



**Copernicus Atmosphere
Monitoring Service**

SUPPORTING REGIONAL AIR QUALITY AND SOLAR RADIATION MONITORING AND FORECASTING

Jean-Noël Thépaut and Vincent-Henri Peuch (ECMWF)



Copernicus EU



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www.copernicus.eu



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QUICK CATCH-UP ABOUT CAMS



FULL – FREE – OPEN DATA



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CAMS PORTFOLIO (AVAILABLE ONLINE)



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
D. Emissions products	Climate forcings
	Anthropogenic emissions
	Fire emissions

1

2

Individual products can also be found using the online "Catalogue" facility.



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AIR QUALITY: GREAT SOCIETAL DEMAND



President Obama Explains How Pollution Affects Our Planet



DNews



1,809,846

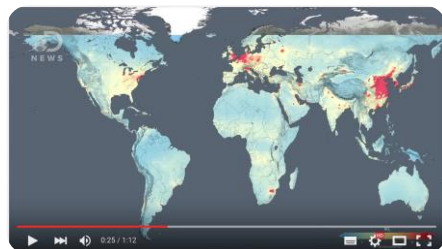
103,161

Add to Share *** More

8,418 326

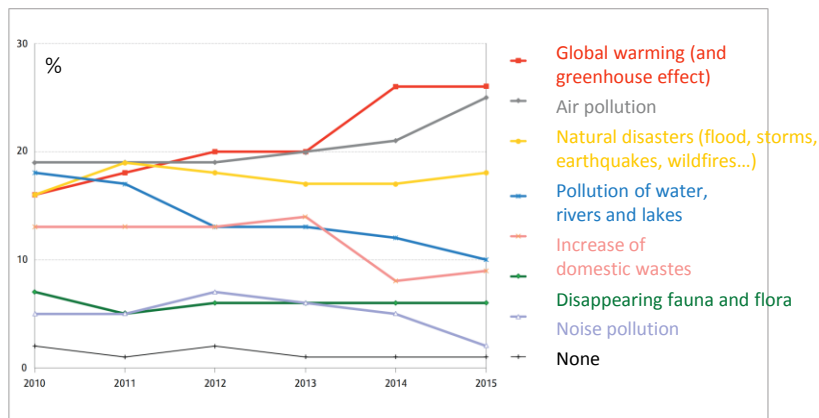
Published on 12 Apr 2016

YouTube



French Ministry of Environment annual survey, April 2016

Among the following issues affecting the environment, which one are you preoccupied most about?



Source : CGDD/SoES, plateforme Environnement de l'enquête « Camille » réalisée par l'Insee en novembre 2015



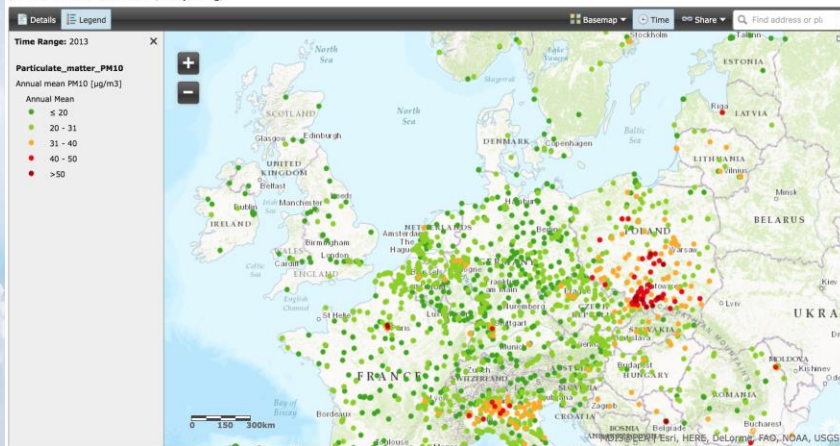
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AIR QUALITY: WHY IS CAMS NEEDED?

European Environment Agency



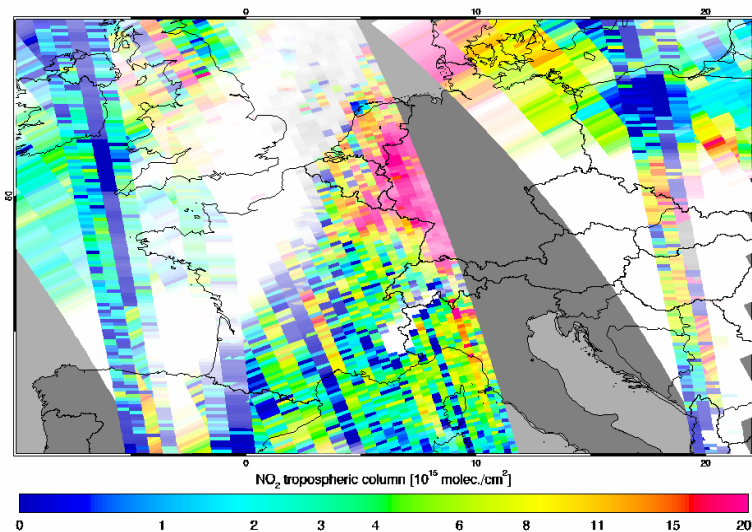
The map shows annual mean concentrations of Particulate Matter (PM10) in Europe based on daily averages with at least 75% of valid measurements, in $\mu\text{g}/\text{m}^3$ (source: EEA, AirBase v.8 & AQ e-Reporting)



Surface observations are essential, but there are lots of gaps in the surface coverage, even in Europe...
People don't always live near a sensor!

