Understanding air quality and its role in urban transportation

Mobilise Your City

Training Developed By

Mobilise Your City

Donors:

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Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection

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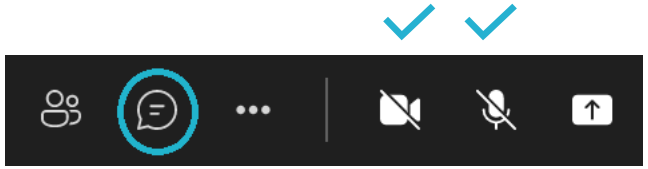
Some General Notes on this session

Make sure you are muted and your camera is turned off



This session will be recorded. You will not appear in the recording if your camera is kept off

Include your questions in the chat, we will pose them in the Q&A at the end of the session

Mastering Mobility Series

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Objectives of the session

- Understand the difference between Greenhouse Gas (GHG) emissions and air pollution
- Identify the main air pollutants, their impact on health and their main sources
- Understand the contribution of transport to air pollution

Contents

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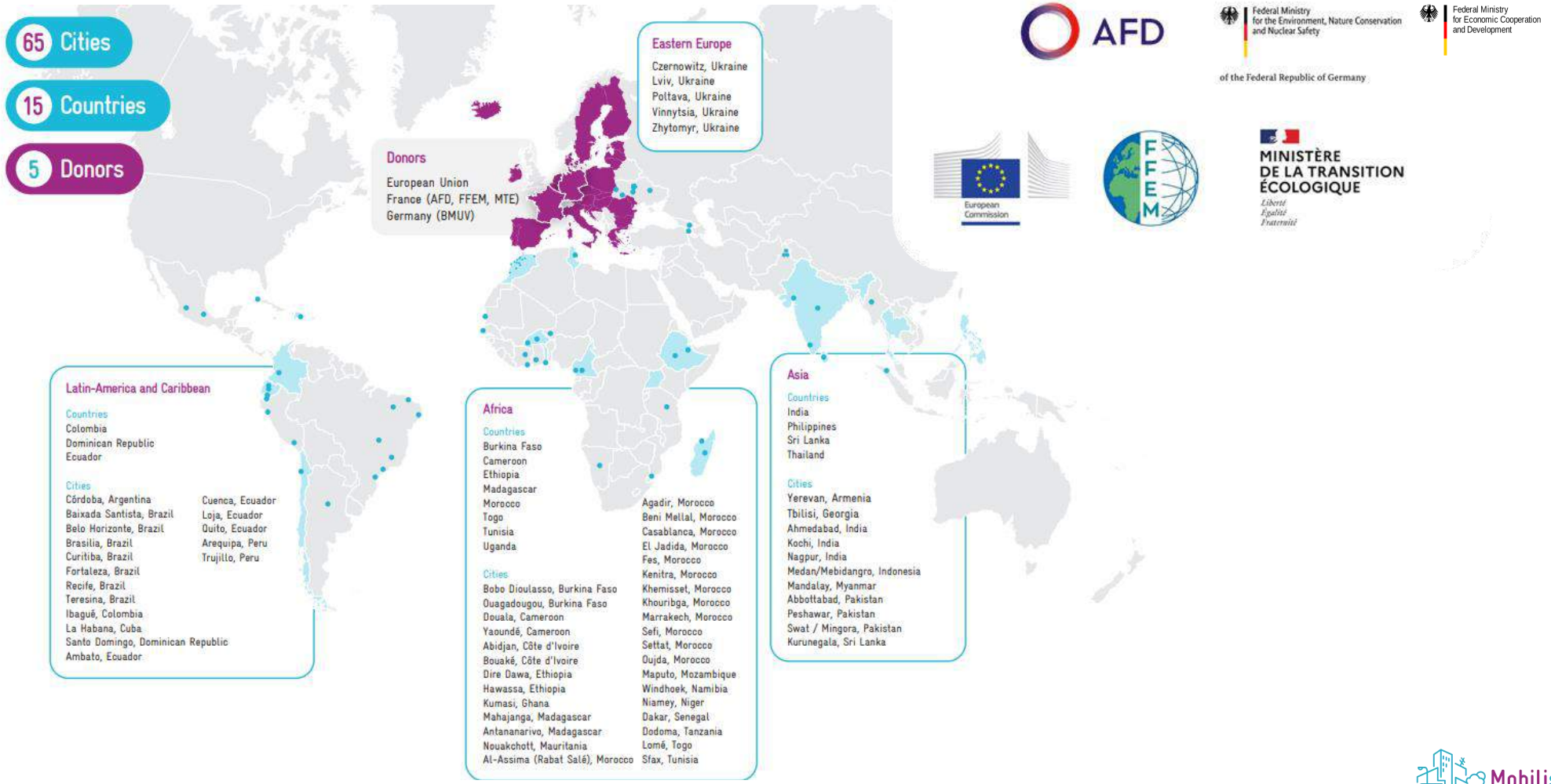
MobiliseYourCity - a truly global Partnership with members on 4 continents



