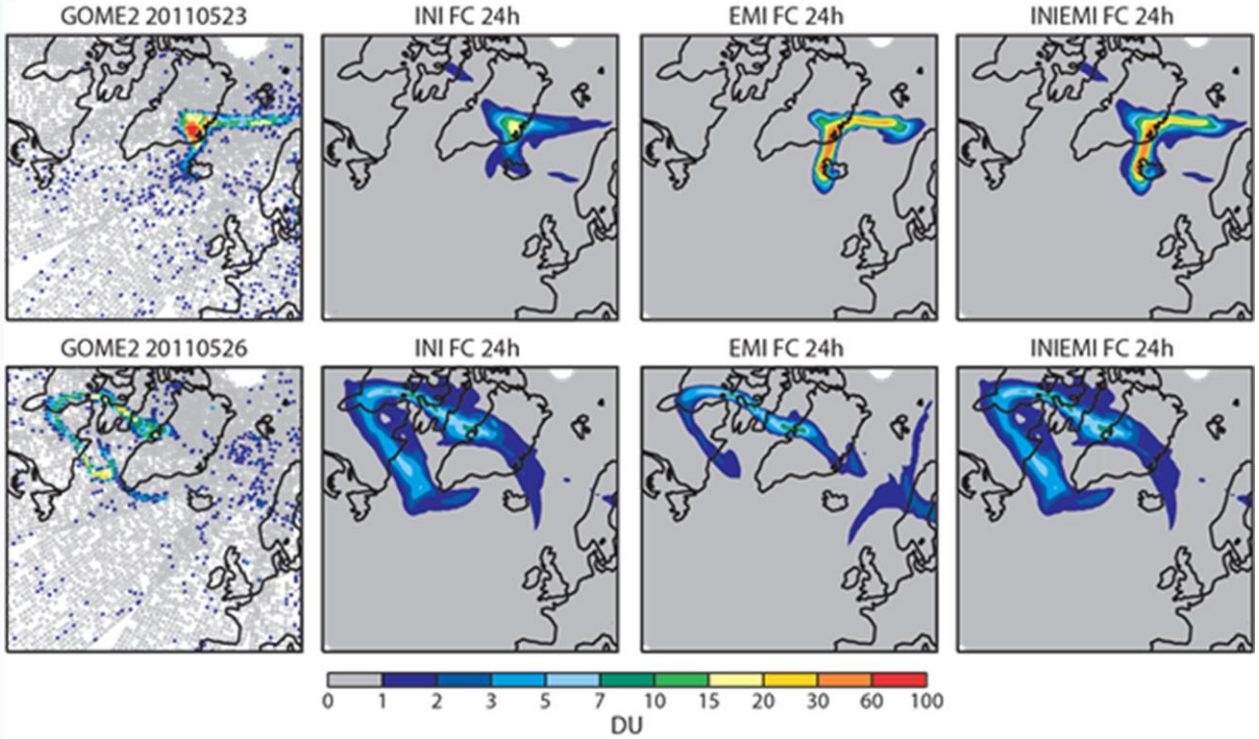
Another example: volcanic eruptions



Both initial conditions and emissions are important to get it right

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Issues with Observations

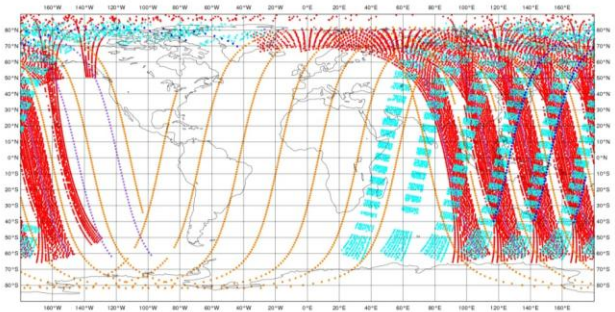
- Little or no vertical information from satellite observations. Total or partial columns retrieved from radiation measurements. Weak or no signal from boundary layer.
- Fixed overpass times and daylight conditions only (UV-VIS) -> no daily maximum/cycle
- Global coverage in a few days (LEO); often limited to cloud free conditions; fixed overpass time.
- Retrieval errors can be large; small scales not resolved

Atmosphere Monitoring

NRT data coverage for reactive gases

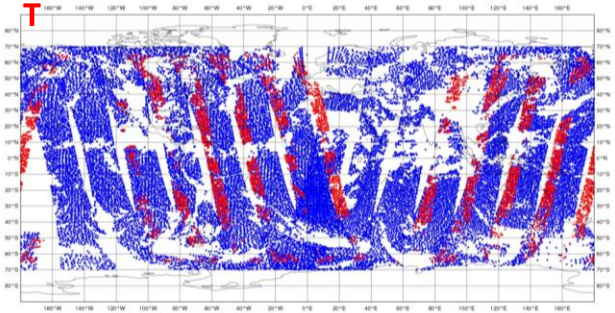
Ozone

SCIA OMI SBUV/2 NOAA-17 SBUV/2 NOAA- MLS



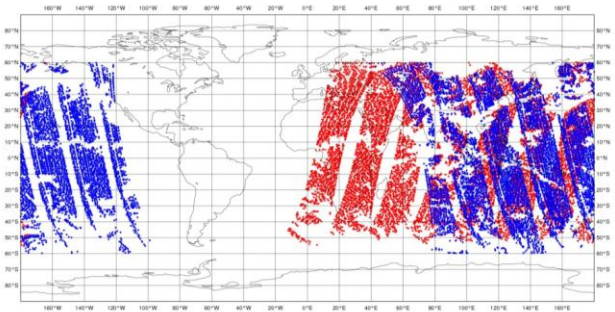
CO

MOPITT IASI



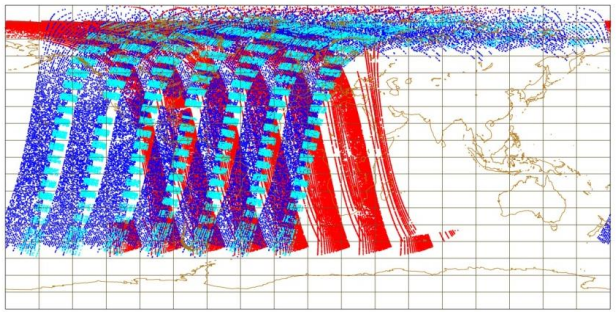
NO2

OMI GOME-2



SO2

OMI SCIA GOME-2



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Single total column O_3 observation