OMI NRT tropospheric NO_2 12 Nov 2016

KNMI/NASA



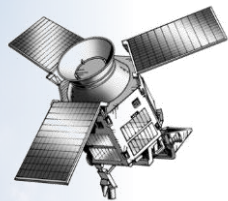
While a range of constituents are observed from space, direct use is challenging or impossible: there are too many gaps and noise in individual measurements!



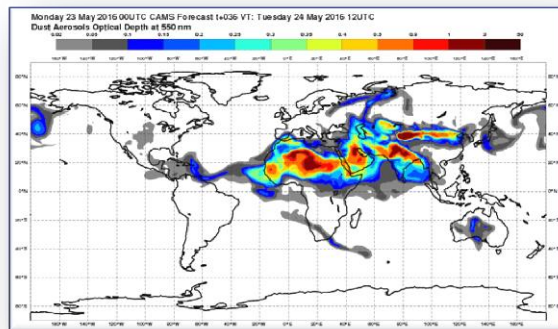
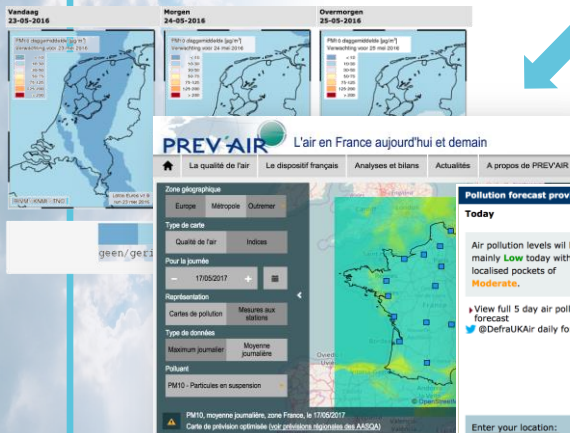
CAMS SERVICE CHAIN

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Space Agencies



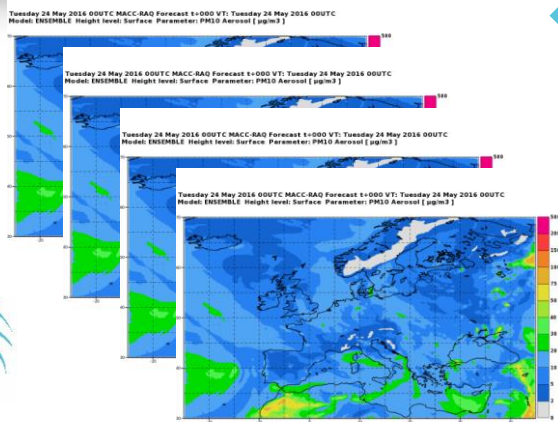
National scale



In-situ observations



>30
providers
from 14
Member
States





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EUROPEAN AIR QUALITY

EUROPEAN AIR QUALITY SERVICES

OTHER AIR QUALITY MAPS

- ENSEMBLE MODEL
 - HOURLY FORECASTS
 - HOURLY ANALYSES
 - DAILY MEAN AND MAXIMUM
 - EPSGRAMS
- PARTNER MODELS
 - HOURLY FORECASTS
 - HOURLY ANALYSES
 - DAILY MEAN AND MAXIMUM
- REANALYSES
 - ENSEMBLE REANALYSIS
 - SIGNIFICANT EVENTS
- NRT OBSERVATIONS