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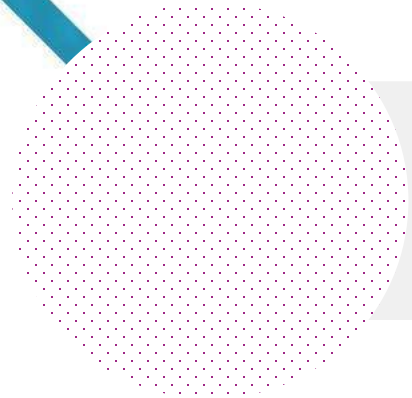
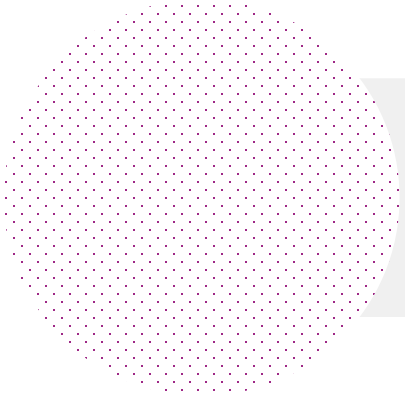
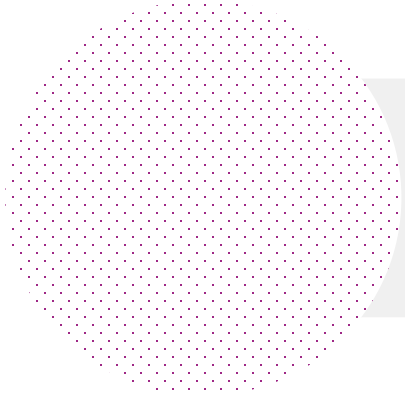
Speakers



