

A large image of Earth from space, showing clouds and continents, occupies the left side of the slide.

Monitoring and forecasting air quality in support of health applications

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European Centre for Medium-Range Weather
Forecasts (ECMWF)





Why does air quality matter so much for our health?

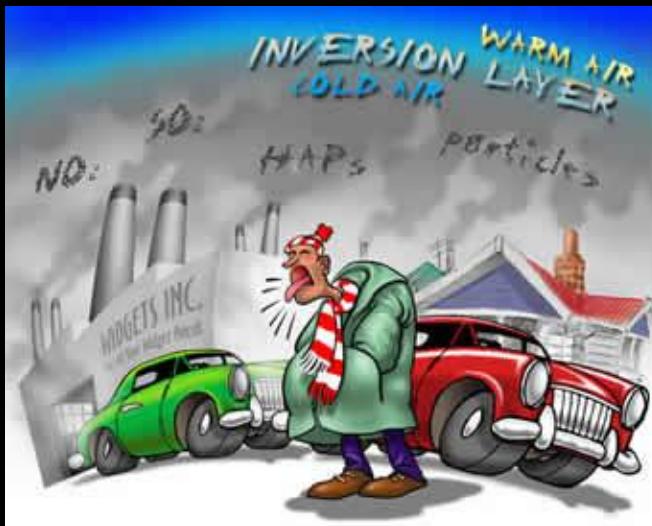
On average,
each one of us

breathes... drinks... eats... daily.

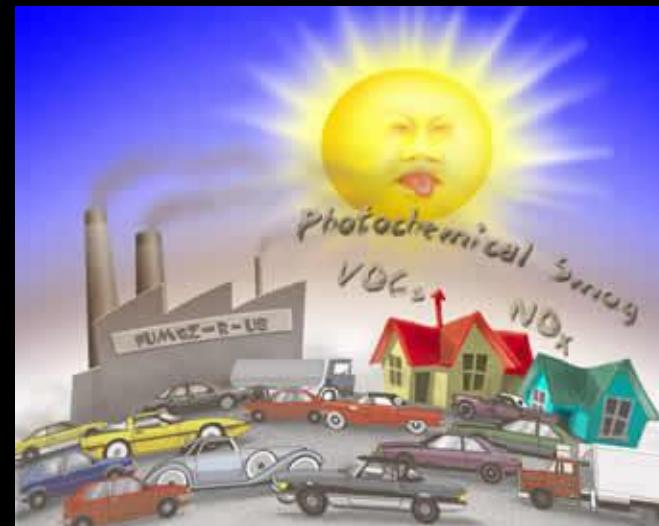




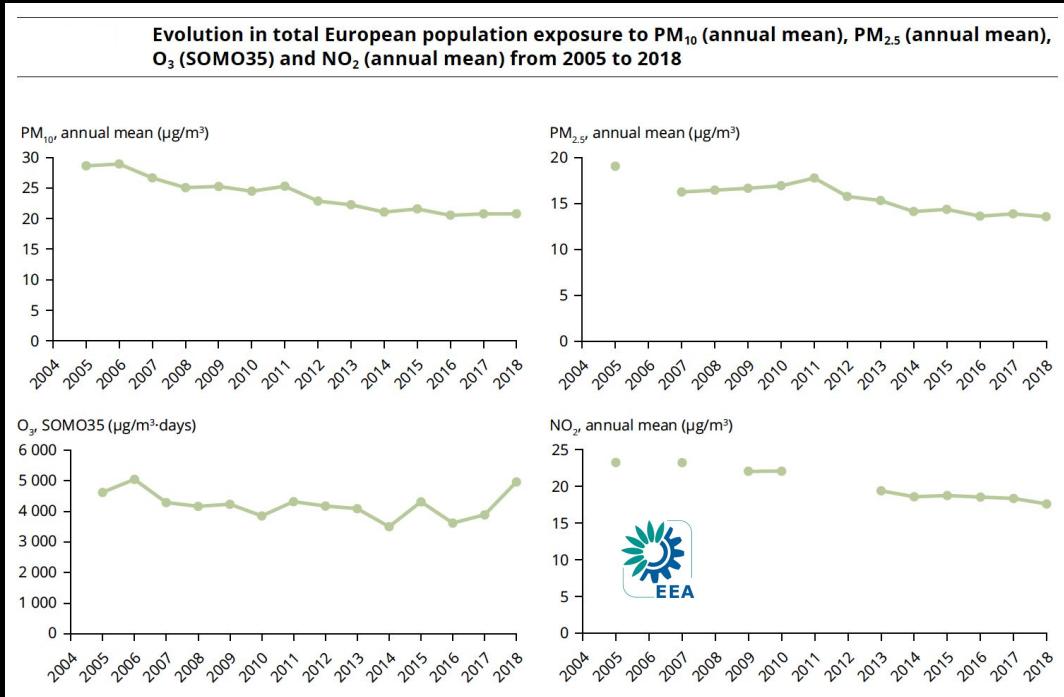
Air pollution is all year round and involves different pollutants



Primary pollution
(PM10, PM2.5, NO_x, SO₂...)



Secondary pollution
(O₃, PM...)