DATA DOWNLOAD

- ONLINE DATA
- ARCHIVES
- REANALYSIS DATA
- **WEB SERVICES**
- CATALOGUE OF SERVICES

API

VERIFICATION RESULTS

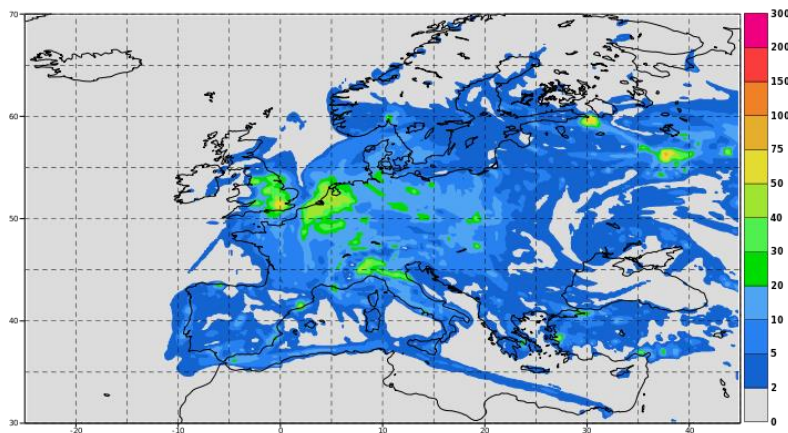
- FORECAST VS OBS
- ANALYSIS VS OBS
- ANALYSIS VS FORECAST
- MEAN SCORES
- TIME SERIES
- TAYLOR DIAGRAMS

DOCUMENTATION

- ABOUT THE PROJECT
- FAQ
- RESOURCES

Direct link: www.regional.atmosphere.copernicus.eu

Monday 14 November 2016 00UTC CAMS Forecast t+000 VT: Monday 14 November 2016 00UTC
Model: ENSEMBLE Height level: Surface Parameter: Nitrogen Dioxide [$\mu\text{g}/\text{m}^3$]



For regulatory pollutants (O_3 , NO_2 , SO_2 , $\text{PM}_{2.5}$, PM_{10} ...) and other key species:

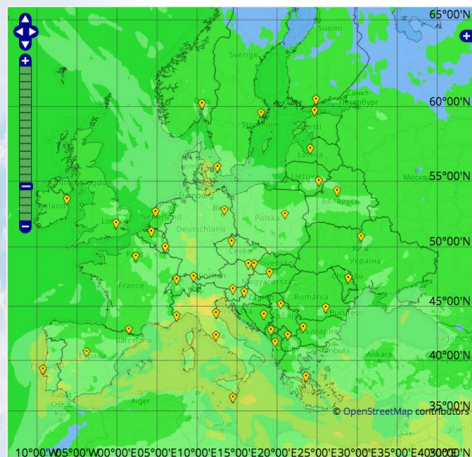
- Real-time analyses and forecasts (4-day)
- Interim reanalyses (shortly after the end of each year)
- Reanalyses based on validated observations (when Airbase is updated)



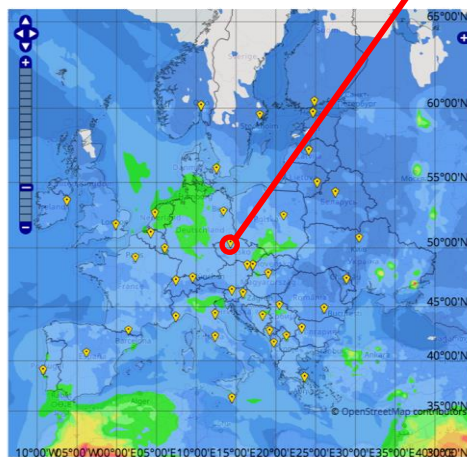
WHAT'S THE AIR QUALITY LIKE?

Forecast for 23 May 2017 (D+0)

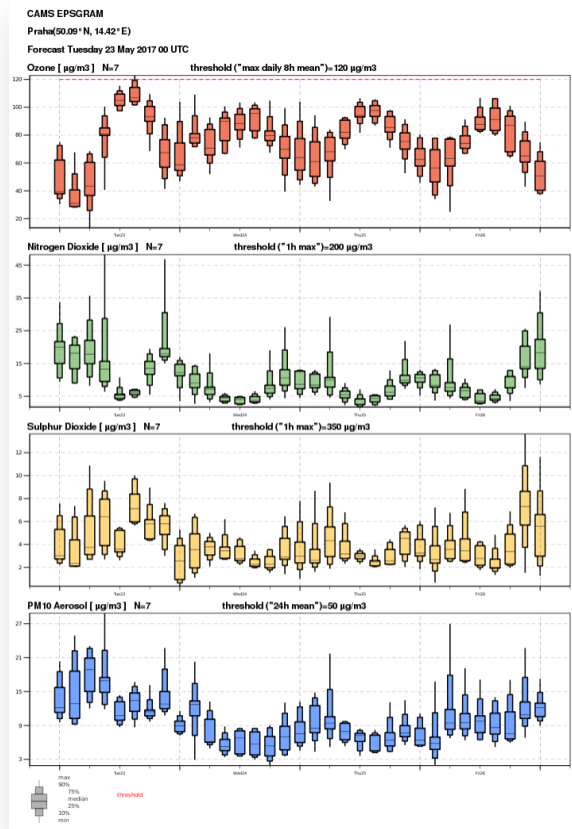
OZONE



PM2.5



Scale for concentration (Unit : $\mu\text{g}/\text{m}^3$)





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AIR QUALITY OVER THE CZECH REPUBLIC