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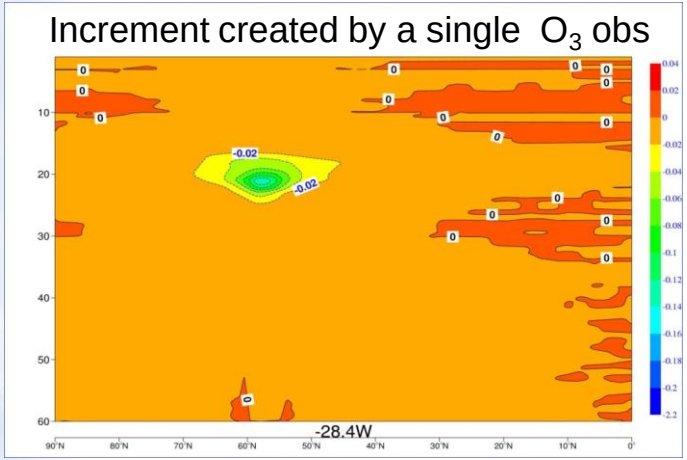
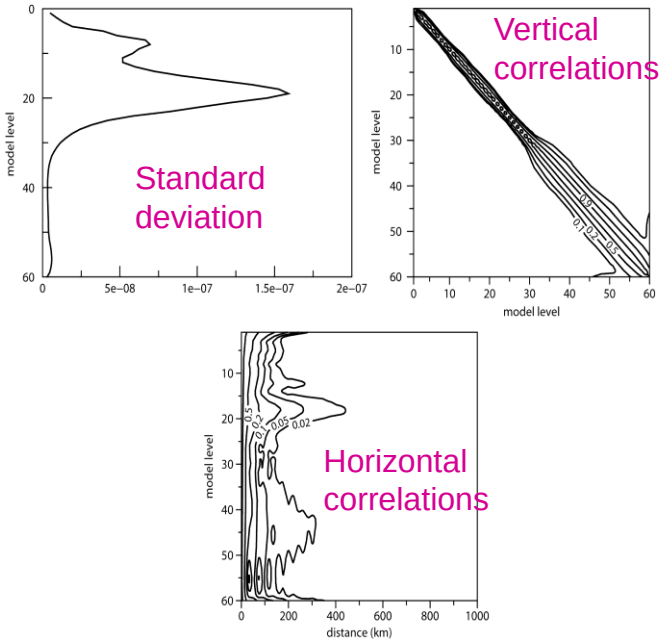


Ozone observation of 247 DU, 66 DU lower than background

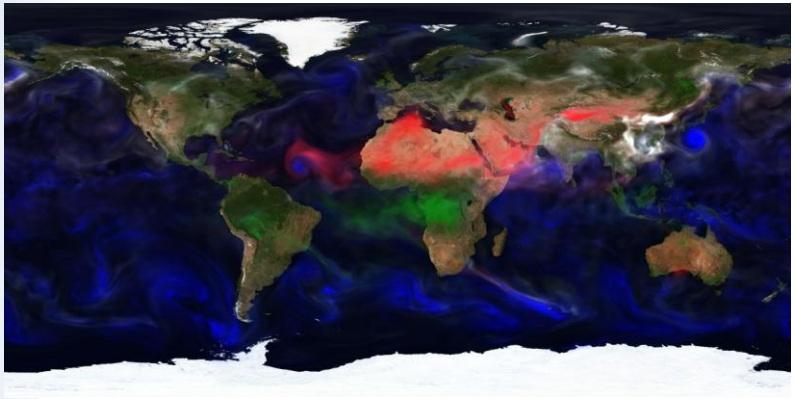
Ozone background errors

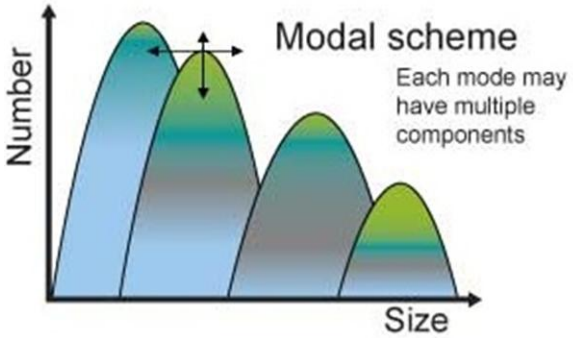


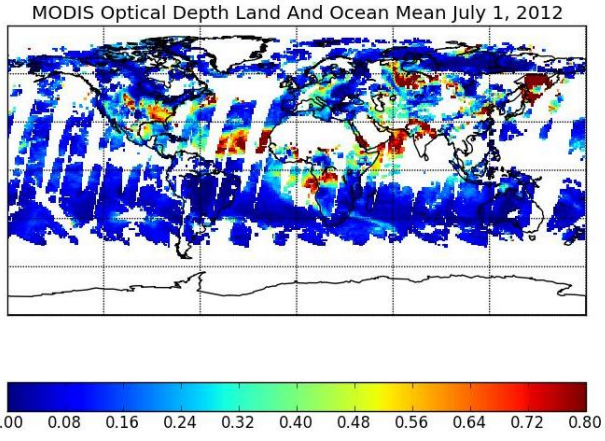
Profile data are important to obtain a good vertical analysis profiles

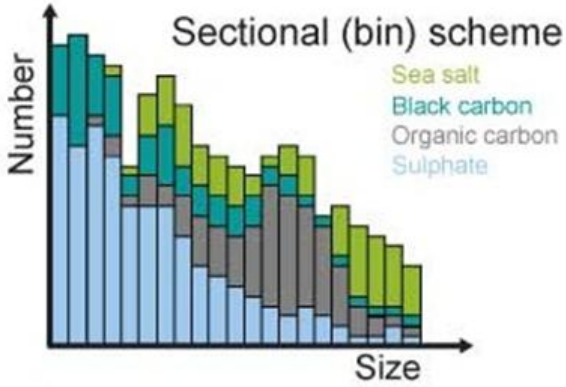
Atmosphere Monitoring

What is the problem with aerosol?