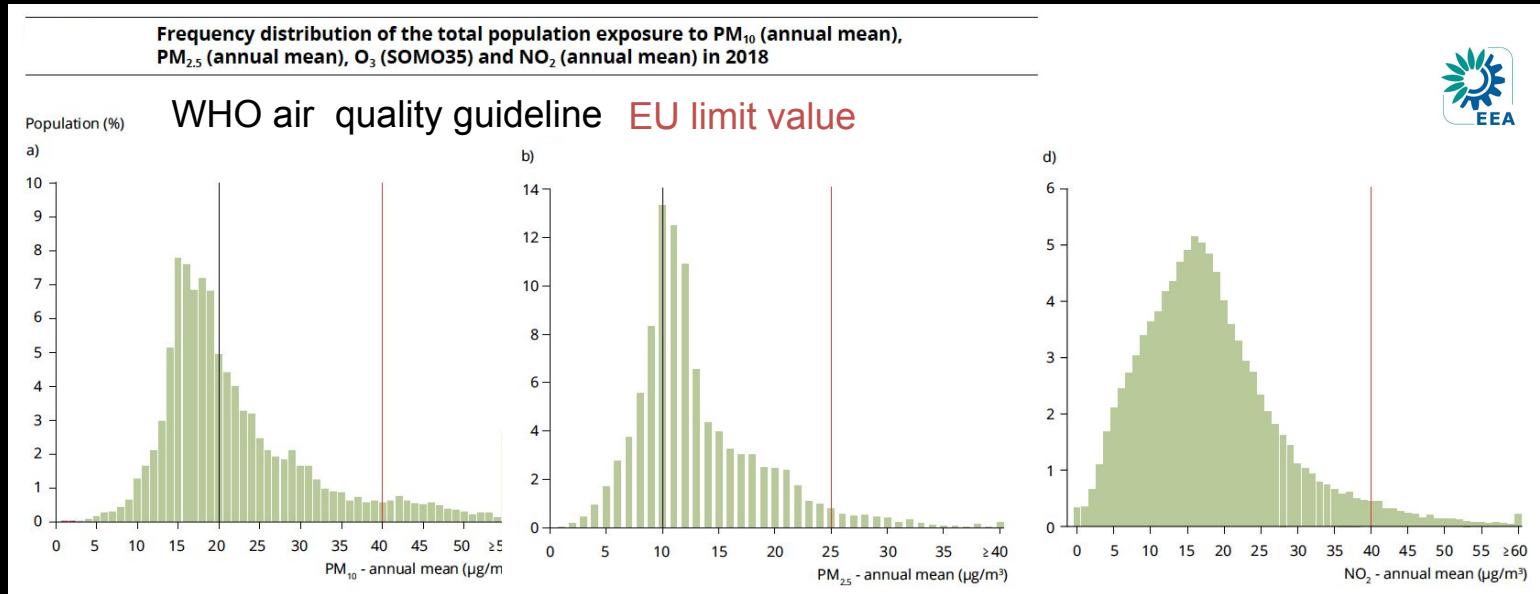
How has air pollution changed in Europe in the last 15 years?

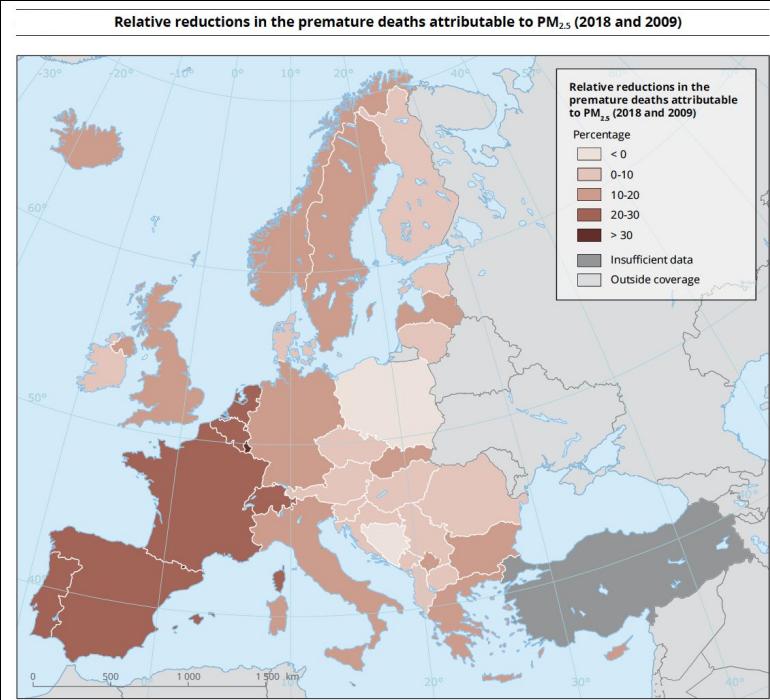
Population-averaged concentrations
(EEA, Air Quality in Europe 2020)





What is the fraction of the population exposed to unhealthy AQ?





According to the EEA, in 2018, there were 452.000 premature deaths in EU-28 due to PM2.5 (83%), NO₂ (12%) and ozone (5%).

Worldwide, air pollution kills more people than smoking.