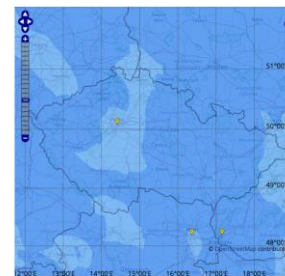
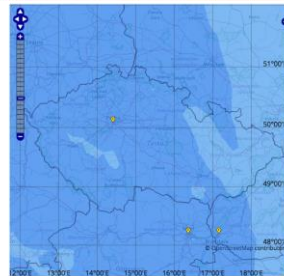
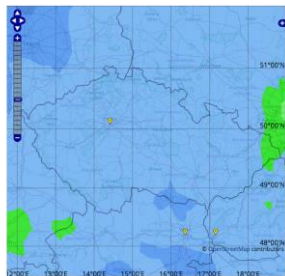
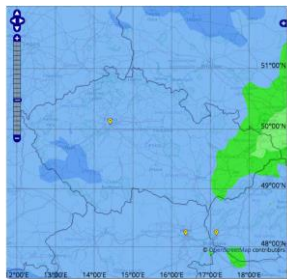
Forecast for
23 May 2017

Forecast for
24 May 2017

Forecast for
25 May 2017

Forecast for
26 May 2017

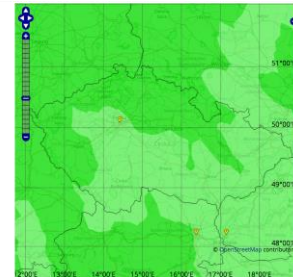
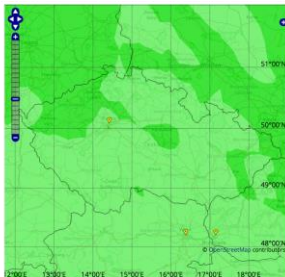
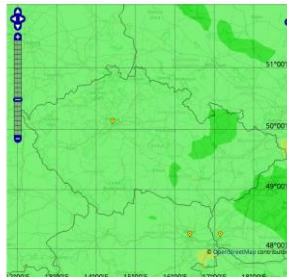
PM2.5



Scale for concentration (Unit : $\mu\text{g}/\text{m}^3$)



OZONE

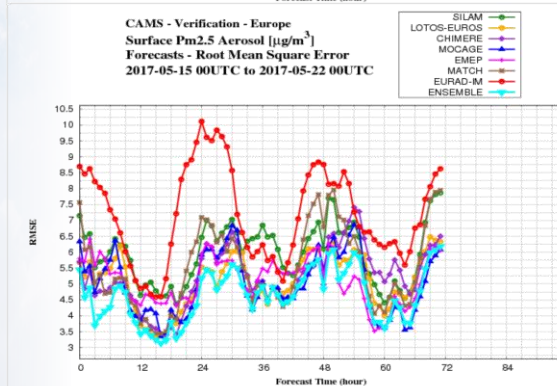
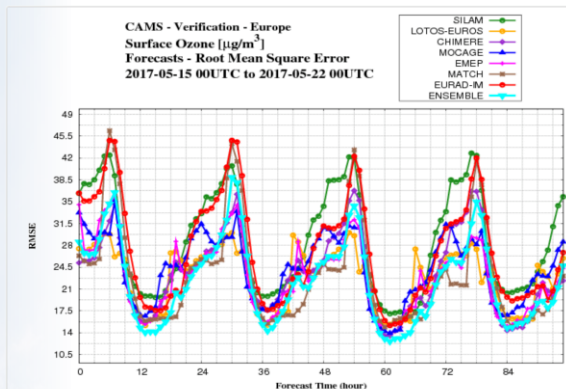




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CAN YOU TRUST THESE FORECASTS?

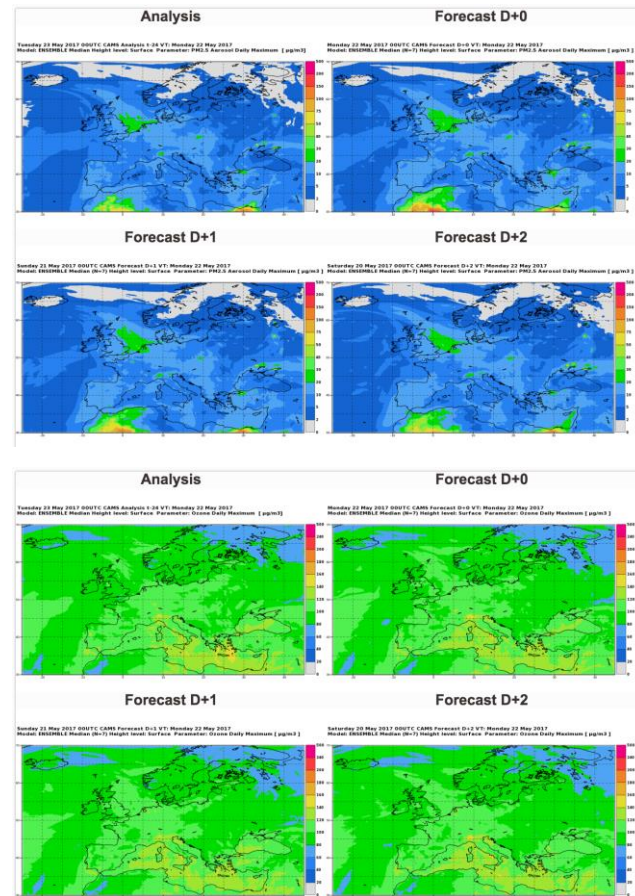
Extensive validation of analyses and forecasts are provided daily for the users.