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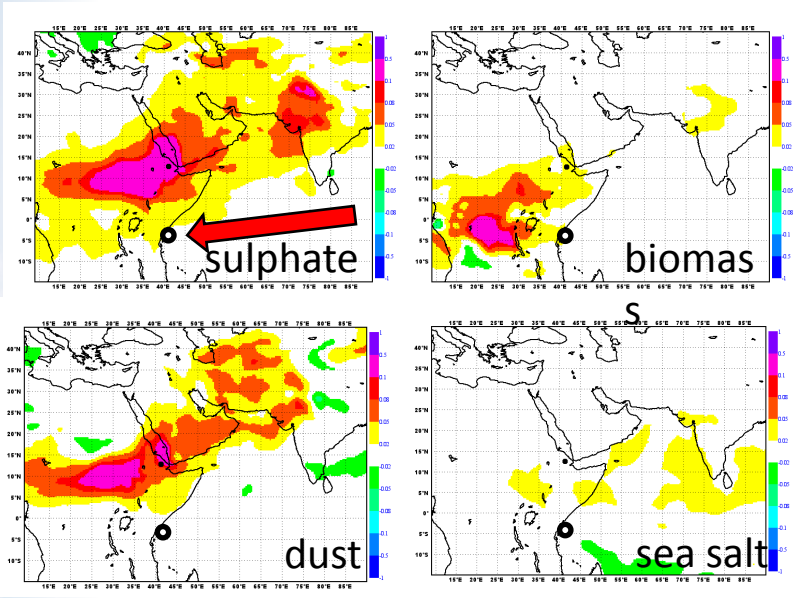
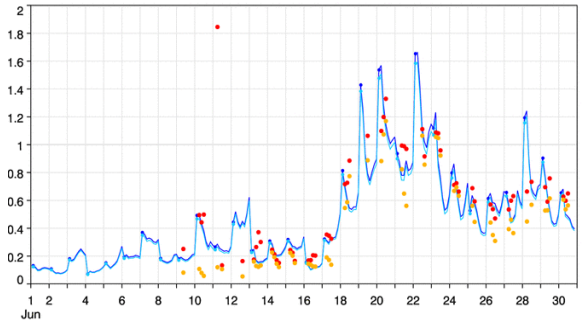
Example for wrong aerosol attribution



Eruption of the Nabro volcano in 2011 put a lot of fine ash into the stratosphere.
This was observed by AERONET stations and the MODIS instrument.

ICIPE-Mbita - AERONET



MACC AOD analysis
AERONET total AOD
AERONET fine mode AOD

The MACC/ECMWF aerosol model does not contain stratospheric aerosol yet, so the observed AOD was wrongly attributed to the available aerosol types.

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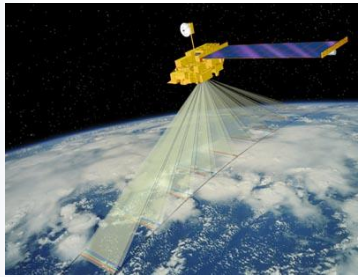
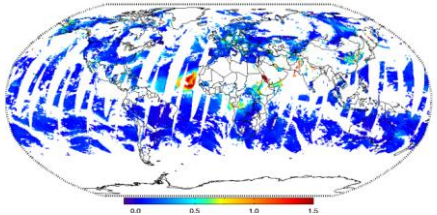
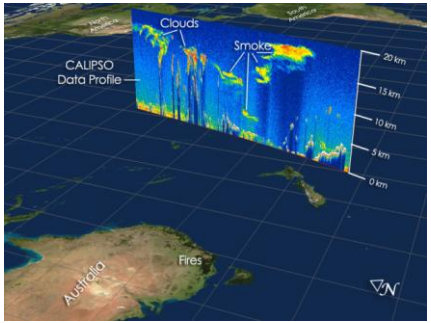
Constraining aerosol

“The most comprehensive approach to monitoring intercontinental smoke transport is to use MISR to observe smoke injection height near source fires, OMPS to track plumes over long distances, MODIS to measure aerosol loading, and CALIOP to capture a vertical profiles of smoke plumes” - Hongbin Yu, University of Maryland.







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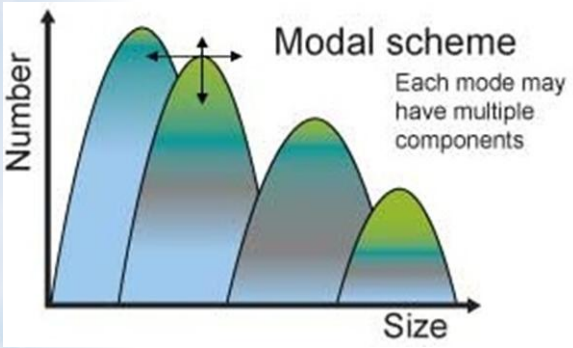
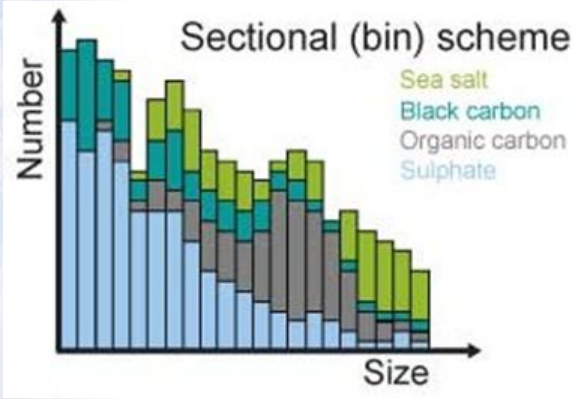
What is the problem with aerosol?