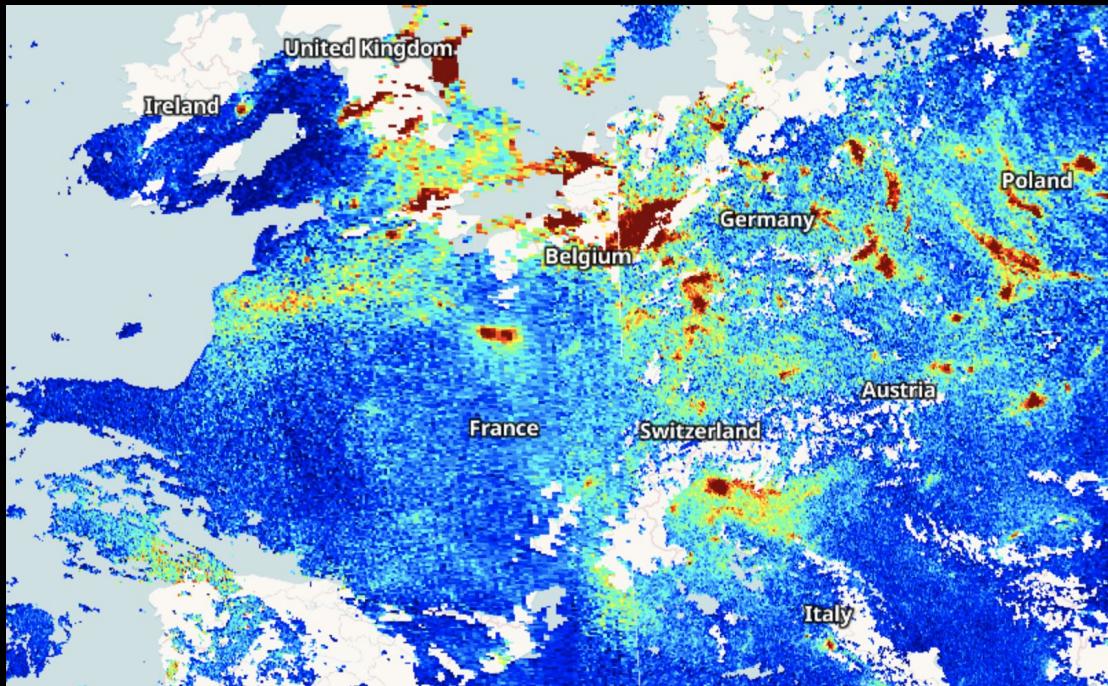


So... what can we do about it?

- Decide and enforce more deliberate policies to reduce pollutants emissions (good for carbon emissions and carbon too if implemented properly).
- Inform decision makers for launching warnings and taking appropriate measures when it is most relevant.
- Inform the general public for reducing exposure and changing own habits and consumption patterns.

...And this should be made based on facts and observational evidence





Copernicus Sentinel-5P
6 September 2021



But don't we have satellites for this?

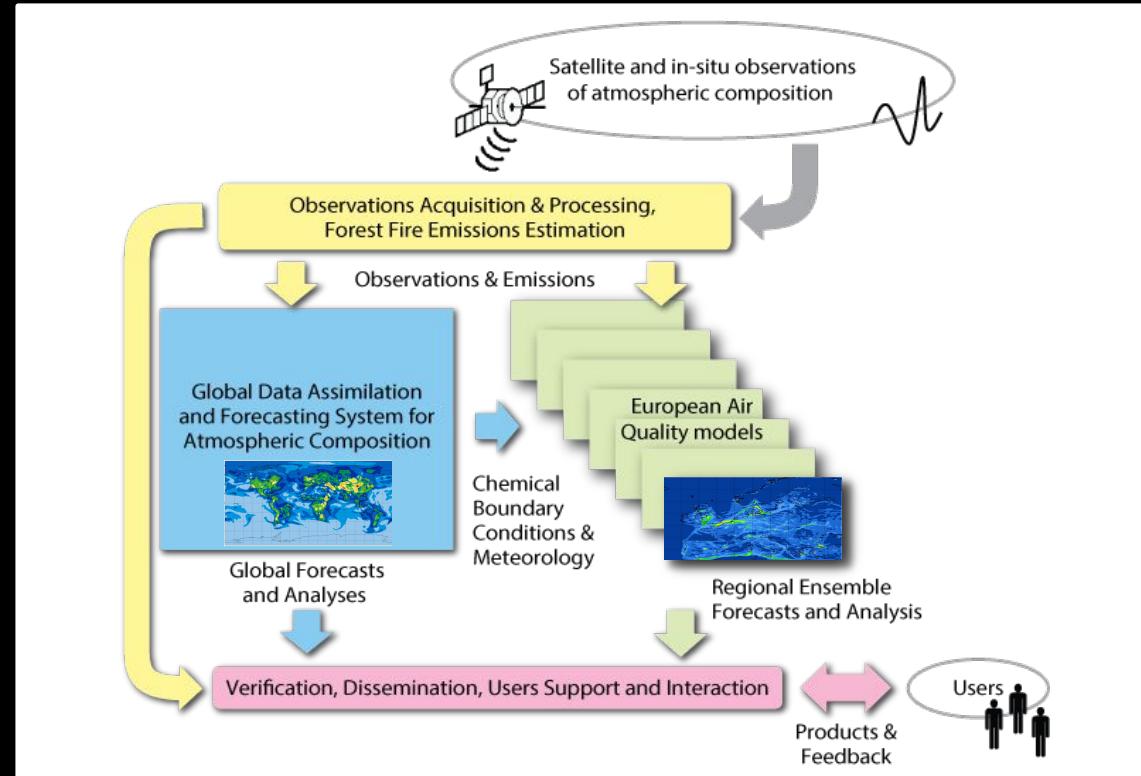
- Yes! Although it is recent
- Just like for weather, not most useful if used in isolation (clouds, 1 overpass per day...)
- It is not a mapping exercise: 3D with lots of physico-chemical processes involved!
- Need to combine satellite, surface & in situ and advanced numerical models



How can we do this?