The multi-
model
european

ENSEMBLE

is the most
reliable
product

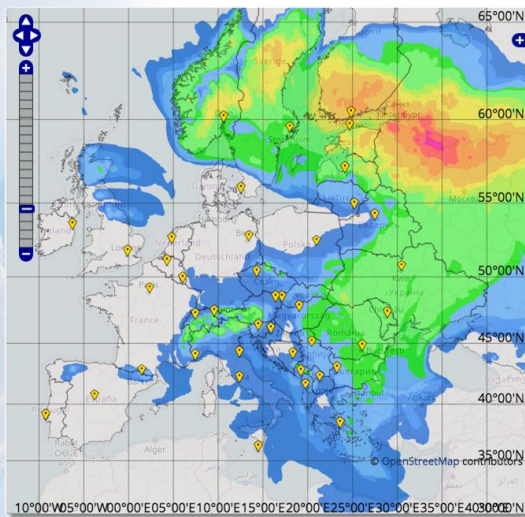




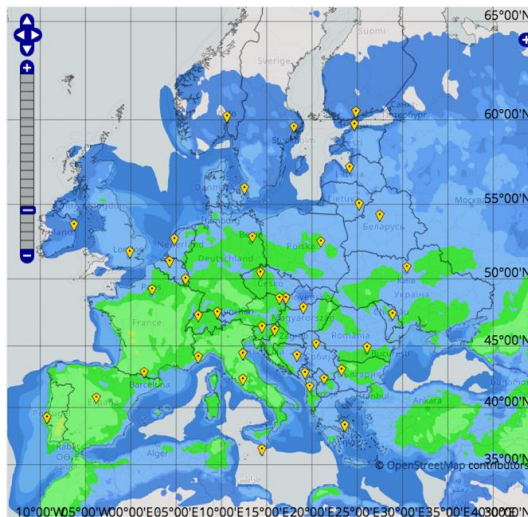
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AND THERE'S MORE: POLLENS

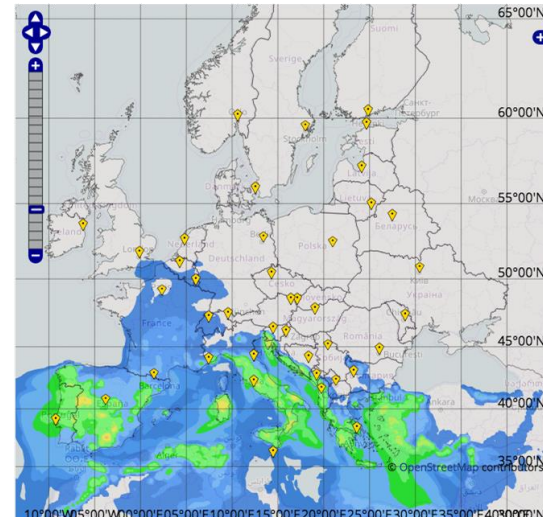
25% of the European population is sensitive to pollens. CAMS provide daily forecasts during season. Example: D+0 forecast for 23 May 2017



BIRCH



GRASS



OLIVE

Scale for concentration (Unit : grains/m^3)



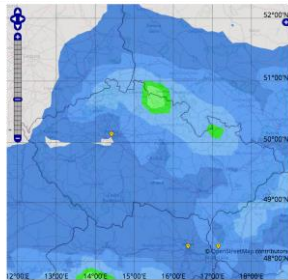


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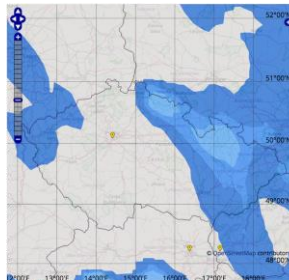
AND OVER THE CZECH REPUBLIC?