Aerosol schemes are not straightforward to translate from one model to another.

This poses a challenge for using boundary conditions for regional or local models.

Aerosol-meteorology feedbacks

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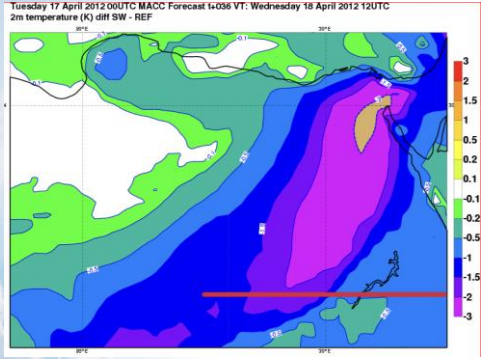

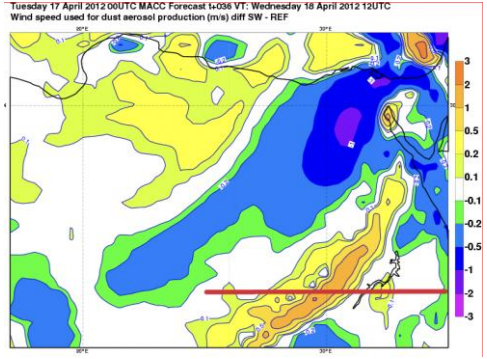

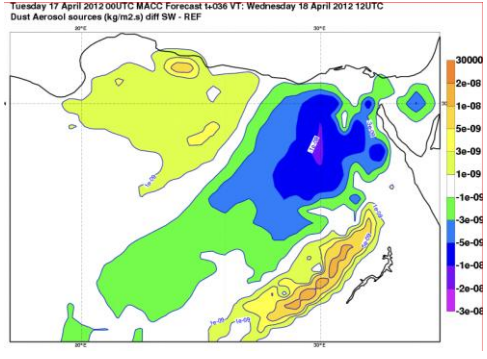

S. Rémy et al., 2015

The dust aerosol in a dust storm affects the local boundary meteorology though short-wave and long-wave radiation effects. This in term can influence the dust source.

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Atmosphere Monitoring

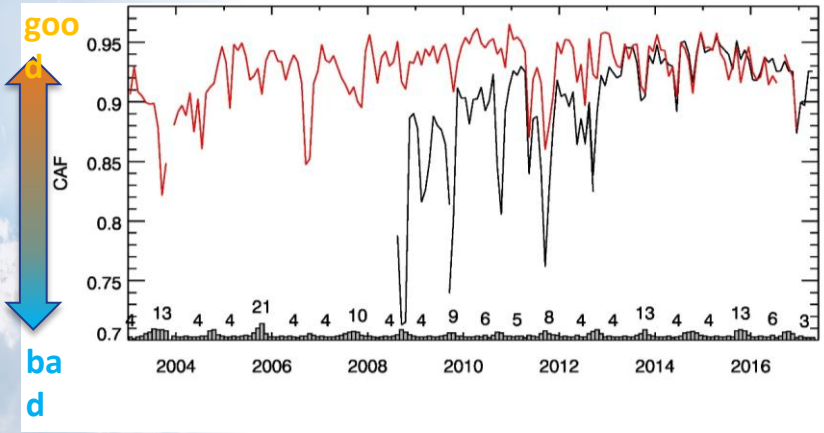
Reanalysis and real-time analyses

- Real-Time CAMS system (twice-daily analysis and 5-day forecast):
  - Evolves with time: Usually 2 model updates per year
  - Horizontal and vertical resolution can change
  - Observation usage changes
  - Emission data sets might change (e.g. change from GFED to GFAS fire emissions)

- Reanalysis (retrospective):
  - Consistent long term dataset produced with one model version
  - Consistent emissions
  - Consistent, reprocessed data sets
  - Gridded continuous presentation of atmospheric composition combining model and satellite retrievals in an optimal way
  - Can be used for trend analysis

Evolution of NRT system

O3 score at Neumayer station

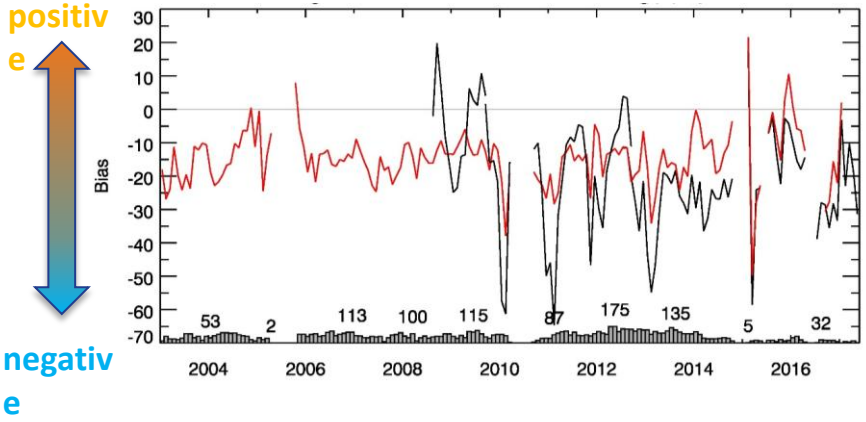


- More consistent timeseries in reanalysis
- NRT timeseries shows model evolution and problems in earlier years