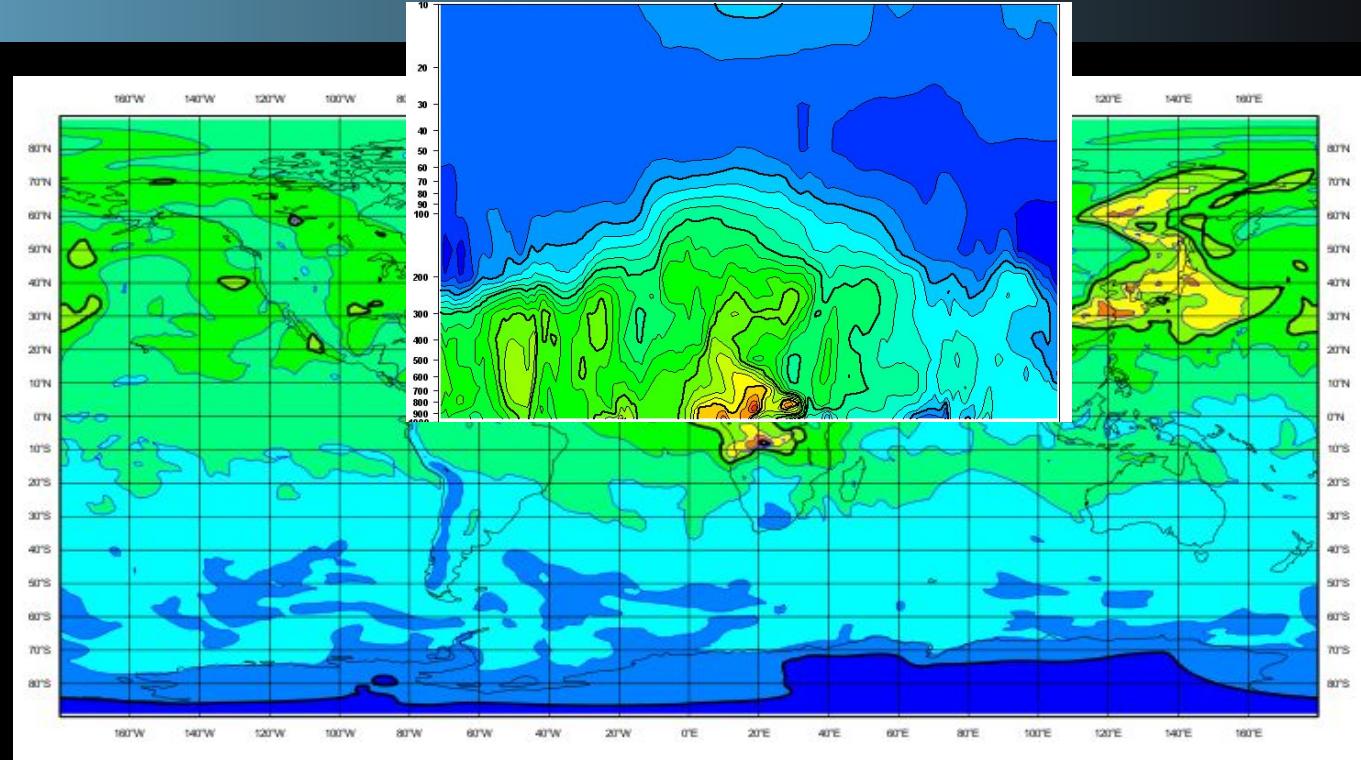
*Example: the
Copernicus Atmosphere
Monitoring Service
(CAMS) system*

- Actually, it is an augmented version of ECMWF's world leading numerical weather prediction system





Data assimilation

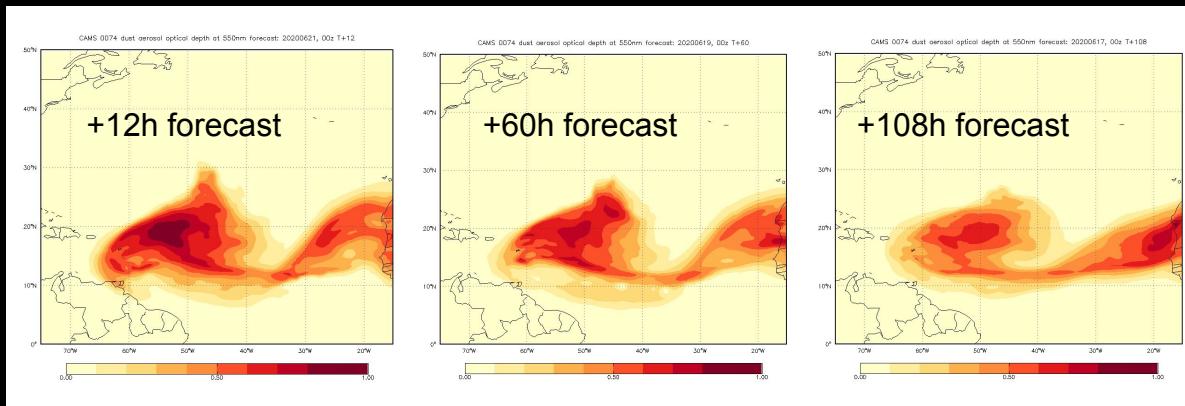


IASI CO
(LATMOS/ULB)

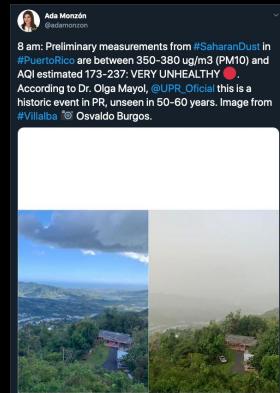
Carbon monoxide is a tracer of combustion sources, which is well monitored from space



NASA/NOAA
Suomi-NPP VIIRS
imagery for 21 June
2020



ECMWF CAMS



*“Godzilla” dust
plume (June 2020)*



Growing media attention



Le Monde

NOS VIES CONFINÉES
bonnes nouvelles, initiatives solidaires.

PLANÈTE - CORONAVIRUS ET PANDEMIE DE COVID-19

Coronavirus : la pollution de l'air est « facteur aggravant », alertent médecins et chercheurs

Les épidémies agricoles ont été à l'origine de pics de pollution en Ile-de-France et Grand-Est ce week-end. Un collectif appelle l'Etat à les « limiter drastiquement ».

Par Stéphane Mandrand - Publié le 30 mars 2020 à 10H30 - Mis à jour le 31 mars 2020 à 10H30

Le Figaro

Pays : FR - Quotidien
Periodicität : Täglich
COD : 305701

SCIENCE

Le « trou » dans la couche d'ozon

The Washington Post

Pollutants from the bush fires in Australia will circle the globe

The smoky haze has drifted thousands of miles across the Pacific

Capital Weather Gang

ORTNUM & MASON EST. 1897

Newsletter

European Commission

Süddeutsche Zeitung
SZ.de Zeitung Magazin

Die Arktis brennt

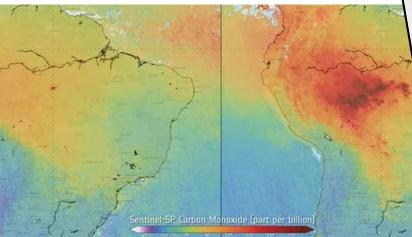
12.Juli.2020, 18:00 Uhr | Erde/Klima



LA STAMPA

I satelliti europei che aiutano a prevedere il clima

Per capire quale irraggiamento avrà un impianto solare, se si costruisce un resort sciistico, per decidere come gestire pregiate e costose vigne, servono buoni "occhi": quelli di Copernicus atmosphere monitoring service (Cams)



Liberation

Que sait-on des incendies qui se sont propagés en Sibérie cet été ?

