



# Global to City-scale Air Quality Services

---

**Idir Bouarar**

Max Planck Institute for Meteorology, Hamburg, Germany



# Outline

---

- **General Objectives**
- **Global to City-scale Services**
- **Use Cases**
- **Major Challenges for AQ Services**

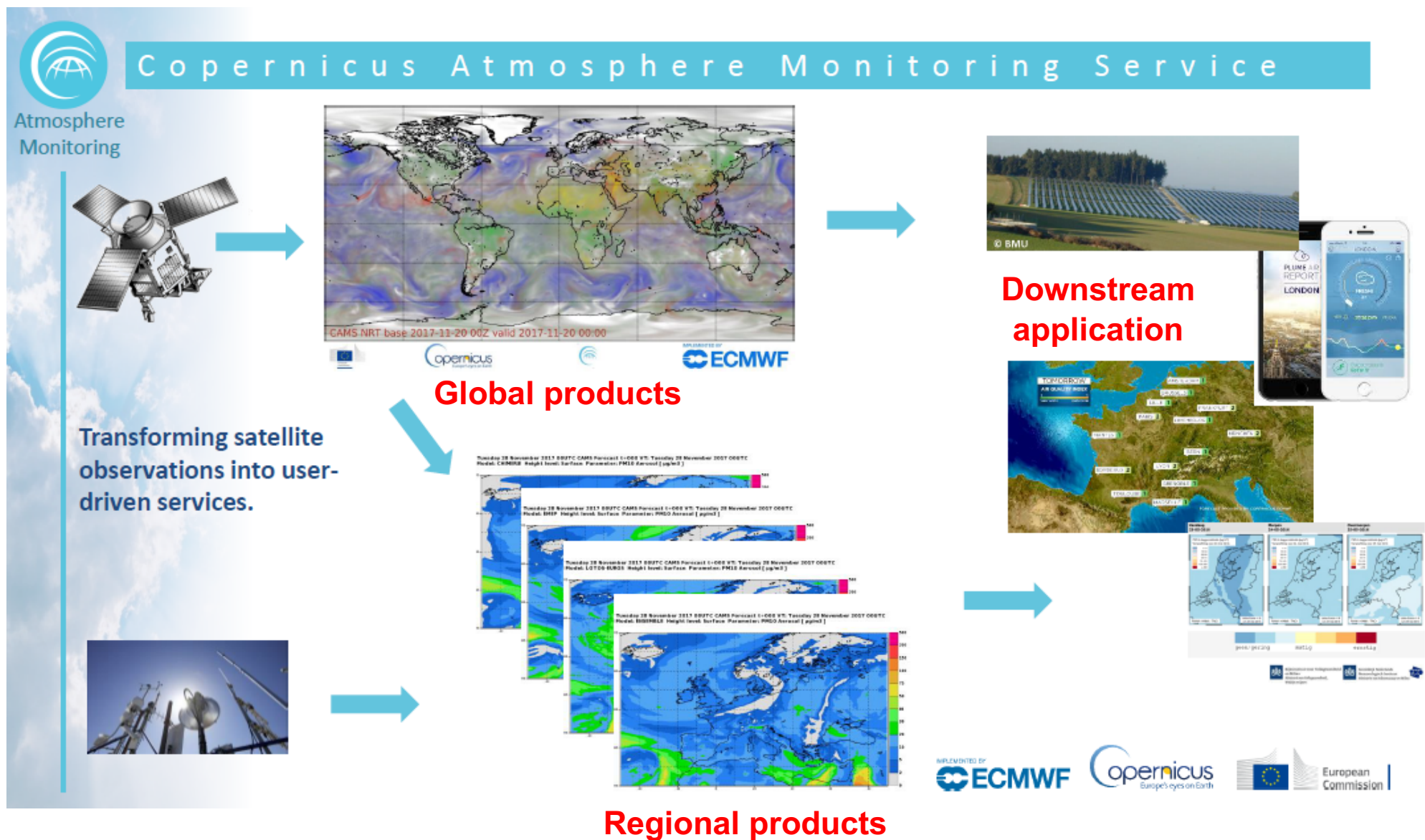
## Air Quality Services: General Objectives

---

**Understand and reduce risks of poor air quality, especially through:**

- **Monitoring** – Observational networks and field studies to assess levels of air pollution and population exposure
- **Modelling** – Implement appropriate models, tools, and case studies to assist in urban planning
- **Forecasting** – Anticipate specific hazardous conditions in order to take action to improve air quality, to advise the public by e.g. providing Air Quality Indexes.
- **Long-term projections** – Forecast future trends and problem areas in order to inform policy and prepare measures to protect health
- **Support policy implementation and decision making**- Coordination between science and policymakers; Sources and impacts of air pollution and strategies for its mitigation; Socio-Economic Benefits

# Global to Regional AQ services: e.g. CAMS







Atmosphere  
Monitoring

## CAMS Portfolio



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

Portfolio	Product groups
A. Regional products	Real-time analyses
	Real-time forecasts
	Interim annual reanalyses
	Annual reanalyses
B. Global products	Real-time analyses
	Real-time forecasts
	Reanalyses
C. Supplementary products	Policy support products
	Solar radiation
	Greenhouse gas flux inversions
	Climate forcings
D. Emissions products	Anthropogenic emissions
	Fire emissions
	Natural emissions



# Regional AQ services

## International Air Quality



[For more about AirNow International Partners](#)

[Asia](#) [Australia/Oceania](#) [Europe](#) [North America](#) [South America](#)

~ 75 services

### ASIA

Country	Air Quality Program Name	Language
China	<a href="#">Current Air Pollution Index (API)</a>	Chinese & English
China	<a href="#">SEMC's Expo site</a>	Chinese & English
China	<a href="#">Shanghai Environment Monitoring Center (SEMC)</a>	Chinese Simplified
Indonesia	<a href="#">US Embassy Air Quality Index</a>	English
Taiwan	<a href="#">Current PSI</a>	Chinese & English
Thailand	<a href="#">Regional Air Quality Data</a>	English

### AUSTRALIA/OCEANIA

Country	Air Quality Program Name	Language
Australia	<a href="#">Air Quality Index for Western Australia</a>	English
Australia	<a href="#">Daily Air Quality Index (AQI) New South Wales</a>	English
Australia	<a href="#">EPA Victoria</a>	English
Australia	<a href="#">Queensland Department of Environment and Resource Management - Air Data</a>	English
New Zealand	<a href="#">New Zealand Ministry for the Environment - Air Quality</a>	English

### SOUTH AMERICA

Country	Air Quality Program Name	Language
Brazil	<a href="#">Qualidade do Ar - São Paulo</a>	Portuguese



## Local Air Quality Conditions

Zip Code:  Zip Code  State:

Current AQI

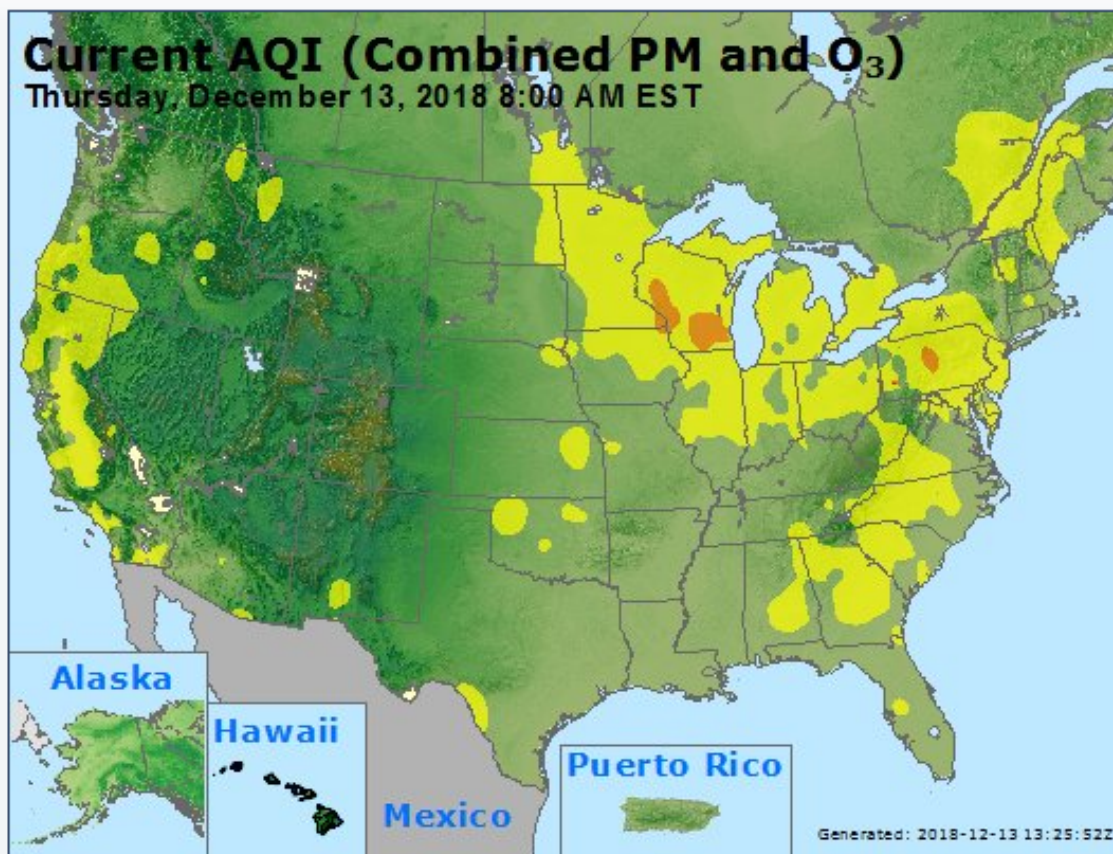
Forecast

AQI Loop

More Maps

## Current AQI (Combined PM and O<sub>3</sub>)

Thursday, December 13, 2018 8:00 AM EST



## Data and Forecasts courtesy of:

Forest County Potawatomi Community, Wisconsin Department of Natural Resources

Click on the city name for more detailed information.

[printable summary](#)

## FORECAST

Thu  
Dec 13

Fri  
Dec 14

CURRENT  
AQI

[Eau Claire](#)

Mod

Mod

105

[Fond du Lac](#)

Mod

Mod

116

[Forest County Potawatomi  
Community](#)

Mod

Good

16

[Green Bay](#)

Mod

Good

85

[La Crosse](#)

USG

Mod

106

[Madison](#)

USG

Mod

105

[Milwaukee](#)

Mod

Mod

109

[Racine-Kenosha](#)

Mod

Mod

94

[Sheboygan](#)

Mod

Mod

91

Note: Values above 500 are considered Beyond the AQI. Follow recommendations for the Hazardous category. Additional information on reducing exposure to extremely high levels of particle pollution is available [here](#).