Person 1



Person 2



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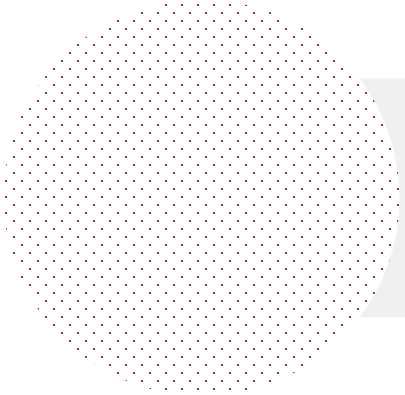
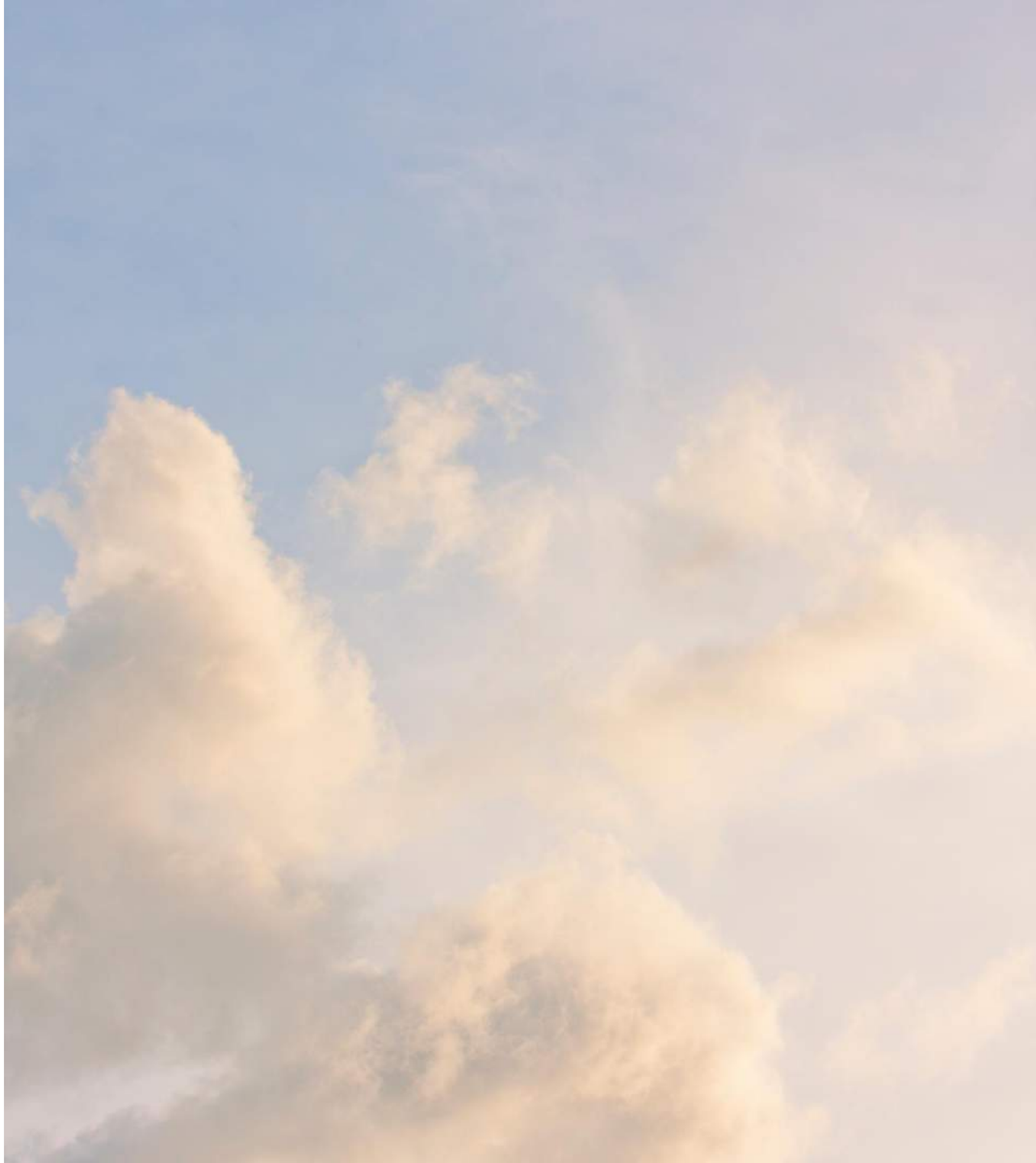


Person 4

Word Cloud: Air quality – what does it mean to you?

→ Check the chat for instructions or use the QR code for access



Introduction to air quality

What does air quality mean and why is it important?

What are the main pollutants and where do they come from?

Impacts of atmospheric pollution

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3.1

What does air quality mean and why is it important?