CIRA (CAMS Interim Reanalysis)

NRT CAMS analysis

CO bias (1000-700 hPa) at Frankfurt



Datasets used in CAMS reanalysis

OMI *Aura*	NO2
SCIAMACHY *Envisat*	CO2,
SCIAMACHY *Envisat*	CH4
MOPITT *Terra*	NO2
AATSR *Envisat*	CO
MIPAS *Envisat*	AOD
SCIAMACHY *Envisat*	O3
SBUV/2 *NOAA-18*	O3
SBUV/2 *NOAA-17*	O3
SBUV/2 *NOAA-16*	O3
SBUV/2 NOAA-14	*O3*
OMI *Aura*	O3
MLS *Aqua*	O3
GOME *ERS-2*	O3
MODIS *Terra*	*O3*
MODIS *Aqua*	AOD
	AOD

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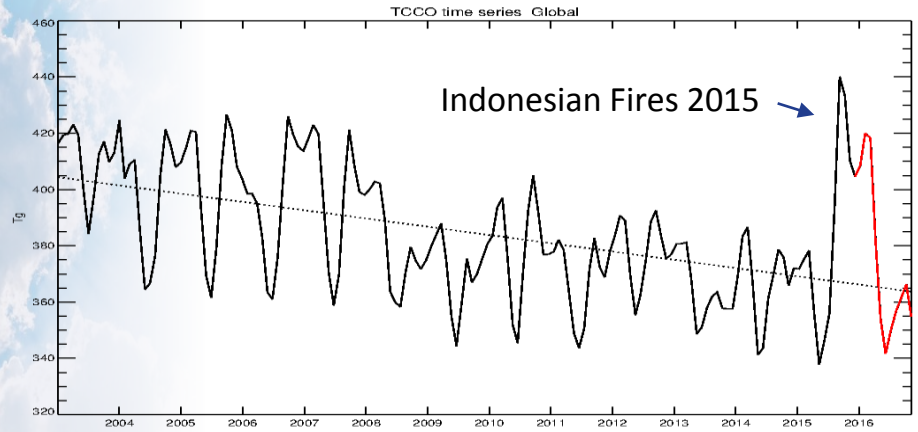
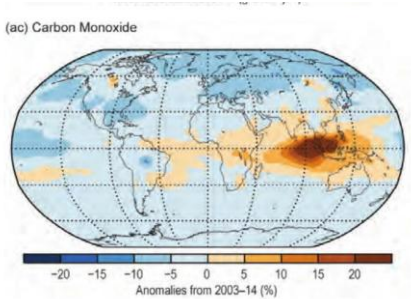
GLOBAL Trends of CO burden

CAMS interim Reanalysis

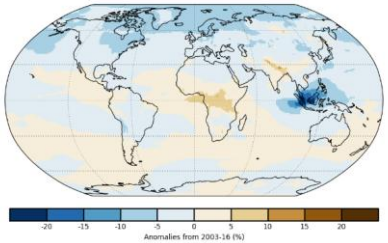
GLOBAL CO Burden in Tg 2003-2016



Anomaly (%) 2015



Anomaly (%) 2016



Flemming and Inness, BAMS State of Climate 2015

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CAMS Reanalysis aerosol

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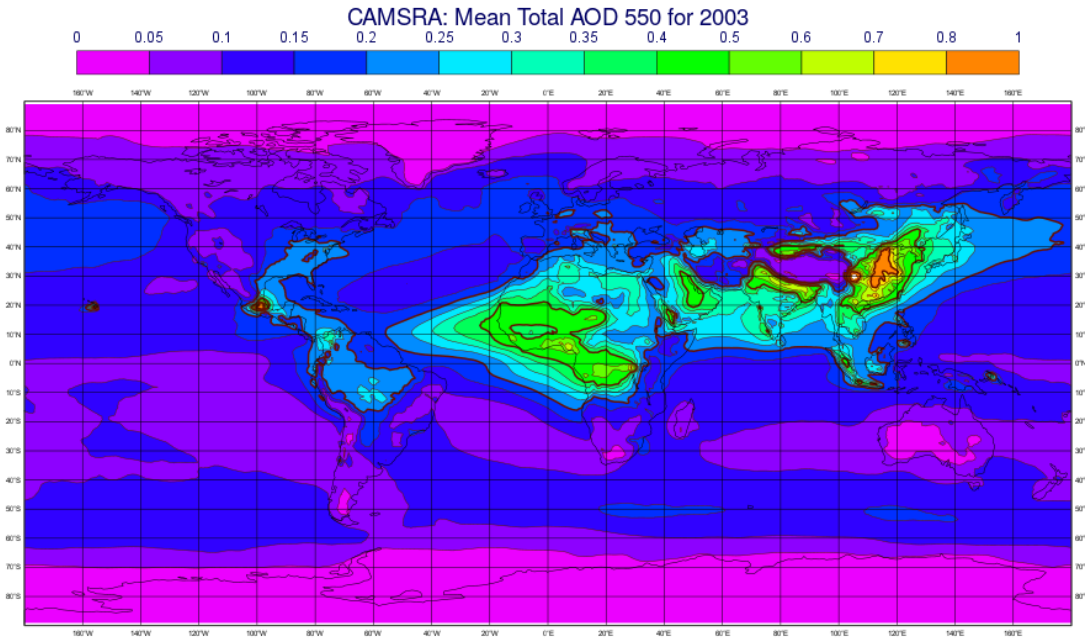

- New reanalysis currently in the process of being produced by CAMS
- Will cover the period 2003-current day
- First data will be released in Autumn 2017
- Current aim is to have full data released in early 2018