Good

Moderate

USG

Unhealthy

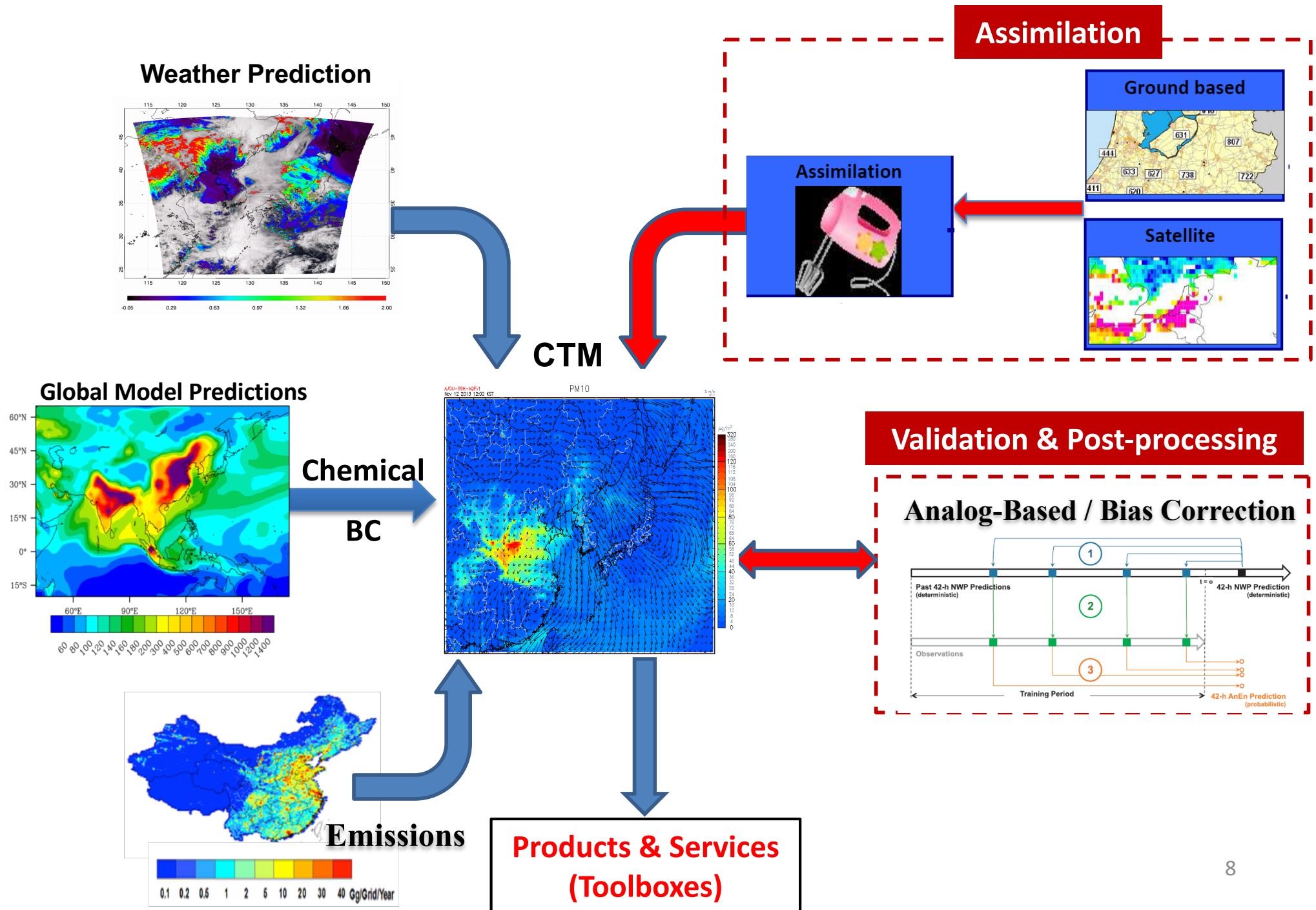
Very  
Unhealthy

Hazardous



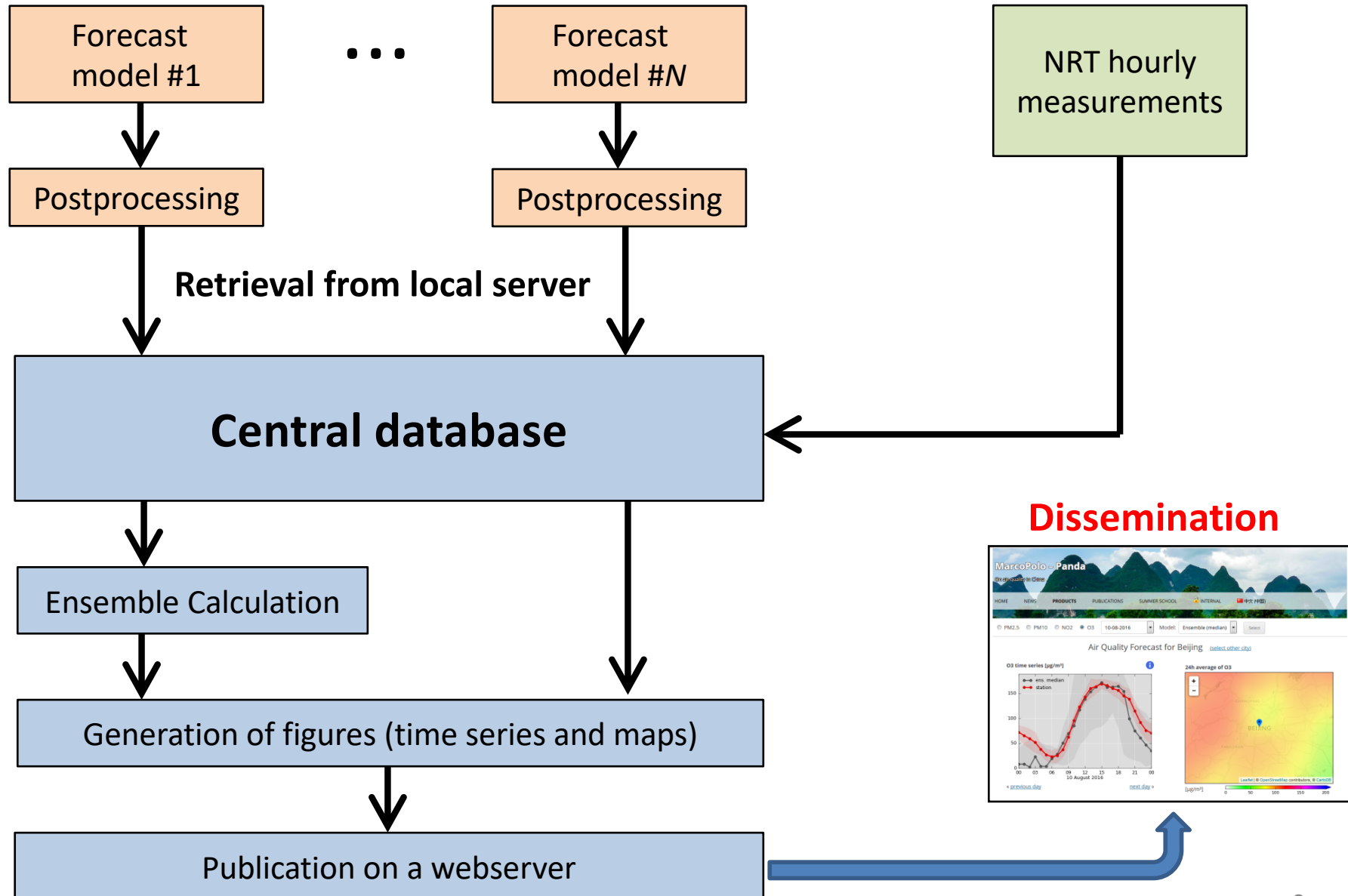
Action Day

# Structure of Global/Regional AQ Prediction Systems





# Air Quality Services for China (Panda-MarcoPolo) and Latin America (PAPILA)



- Many Global and Regional AQ services are based on dissemination websites
- Generally, they include maps, time series, AQI, information on AQ, risks (health)
- Developed by the scientific community

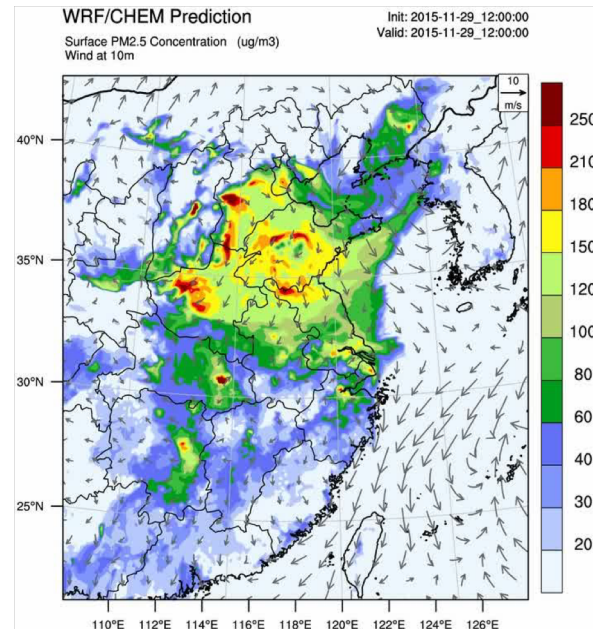
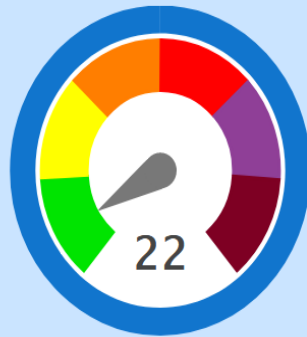
## Air Quality Index

Current conditions in Philadelphia

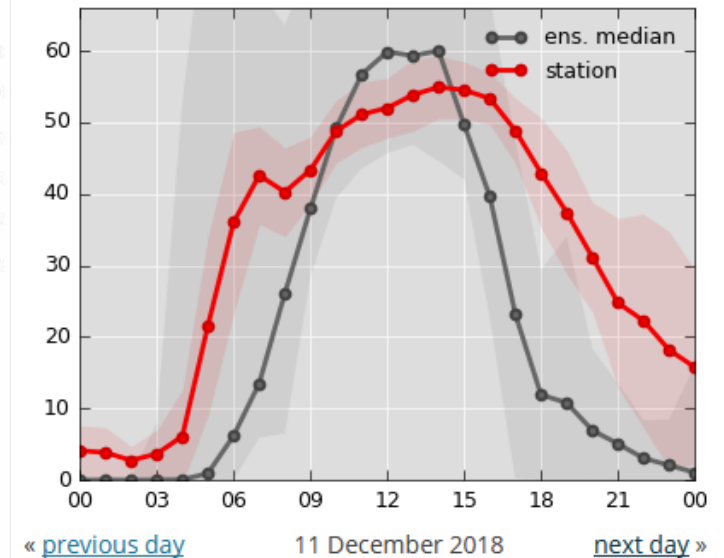
Dec. 16, 2018 3:00 pm

Good

*Air quality is satisfactory,  
and air pollution poses  
little or no risk.*



O3 time series [ $\mu\text{g}/\text{m}^3$ ]



**Air Quality Flag  
PROGRAM**  
Know Your Air Quality  
to Protect Your Health



# Air Quality Services for Cities

**Airparif**, Air Normand, Air Breizh, Atmo Picardie, Atmo Champagne-Ardenne, Atmosf'air Bourgogne, Lig'air, Aircom, Atmo Nord-Pas de Calais

<https://www.airparif.asso.fr/indices/horair>

The screenshot displays the Airparif website interface. At the top, there's a navigation bar with the Airparif logo, contact links, and a search bar. Below this, a banner shows the Paris skyline. The main content area is divided into two columns. The left column, titled 'La pollution de l'air en Île-de-France', features a section for the 'Indice agglomération parisienne' with buttons for 'Hier', 'Aujourd'hui', and 'Demain', showing values 'Moyen', 'Faible', and 'Moyen' respectively. It also includes a 'Carte prévision journalière' for the 12th of December 2018. The right column, titled 'Focus', lists recent news items with dates and titles, such as '07/12/2018 Respirons mieux dans le 20e : c'est parti !' and '13/11/2018 Challenge Microcapteurs 2018 :'. A footer bar contains links for 'Informations par stations', 'Suivi de réglementation', and 'Bulletin des pollens'.

**AIRPARIF**

POLLUTION ► AUJOURD'HUI 41 DEMAIN 54

Nous contacter | Recrutement | Nos liens | Airparif Services | English version | rechercher sur le site...