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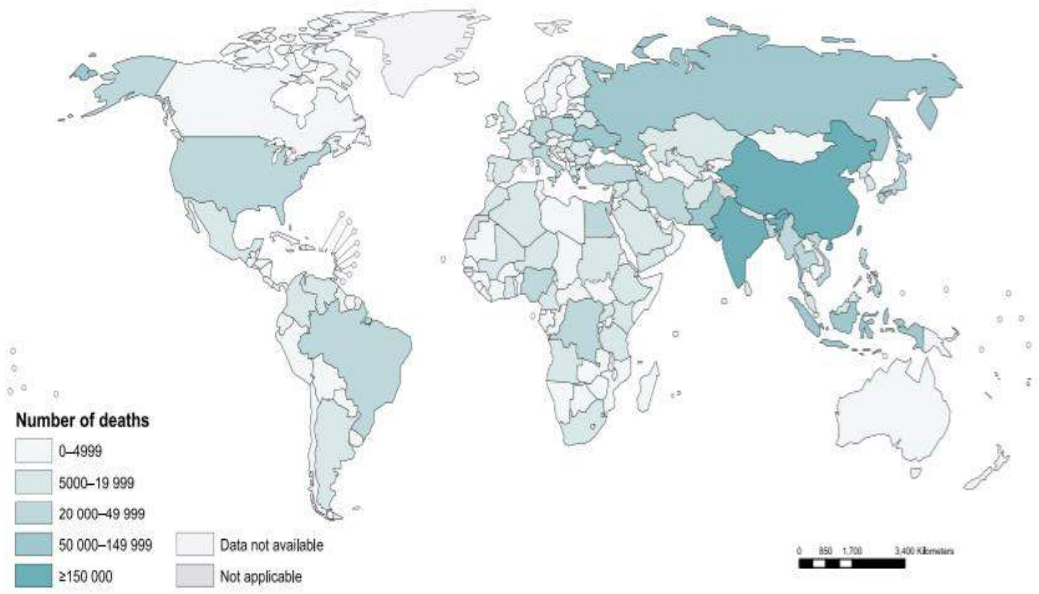
Figure 16: Deaths attributable to AAP in 2012, by country



AAP: Ambient air pollution

Ambient air pollution: a global assessment of exposure and burden of disease, WHO 2016

ADEME