Par Norbert Marat - 28 janvier 2020 à 03h31



Abonnement Anmelden

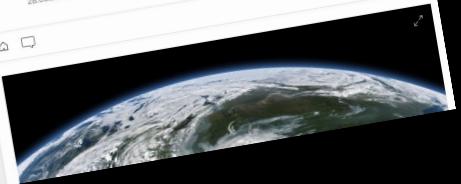
SPiegel Wissenschaft

Auswertung von Satellitenbildern

Am Nordpolarkreis drohen erneut riesige Brände

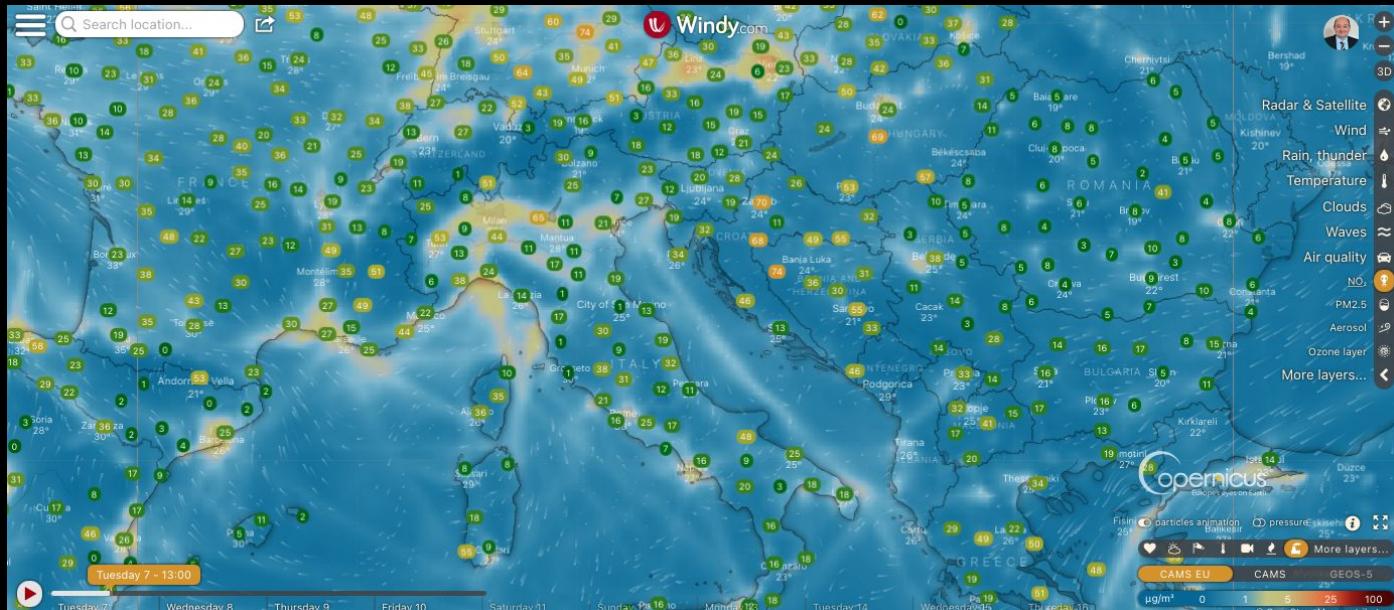
Große Flächen im arktischen Norden Russlands wurden 2019 durch Wald- und Moorbrände verbraucht. Satellitenaufnahmen zeigen britischen Forschern zufolge, dass es dort offenbar wieder brennt.

28.05.2020, 10:28 Uhr





AQ becoming mainstream information



The Weather Channel



euro news.