BIRCH

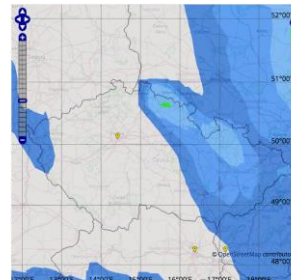
Forecast for
23 May 2017



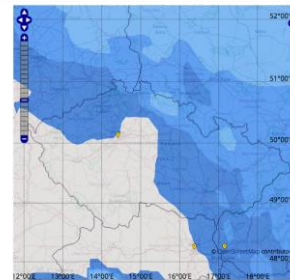
Forecast for
24 May 2017



Forecast for
25 May 2017



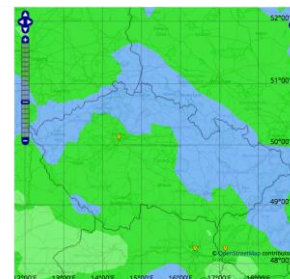
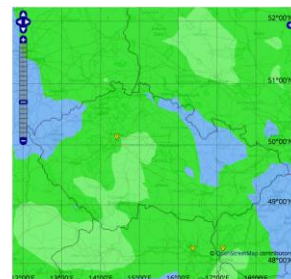
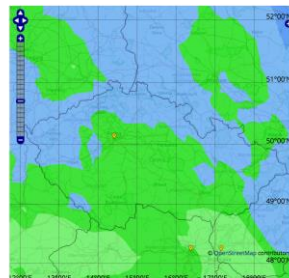
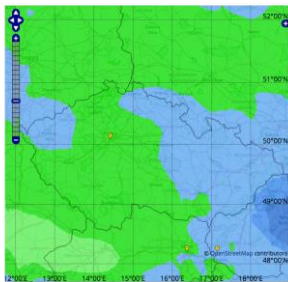
Forecast for
26 May 2017



Scale for concentration (Unit : grains/m³)



GRASS





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SOLAR RADIATION: WHY CAMS IS NEEDED?

		Skin Type			
		I and II	III and IV	V	VI
UV Index		low	low	low	low
		medium	low	low	low
		high	medium	low	low
		high	medium	medium	low
		very high	high	medium	medium
		very high	high	high	medium