7 million premature deaths due to the effects of air pollution (WHO)

Air pollution, a public health issue

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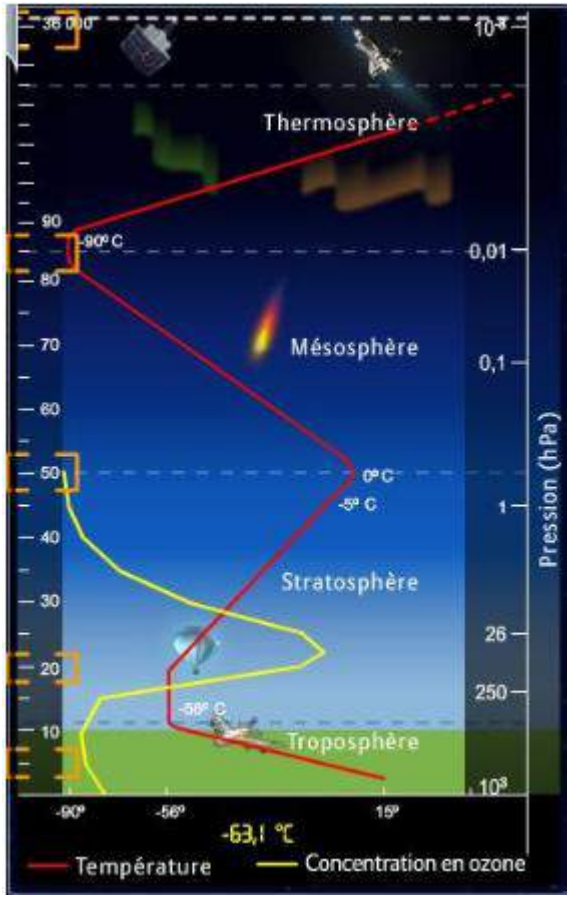
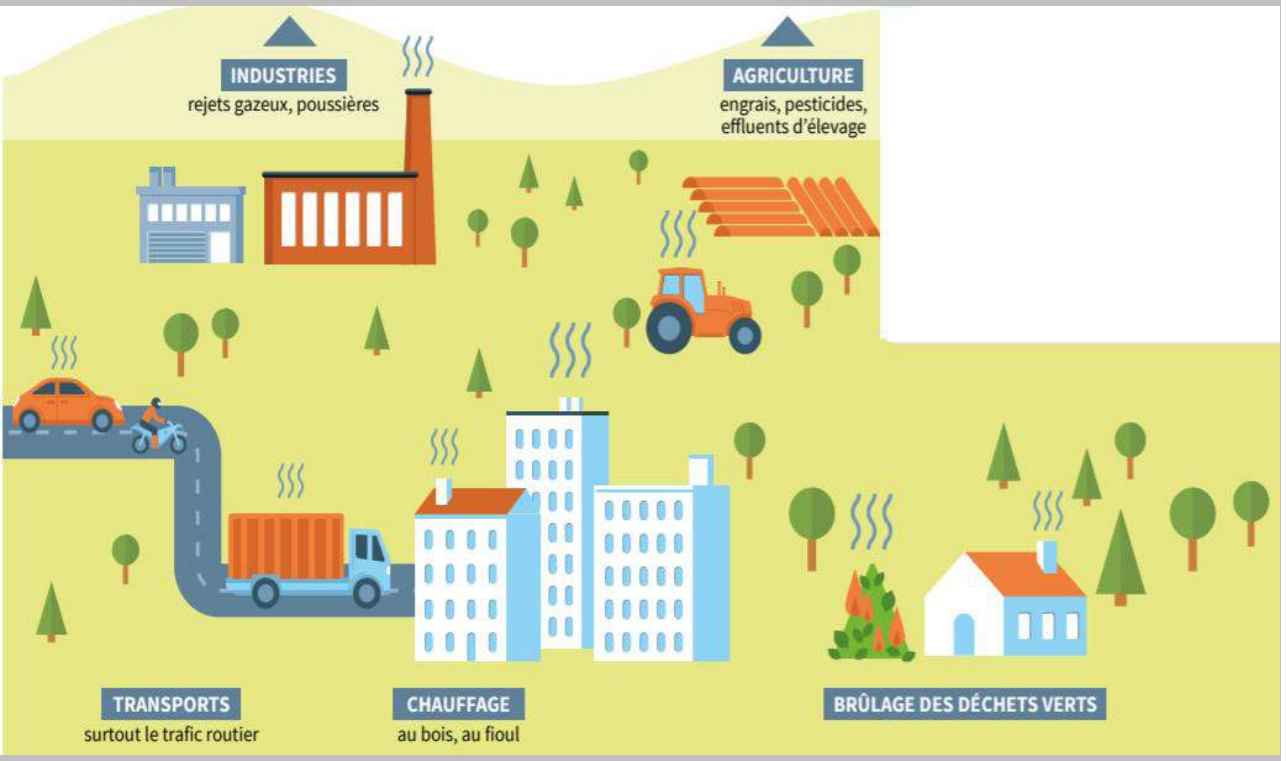
Air composition and atmospheric structure