CNN

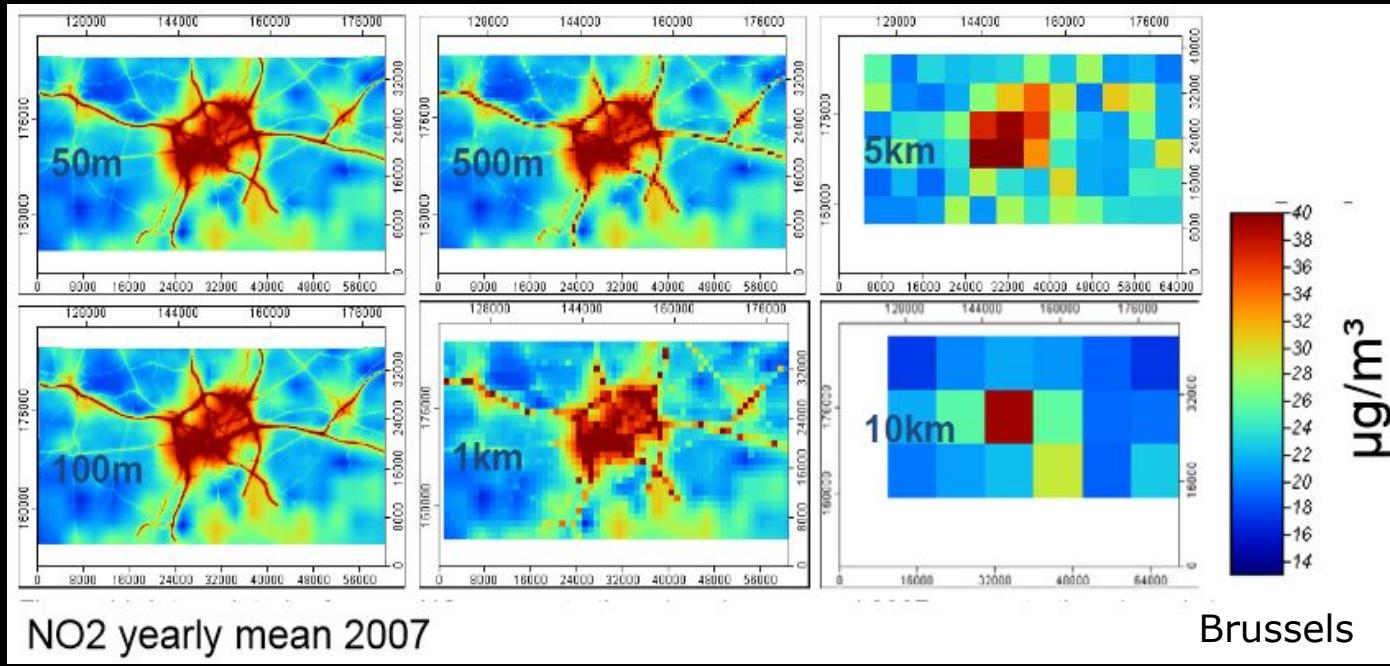


Copernicus
Europe's eyes on Earth

Implemented by ECMWF



But are 10km resolution monitoring/forecast useful?

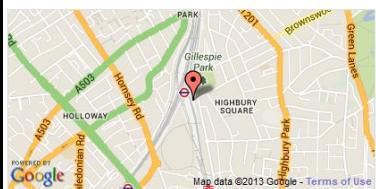




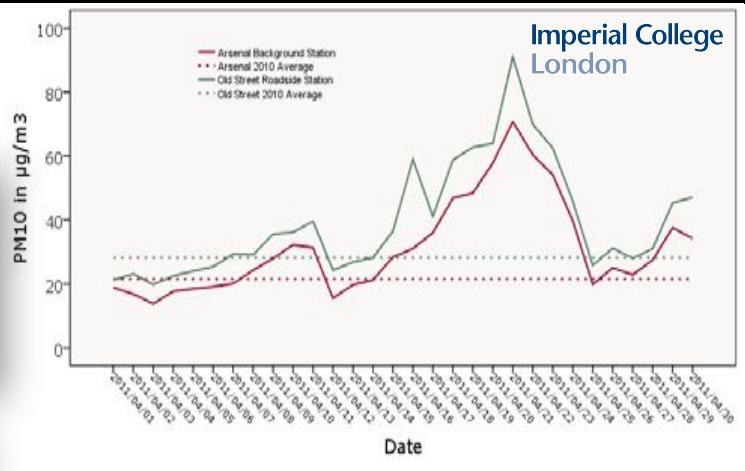
Clearly yes: information is both in space and time!



Address: Islington Ecology Centre, 191 Drayton Pk
Grid Ref: 531325, 186032
Latitude & Longitude: 51.557895000000, -0.106990000000
 Click on the map to see the nearest street view (if available).

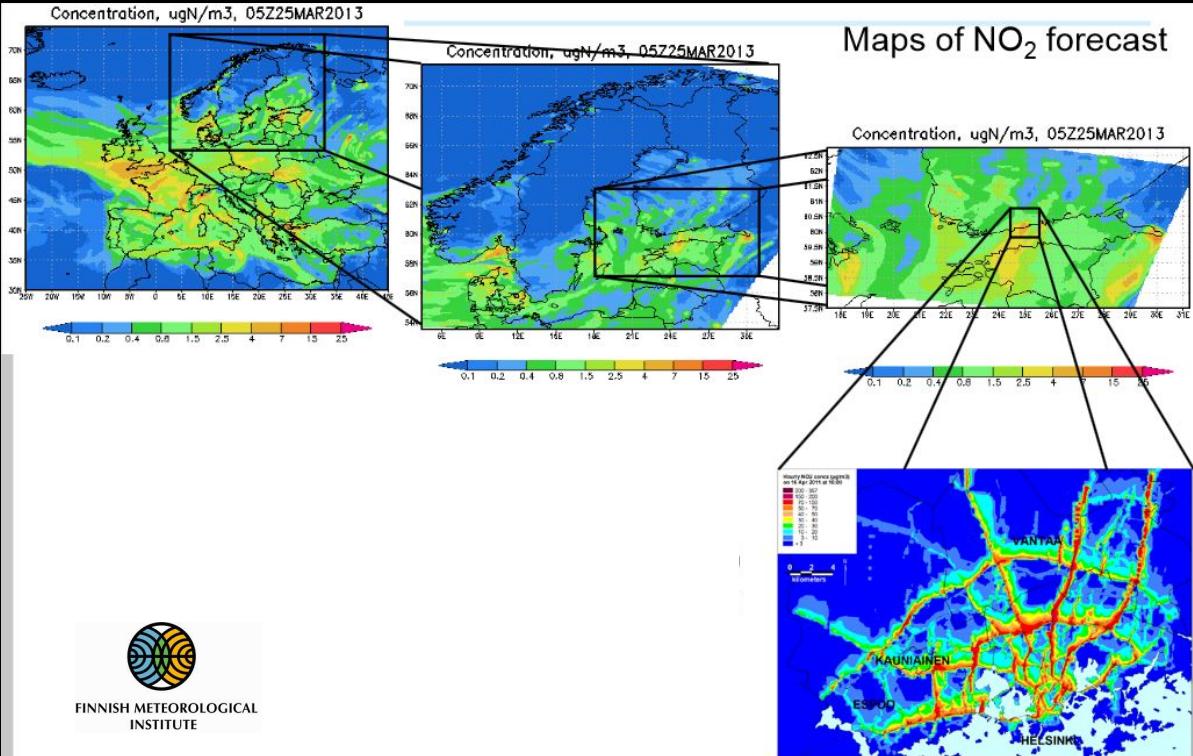


**Islington Arsenal
Urban
Background
station**



Address: Old Street
Grid Ref: 532947, 182575
Latitude & Longitude: 51.526454000000, -0.084910000000
 Click on the map to see the nearest street view (if available).