Association de surveillance de la qualité de l'air

Etat de l'air | Méthodes de surveillance | Pollution | Réglementation | Publications | Qui sommes-nous ?

► La pollution de l'air en Île-de-France

» INDICE FRANÇAIS » INDICE EUROPÉEN

Indice agglomération parisienne

Hier **Moyen**

Aujourd'hui **Faible**

Demain **Moyen**

Carte prévision journalière

Bilan Hier

Aujourd'hui ►

Demain

12 décembre 2018

► Focus

07/12/2018  
Respirons mieux dans le 20e :  
c'est parti !  
Le 12 décembre, les habitants ...

23/11/2018  
Un jeu en ligne et un Kit  
pédagogique  
La qualité de l'air est un enjeu ...

19/11/2018  
Évaluation des bénéfices de la  
mise en place de zones à basses  
émissions  
Airparif a évalué l'impact sur ...

13/11/2018  
Challenge Microcapteurs 2018 :

» Épisode de pollution

Hier

Aujourd'hui

Demain

Informations par stations

Suivi de réglementation

Bulletin des pollens



# Alert Systems and Toolboxes

## Dust Storms



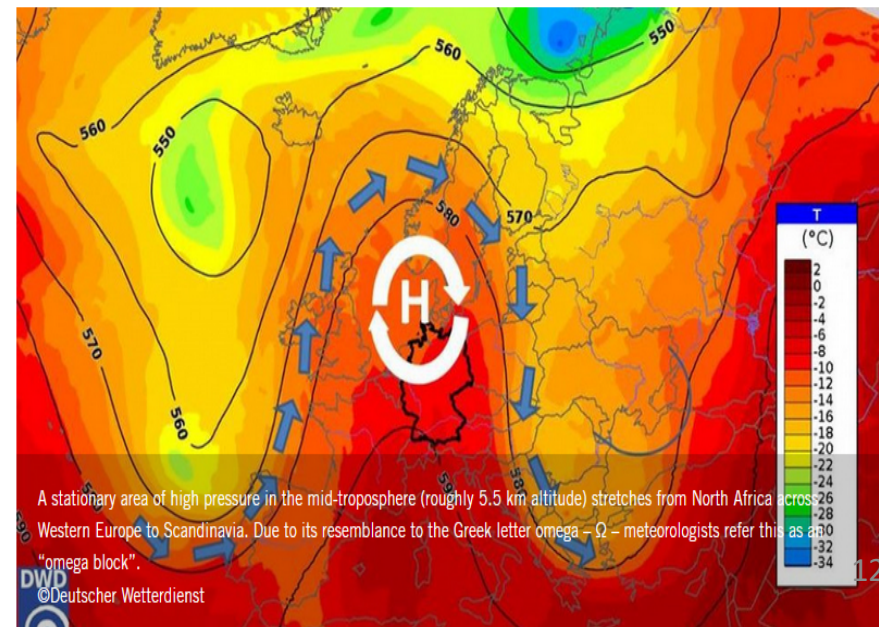
## Fires



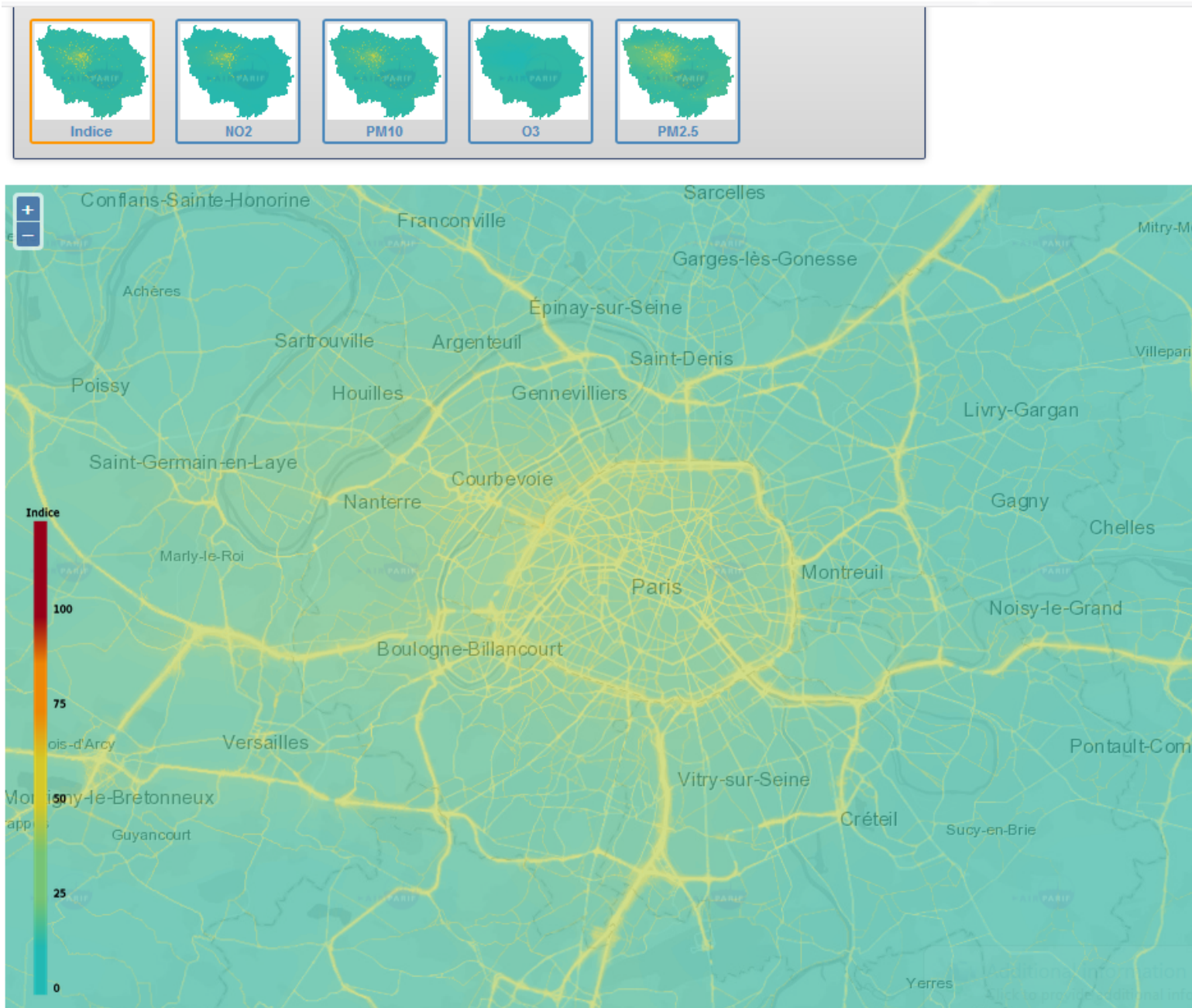
## Heat waves



## Atmospheric blocking



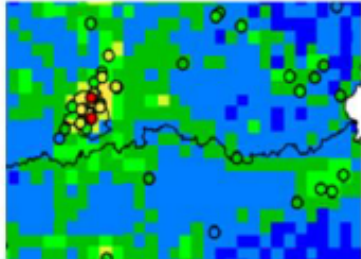




# Downscaling the Regional Information

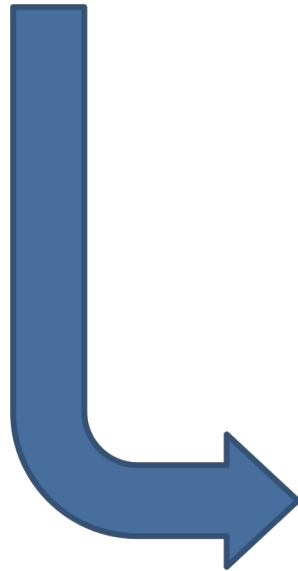
## Atmospheric Dispersion Modeling

“Intelligent” Interpolation  
(landuse, measurements)