UV & health

Materials
lifetime



Ecosystems and
agriculture



© DLR



© BMU



© BMU

Solar Technologies



© BMU

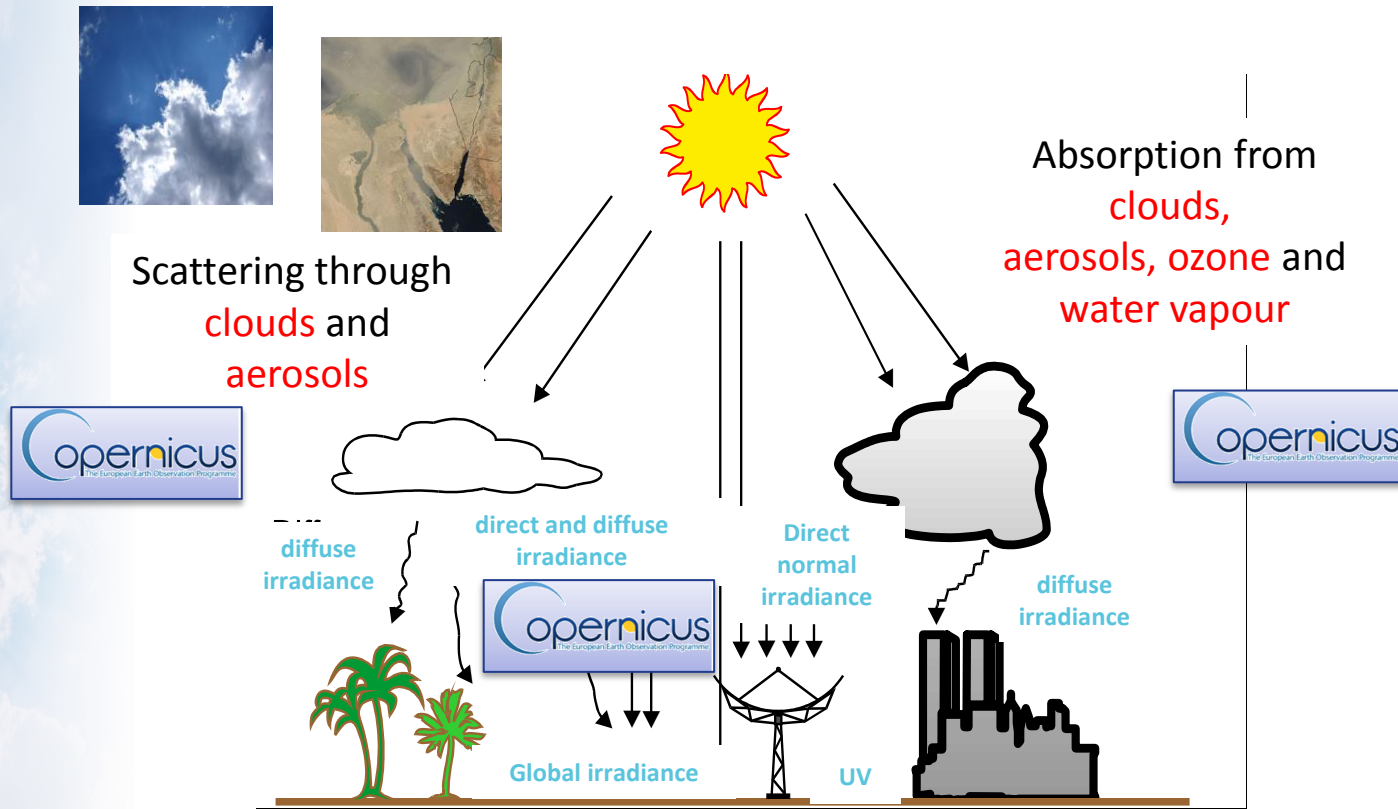


© TSK Flagsol



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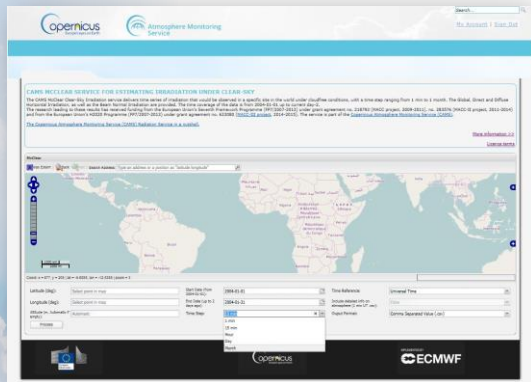
WHY DOES CAMS PROVIDE RADIATION PRODUCTS?



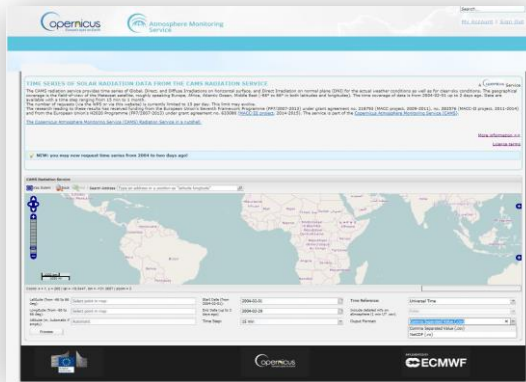


SOLAR RADIATION: WHAT ARE THE PRODUCTS?

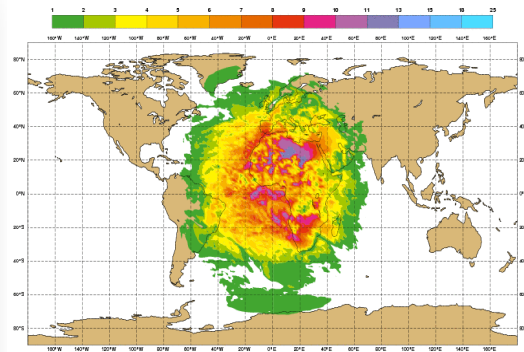
Clear sky irradiation (global)



All- sky irradiation (Europe/Africa/Middle East)



UV forecasts (global)



Example UV index forecast map
for 10th Sept 2016, 12 UTC

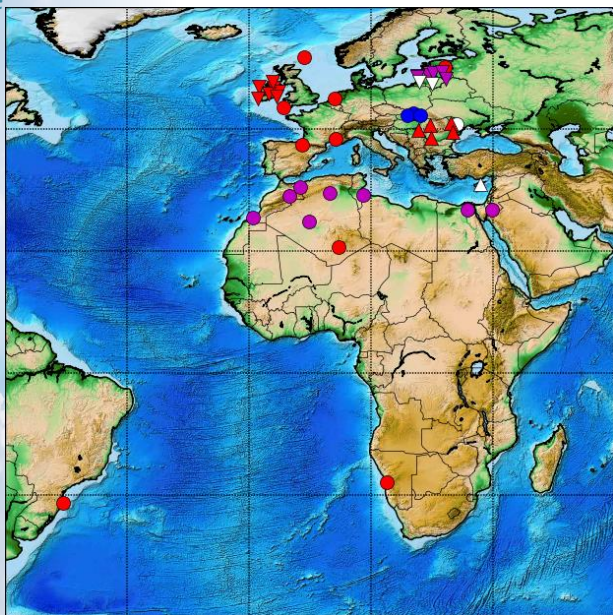
- Timeseries on user-selected point (WCS, Web Coverage Service)
- 2004-present (online after 1-2 days delay)
- global, diffuse, direct and direct normal irradiation
- 1 min, 15 min, 1 hour, 1 day, 1 month temporal resolution
- interactive and OGC script access possible

- Maps and numerical data
- UV index (clear and total sky)
- UV irradiances, spectrally resolved (5 nm, 280-400 nm)
- forecasts up to 5 days, 3-hr