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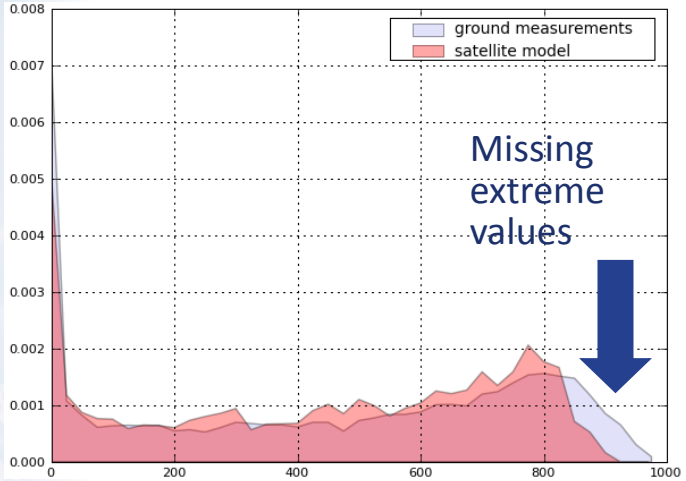
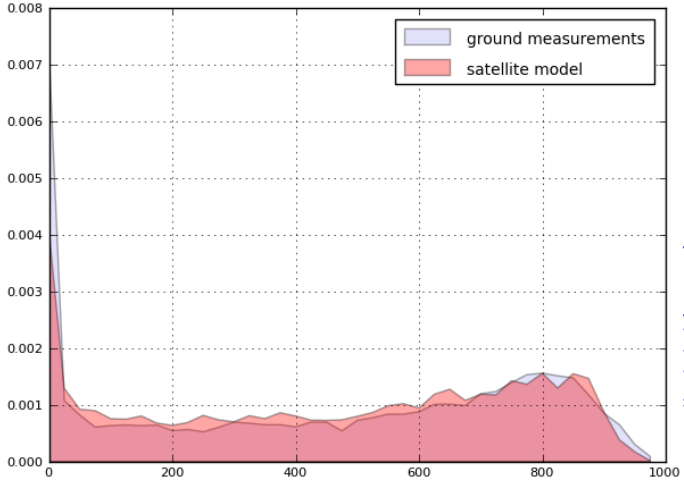
Support for solar energy applications

AOD monthly climatology



GEMS AOD daily values



Valladolid (Spain)

Direct normal irradiance [W/m2]

GeoModel

SME, Bratislava, SK

Climatology databases do not allow correct representation of direct normal irradiance distribution

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CAMS User Support Gateway

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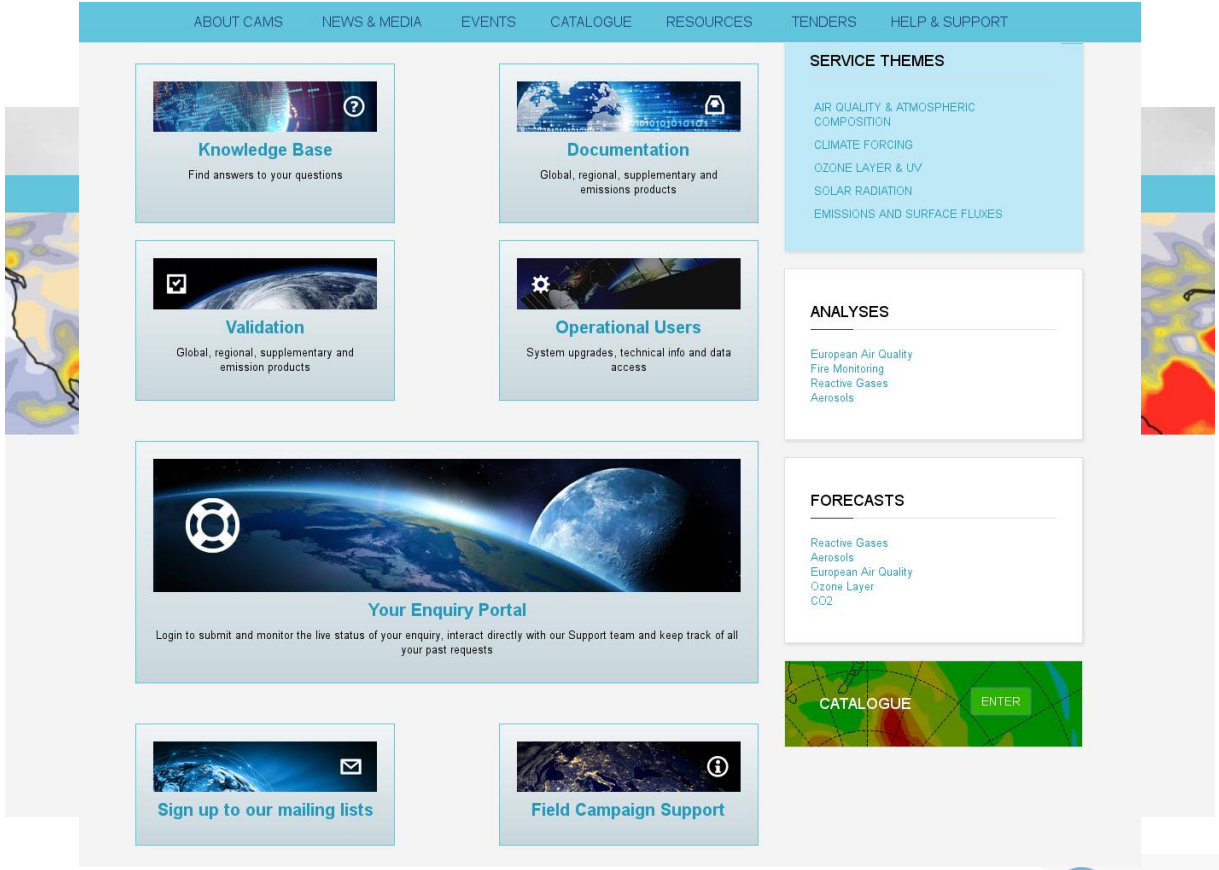