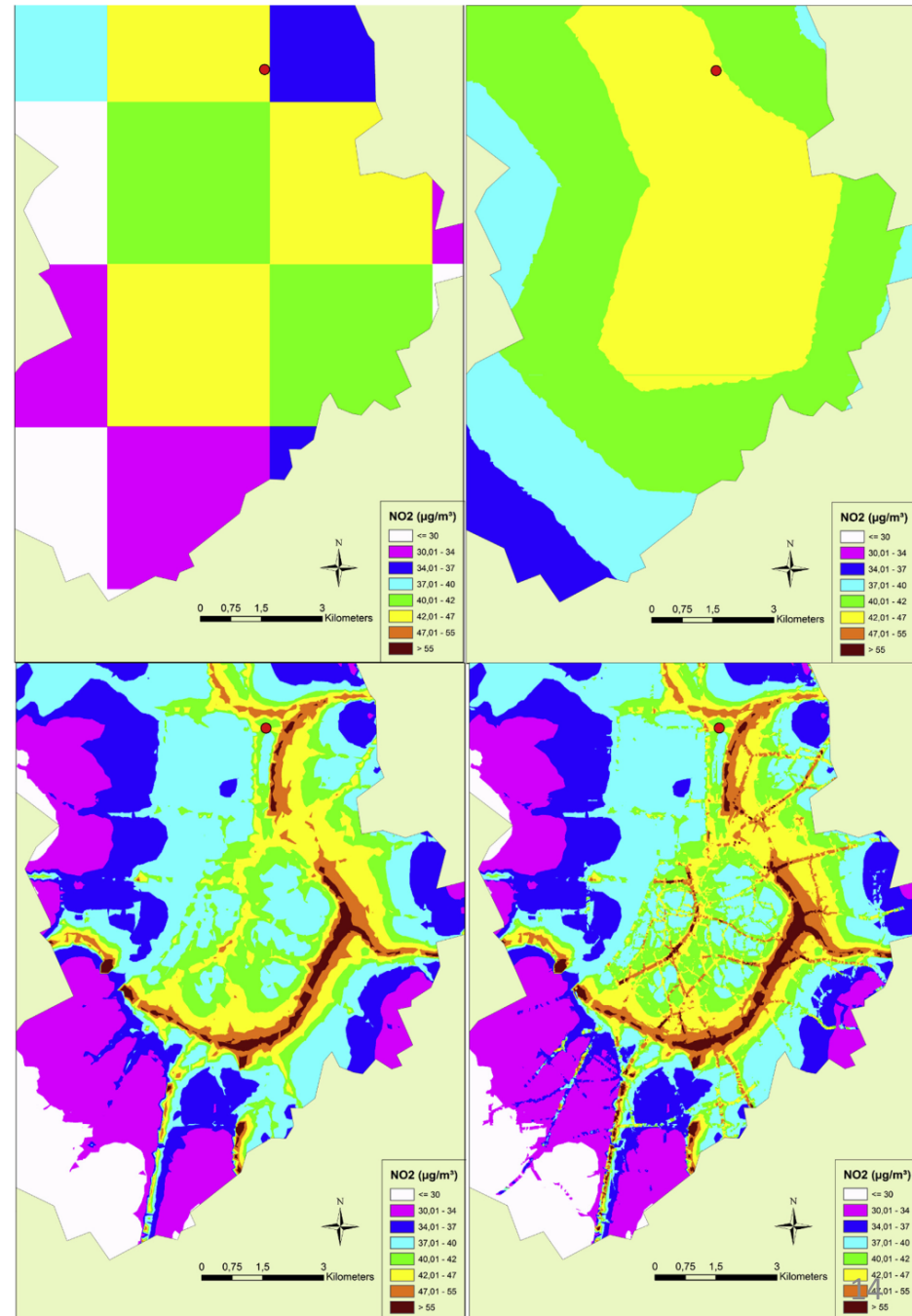


+

Traffic and  
Industrial Emissions



Lefebvre et al. 2013



# Statistical and Machine Learning Approaches

Regional  
forecast

Weather  
forecast

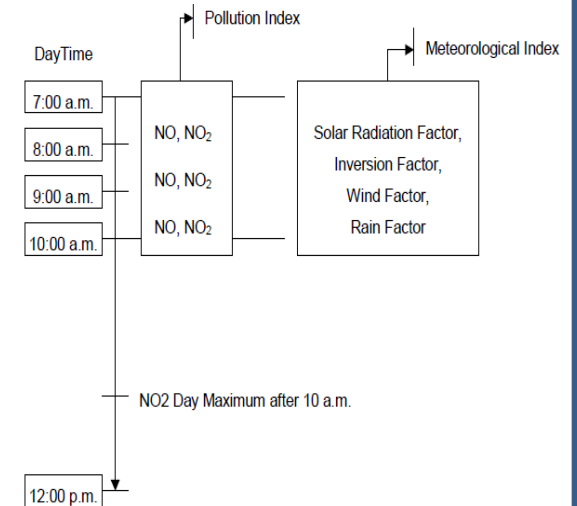
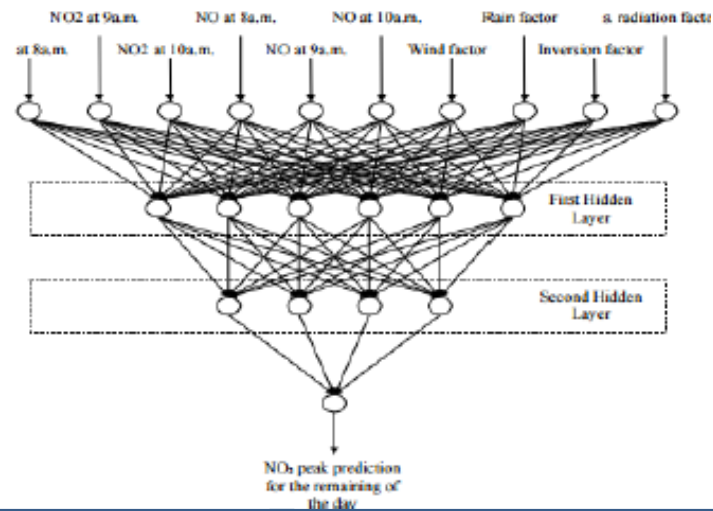
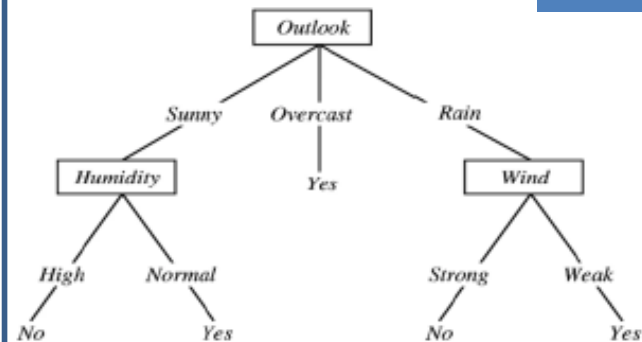
Observations

Previous  
forecasts

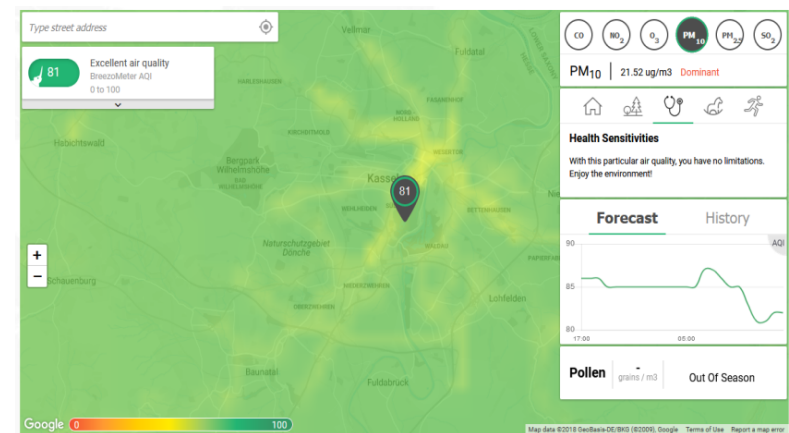
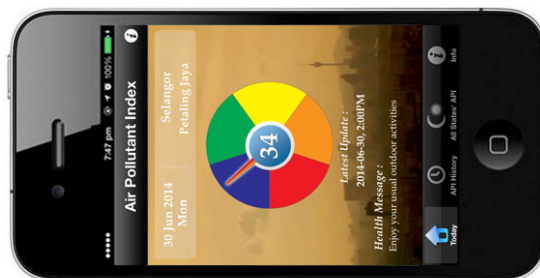
Emissions