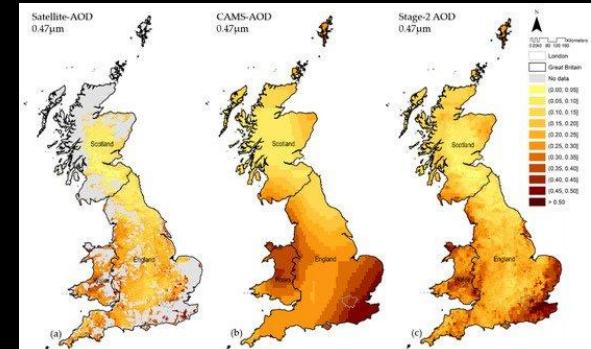
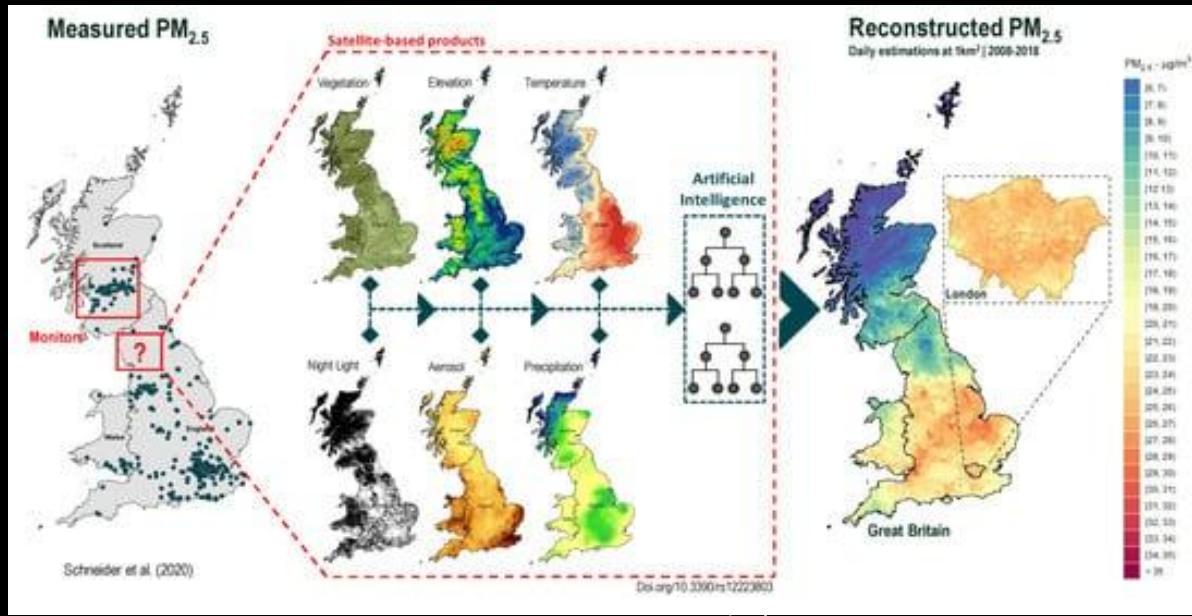
FINNISH METEOROLOGICAL
INSTITUTE

Downscaling: from globe to street-level forecasting

- High resolution is required for certain applications, including assessing health impacts
- Several approaches available, here cascade of numerical models
- No need to start from scratch: lots of processing has already been done at coarse scale



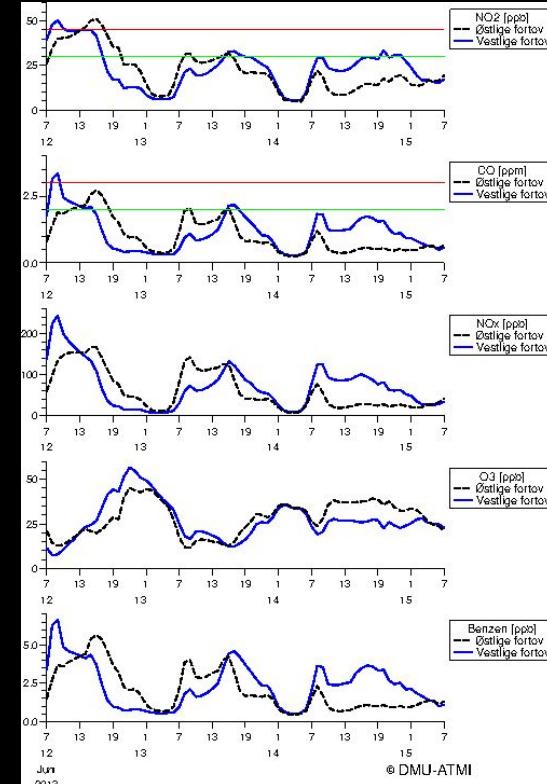
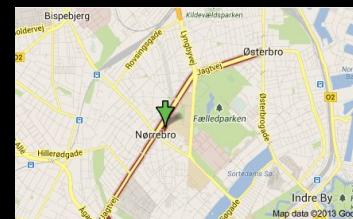
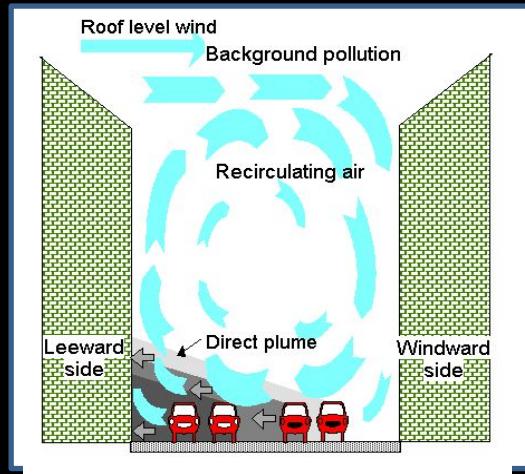
AI: very promising approaches