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CAMS User Support Service in a nutshell

- ✓ Dedicated to aid CAMS data discovery, dissemination, understanding and use by all users
- ✓ Provides a central communication tool (JIRA Service Desk)
- ✓ Promotes an extra source of information through its Customer Portal integrated Knowledge Base

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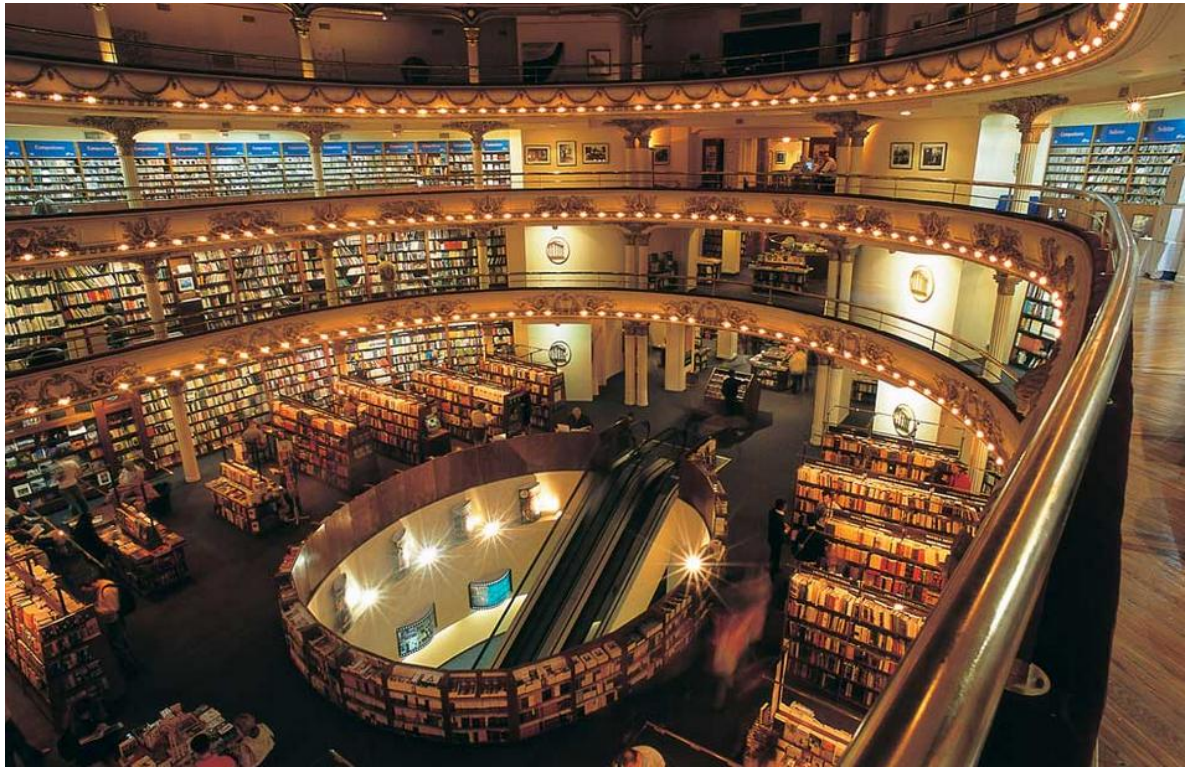
Levels of Support



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Level 0 - Knowledge Base (KB)

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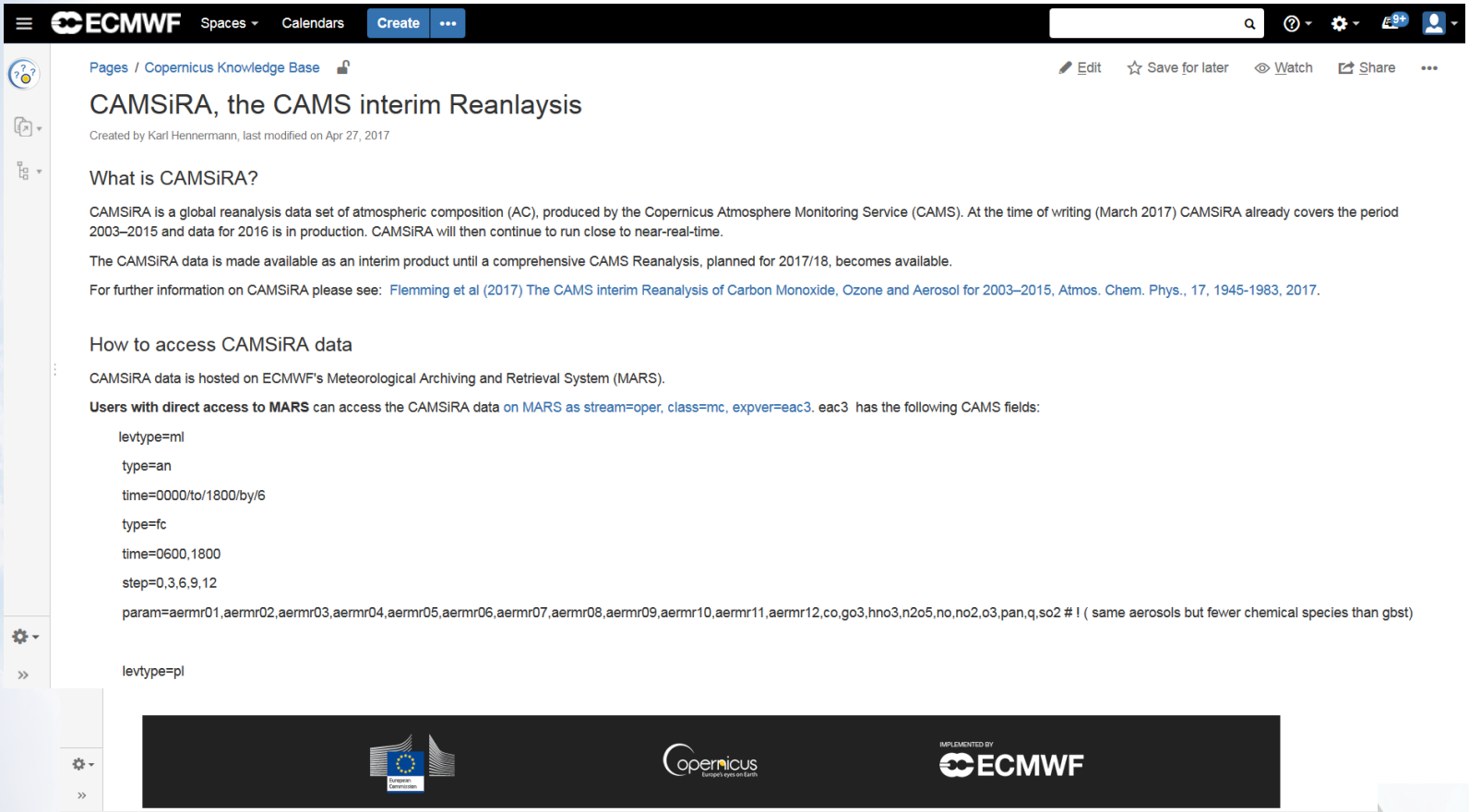