Local  
information

## Classification Using Machine Learning



## Well designed mobile Apps and web pages





# Use Cases

---

**MeteoPollen:** Forecasting pollen in France



**airTEXT:** AQ forecast for London and Riga



**PlumeLabs:** Machine Learning based AQ forecasts



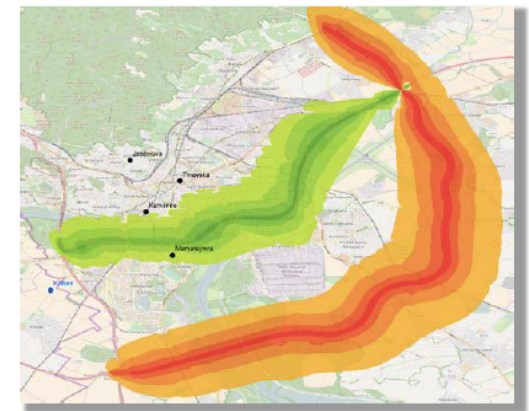
**PASYFO:** Pollen Allergy Risk



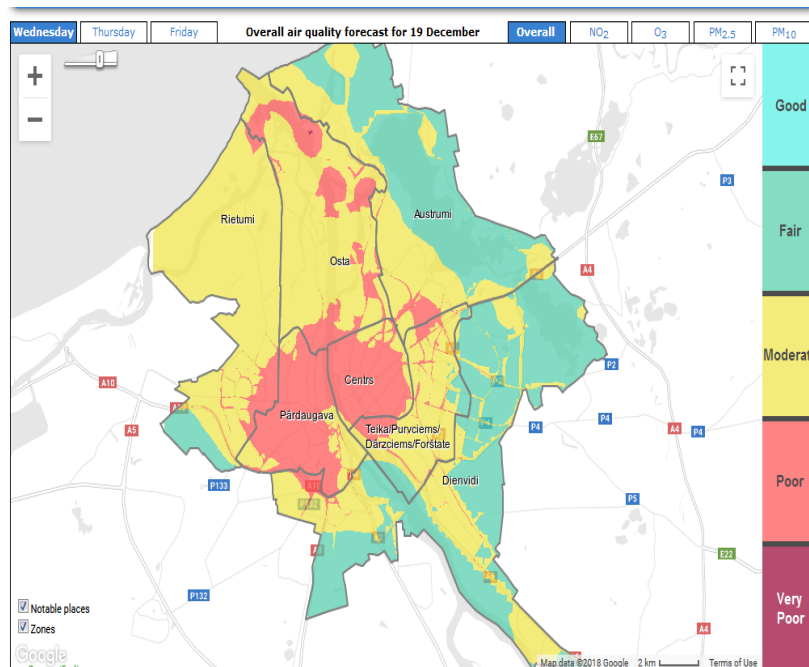
**DiscovAir:** Alert System for tourists in Greece



**Atmosys:** traffic-induced air pollution



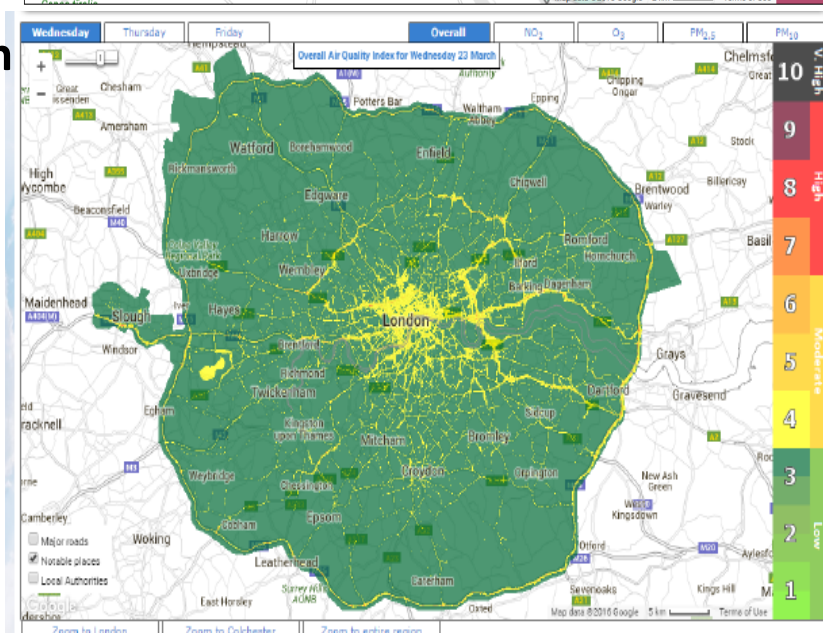
## Riga

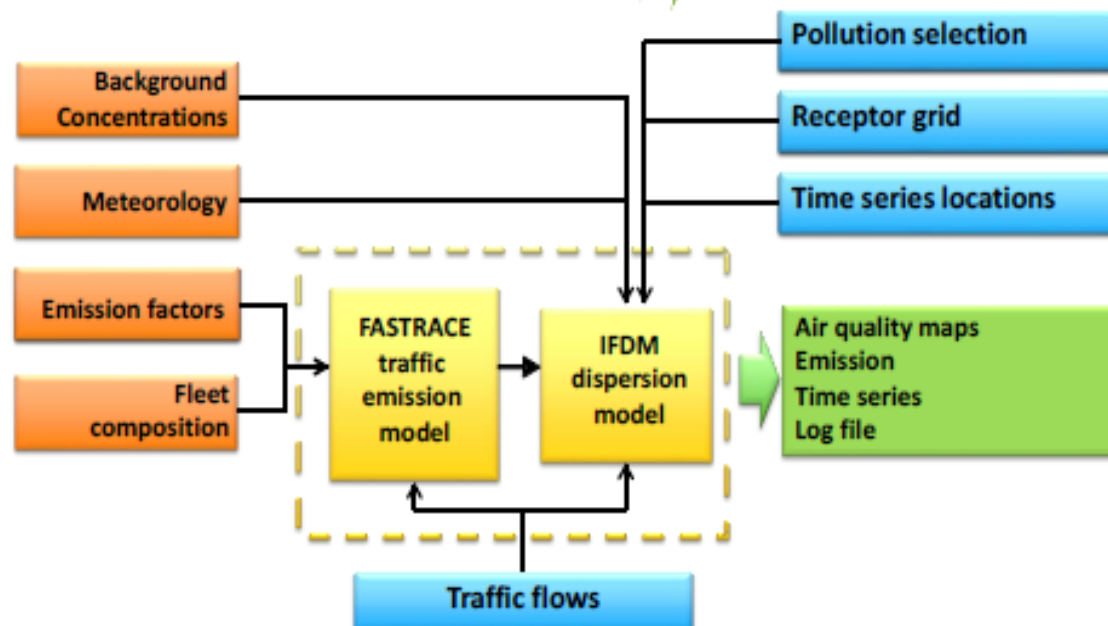
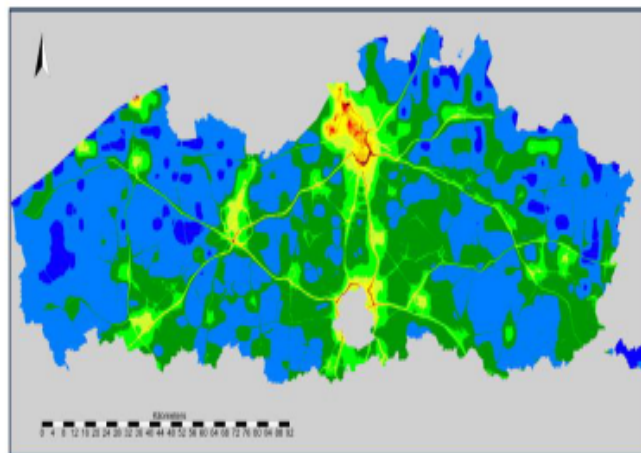