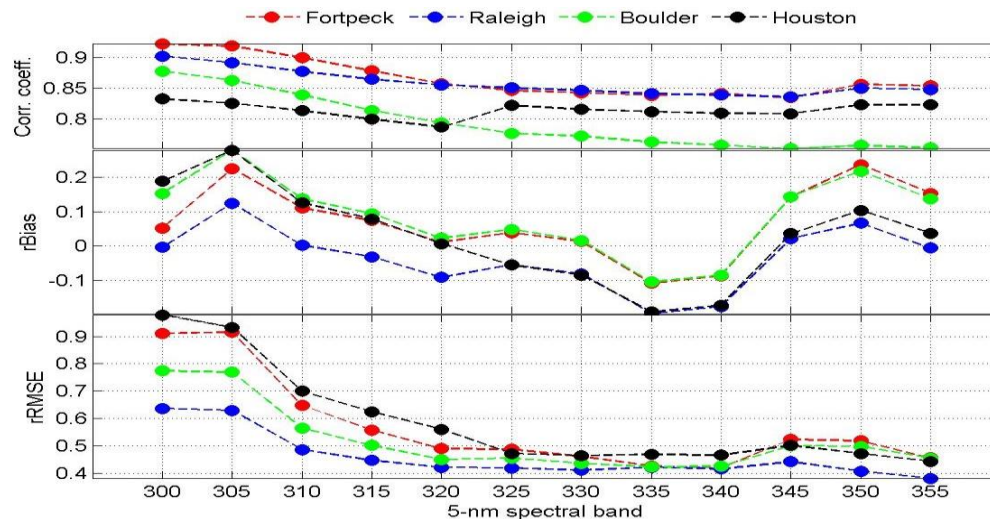


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VALIDATION OF UV AND SOLAR RADIATION



Increasing ground observation availability for validation of solar radiation: sites providing observations with 1-hour resolution



Synthesis of spectrally-resolved UV irradiance for 4 UV measurement sites for the first quarter of 2016

CAMS regional air quality and solar radiation products are ready for use in the Czech Republic. Don't hesitate to try out and contact our Service Desk in case you need support or have questions.

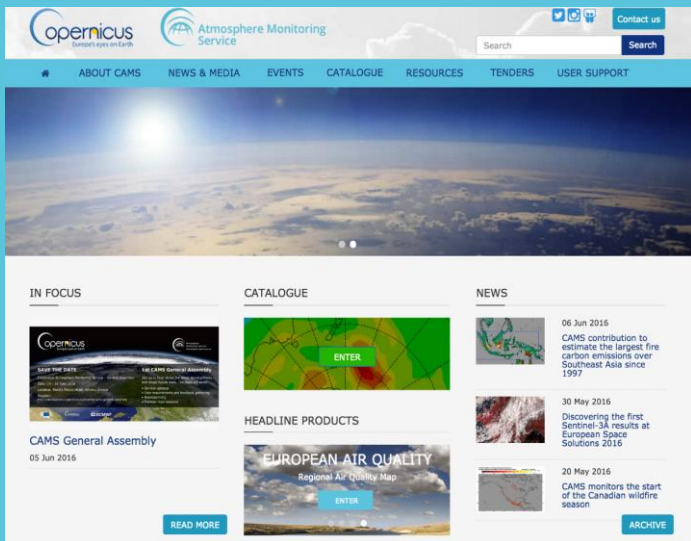


SOLAR RADIATION PRODUCTS: SOME USERS

Companies involved in planning solar equipment... medical doctors looking for UV index information... But not only:

- **José Carlos del Valle, PhD student at Pablo de Olavide University, Seville, Spain:** *"We are investigating the synthesis of protective compounds such as flavonoids in plants as a biological response to abiotic stressors such as UV radiation. Thanks to [the Service], we obtained the data on UV radiation in several populations throughout the coast of the Iberian Peninsula, which helped us to unravel the relationship between the synthesis of these compounds and UV radiation. [This] Service was extremely helpful, and we are very grateful for their kindness and throughout our research."*
- **Olivier Geffroy, French Institute for Vine and Wine, Lisle sur Tarn, France:** *"I work on the impact of viticultural and environmental variables on grape and wine aroma. Data provided by [the Service] were used to get an idea of the variation in solar radiation through a data gathering period. These data might also be useful in the future to model grape surface temperature dynamics. The staff was very friendly and reactive. Thanks for your availability."*
- **Tadzio, photographer, France:** *"Je suis un photographe et vidéaste. Je réalise des reportages en photo et vidéo ainsi que de la photographie d'art. J'utilise les variations de l'irradiation solaire comme variation de la luminosité dans une vidéo. Je suis globalement très satisfait du service et notamment de la précision des données et de la facilité d'utilisation du système."*

<http://atmosphere.copernicus.eu>



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