(R. Schneider et al., *Remote Sens.* 2020, 12(22), 3803;
<https://doi.org/10.3390/rs12223803>)



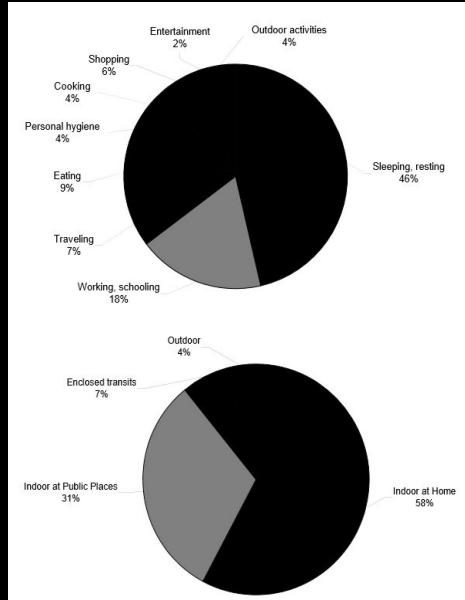
On which side of the street should I walk?



West / East side of Jagtvej (Copenhagen)



Towards personalised medicine



How do we spend our time?

In what type of environments

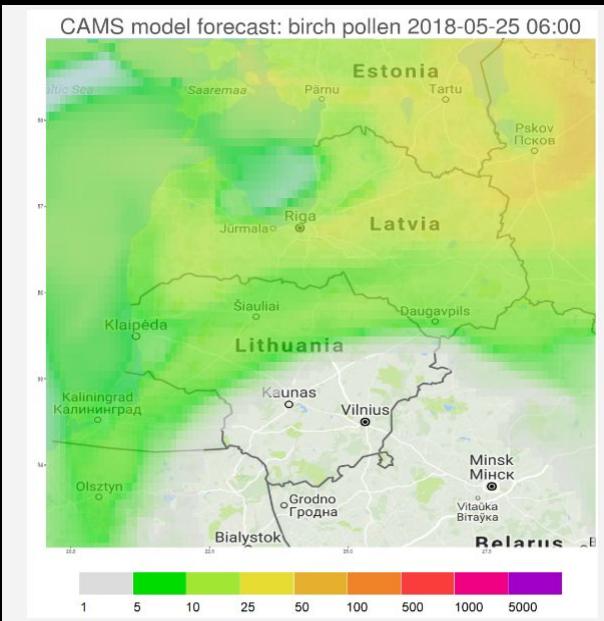
And what is air quality in these environments?

Microenvironments	Air Pollutants			
	CO ($\mu\text{g}/\text{m}^3$)	CO ₂ (mg/m^3)	PM ₁₀ ($\mu\text{g}/\text{m}^3$)	NO ₂ ($\mu\text{g}/\text{m}^3$)
<i>Indoor at home</i>				
Residential building/home	943	1561.6	46.2	118 (119.2 ^[2])
<i>Indoor away from home</i>				
Office building	854.3 ^[1]	1883 ^[1]	29.7 ^[1]	18.9 ^[1]
School	187	2416.1	117	0
Industrial plant	N/A	N/A	N/A	N/A
Restaurant	3750 (3344.9 ^[1])	2370 (2497.8 ^[1])	385 (323 ^[1])	718 (133 ^[1])
Pub/Bar/Night club	9375	2797.2	810	108
Hospital	N/A	747.8	N/A	N/A
Hotel	3500	1620.5	85.6	21.4
Indoor gym.	750	1532.1	80 ^[4]	44 ^[4]
Shopping center	1660 ^[1]	1870.2 ^[1]	78 ^[1]	63.64 ^[1]
Car park/Garage	13750	1021.5	150 ^[4]	356 ^[4]

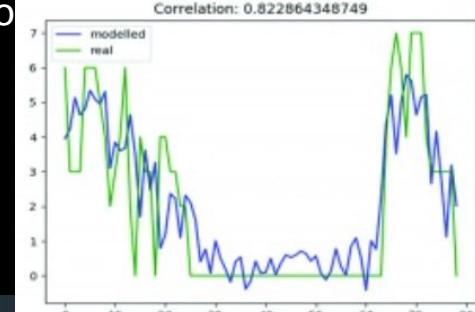
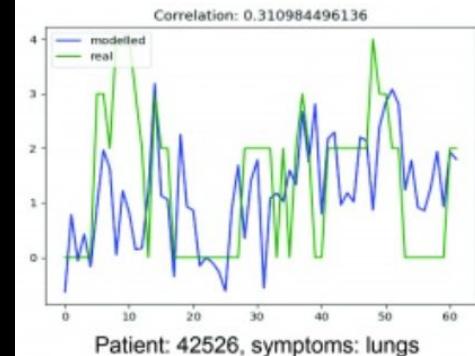
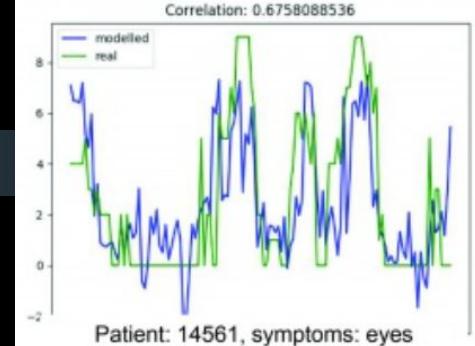
E. Tu You, "Time Budget study and total exposure assessment to air pollutants of Hong-Kong population", PhD, 2005.

Ideas for AI4Copernicus Call

Can we forecast patient-specific allergy symptoms?



The aim of PASYFO is to provide a high-resolution regional system for predicting the personal allergy symptoms of pollen-sensitive people using personalised sensitivity information.





Up to you now!

atmosphere.copernicus.eu