## Business Model

- Free service for users/citizens in the city (e.g. 15000 subscribers in London)
- The City or region authorities pay a set-up fee followed by an annual maintenance fee
- airText disseminates information on air pollution and enables users with particular vulnerabilities to better manage their health conditions
- Economic benefit comes from health improvements and well being in the city

## London



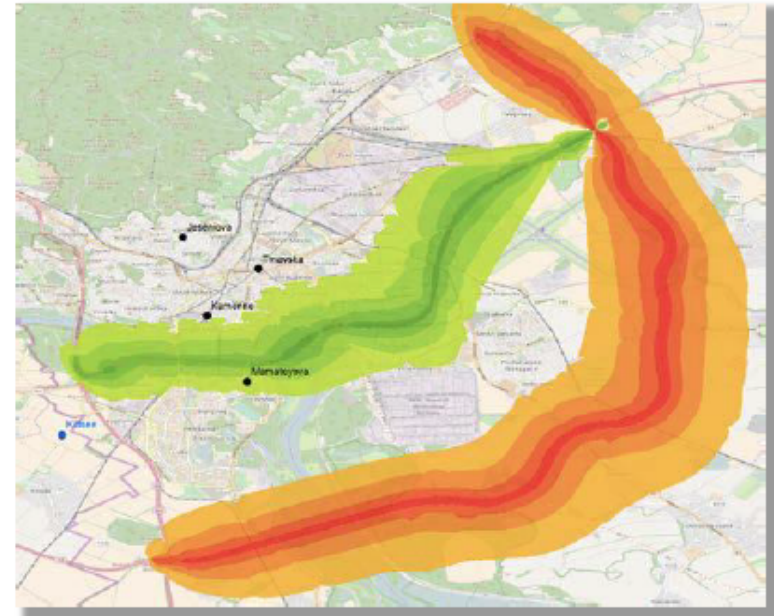


VITO developed a web application for the Flemish Environmental Agency to calculate road traffic emission scenarios in support of regional air quality management.



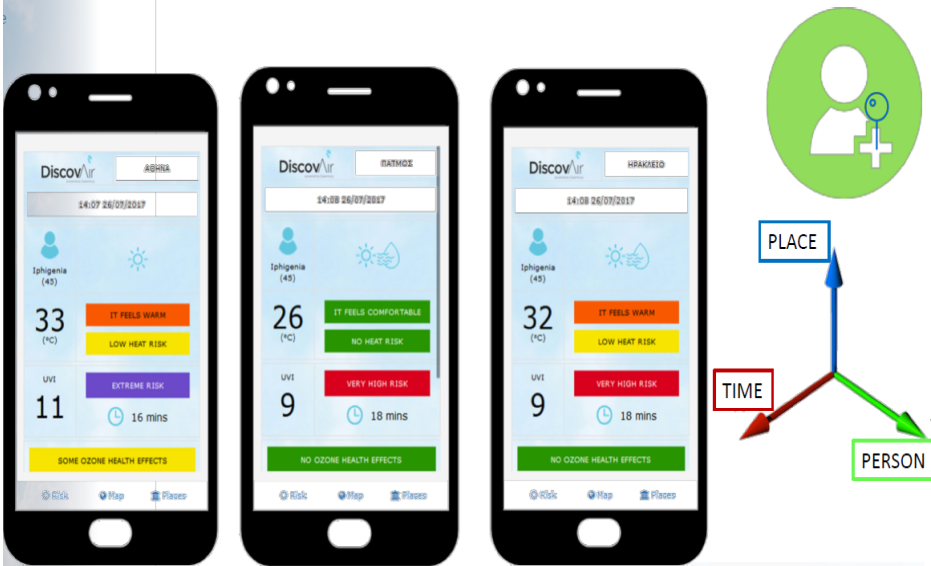
**Business model:**

- Users: national and regional governmental environmental agencies that do not have sufficient tools required to assess and report on air quality and evaluate planning and local emission reduction scenarios
- Over the past 6 years the application has been used for 40 studies by various Flemish agencies
- Extended service is now being tested and promoted in Slovakia, Poland, Italy and Portugal. Outcome will determine pricing model.



*Example of impact of new bypass road on NO2 levels in Bratislava*

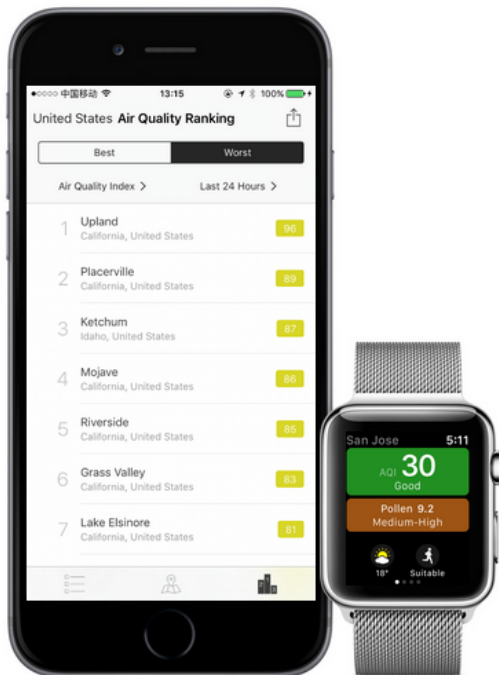
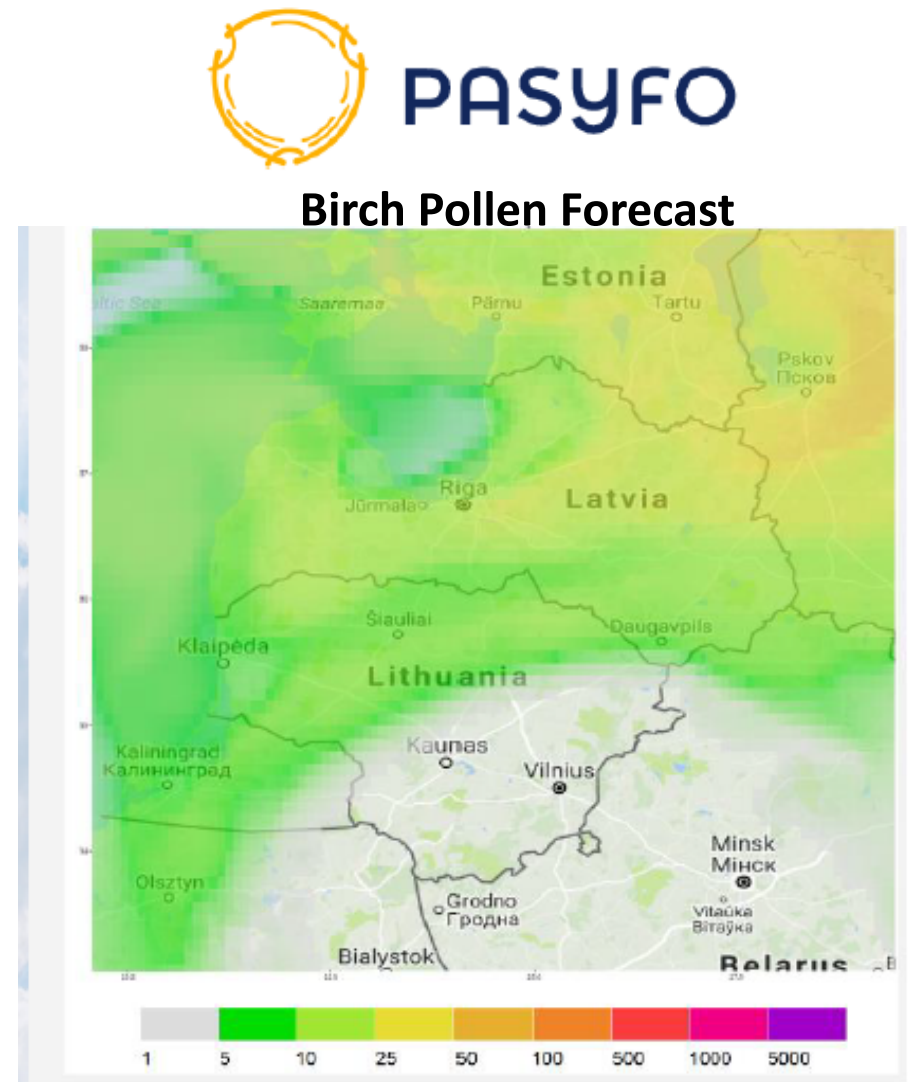
## Personalised, Location-specific