http://copernicus-support.ecmwf.int/knowledgebase

Levels 1 & 2: Service Desk Customer Portal

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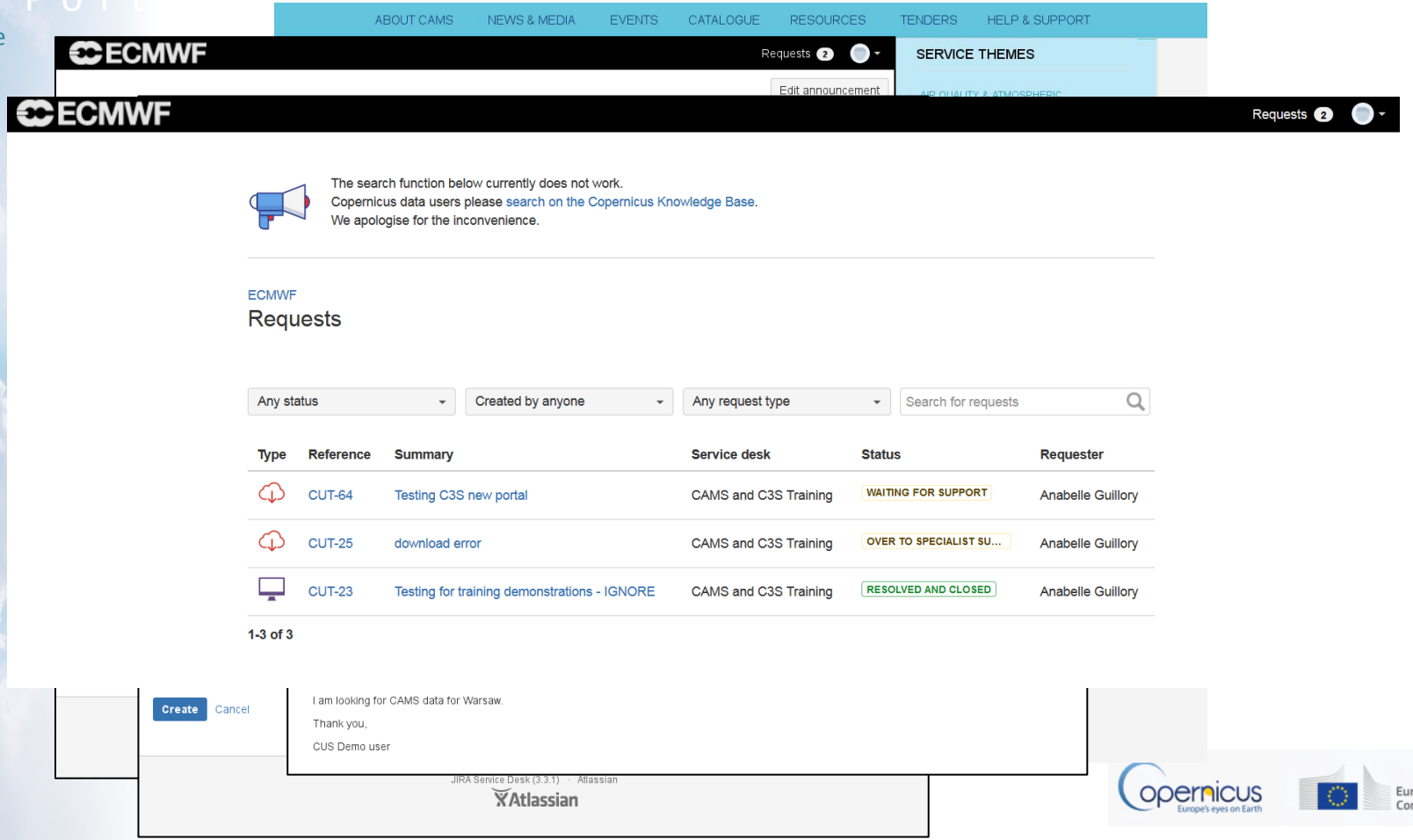

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Why should you contact us?

1. We want to help!
2. It is in part through User Support that we build and consolidate our reputation
3. Tell your friends about us – the best advertising we can have is a loyal customer spreading the word about how great our services are!
4. Send us your user stories
5. We want to grow our services for your benefit

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What to remember

- User Support Gateway page on CAMS website
- Levels of support
- We’re happy to help and with a smile! ☺

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and finally …

"Coming together is a beginning.

Keeping together is progress.

Working together is success."

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