### Business model:

- Users: tourists & citizens, tourism operators and public authorities
- Revenues through e.g., premium version of smartphone app and advertising on mobile and web apps.
- Intention to expand the product beyond the borders of Greece and Cyprus. The service can be applicable to all EU countries and beyond; this is ensured through the utilisation of CAMS products.

- Provides location-specific, personalised advice and alerts for comfort and health in Greece and Cyprus.
- Designed for tourists and citizens, it enhances their trips, travels and days out by making it easier to answer questions like:
  - For how long is it safe to stay in the sun without protection?
  - What is the air quality like in the place I wish to visit?
  - Is it likely that I will have breathing difficulties in the place I wish to visit?
  - Are my allergies likely to be triggered?



Information on pollen allergies; regional system for predicting personal allergy symptoms for pollen-sensitive people

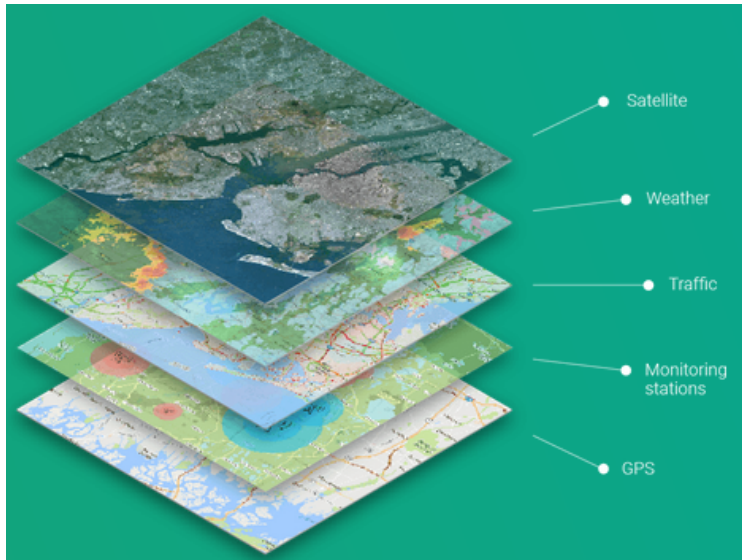
MeteoPollen and PASYFO are building on a well defined business plan and strong market potential



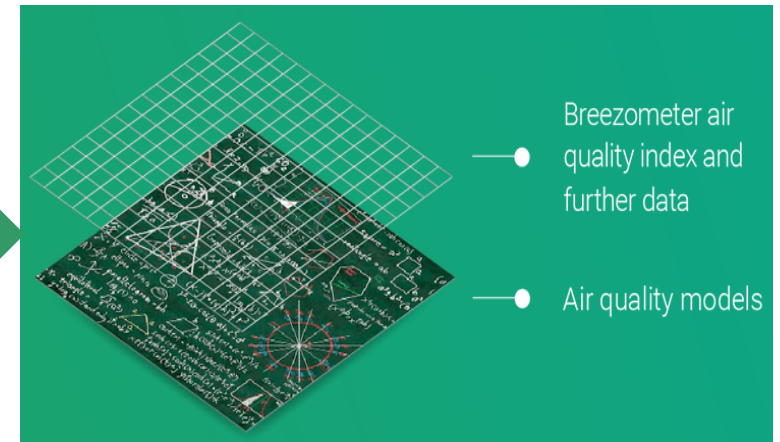
Data: 1.6TB/h; 420M data points



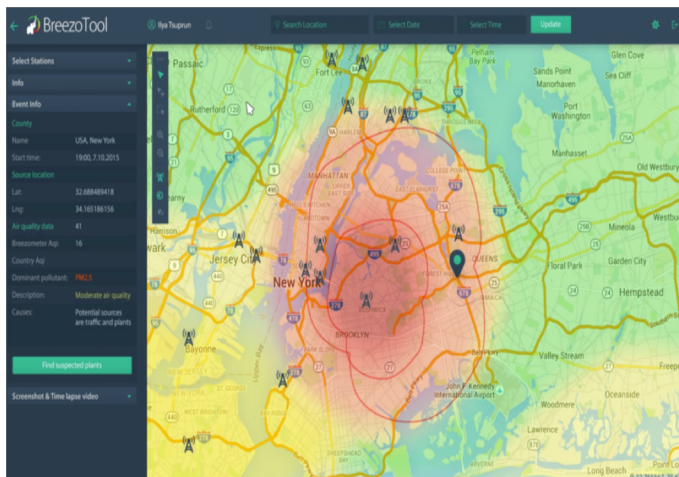
BreezoMeter



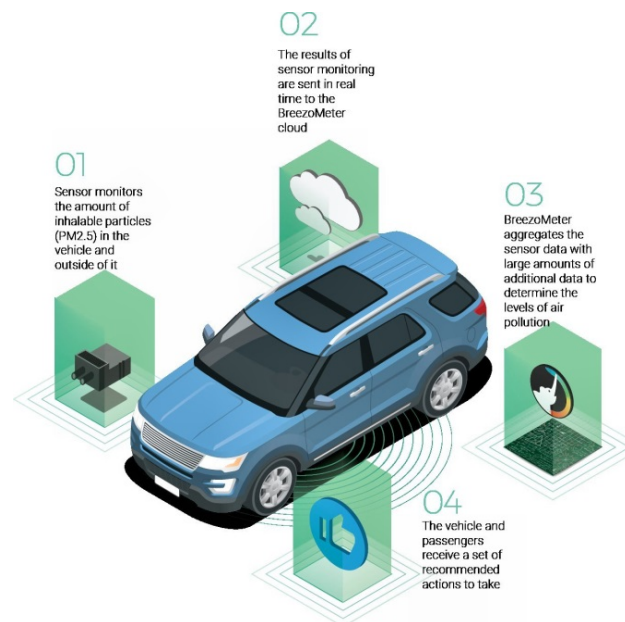
## Machine Learning Algorithms



## Monitoring and measurement of pollution in Paris



## Air Quality APPs for the Industrial Sector



dyson

VEOLIA

current  
powered by GE

dermalogica

L'ORÉAL

AccuWeather



## Major Challenges for Air Quality Services

---

- Translate science to public
- Developing products with a distinctive advantage and quality
- Making sustainable products and services
- Find users, provide support and training
- Respond to user needs, and help them to define what they need
- Integrate user requirements and feedback into product/service development
- Provide easy access, discovery, visualisation, manipulation of data
- Continuous service improvements: web and mobile services, documentation, data access, quality of products
- Increase visibility of the products/services: communication, design...
- **Well defined business model, especially for city and urban areas**
- ...etc



Thank You