http://education.meteofrance.fr/

Constitutive gases of dry air	% in volume
Nitrogen (N_2)	78.09
Oxygen (O_2)	20.95
Argon (A)	0.93
Carbon dioxide (CO_2)	0.035
Neon (Ne)	$1.8\ 10^{-3}$
Helium (He)	$5.24\ 10^{-4}$
Krypton (Kr)	$1.0\ 10^{-4}$
Hydrogen (H_2)	$5.0\ 10^{-5}$
Xenon (Xe)	$8.0\ 10^{-6}$
Ozone (O_3)	$1.0\ 10^{-6}$
Radon (Rn)	$6.0\ 10^{-18}$



La pollution de l'air en 10 questions, ADEME 2020

Emissions / concentrations

Some figures for France (CITEPA, 2020)

- About 90% of primary particulate matter and nitrogen oxide emissions from road transport are from diesel vehicles
- 84% of fine particles emissions from the residential sector are linked to heating

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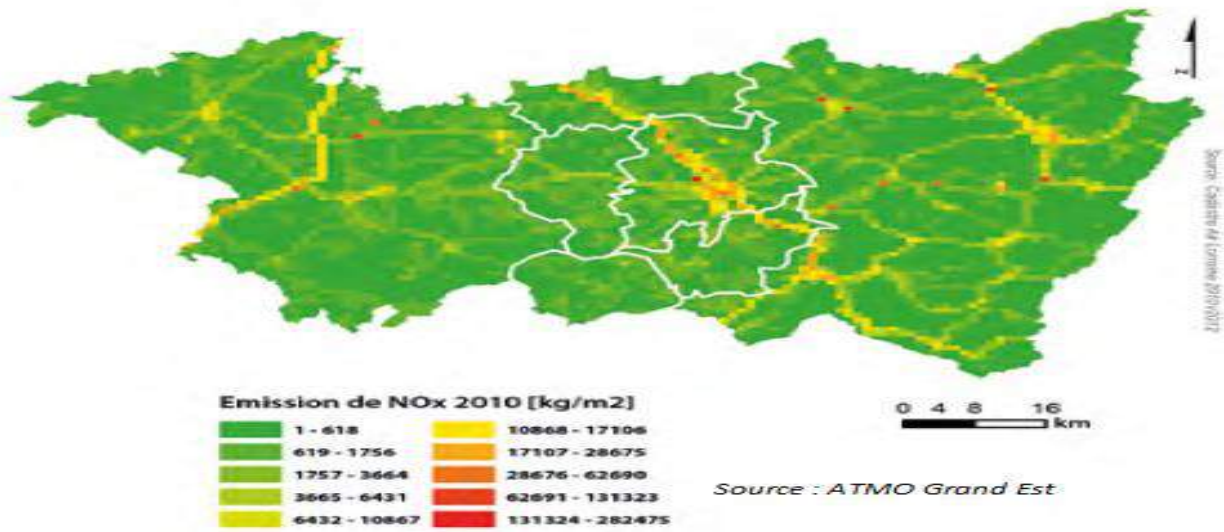
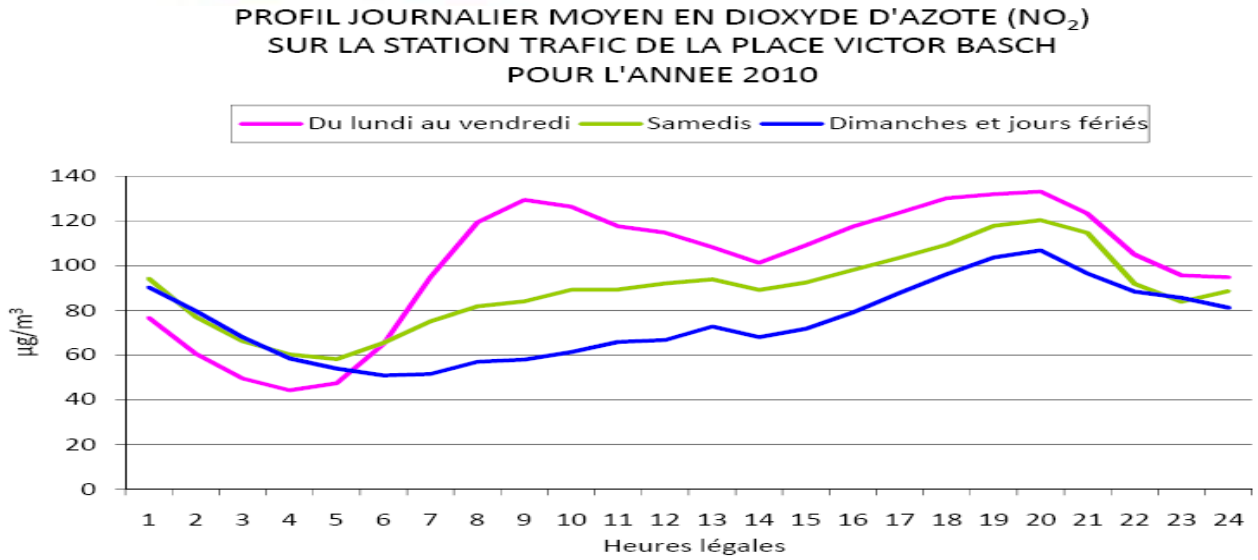
Emissions / Concentrations

- **An emission inventory** consists of recording the nature and quantity of **air pollutants emitted by different sources** according to their location and over time. When emissions are geographically distributed, it is generally referred to as an emissions register.

- **Concentrations** correspond to the mass of pollutants per volume of air. They can be transformed into an air quality index. These are the local concentrations that we breathe. Assessing these concentrations requires the setting up of measurement network stations.

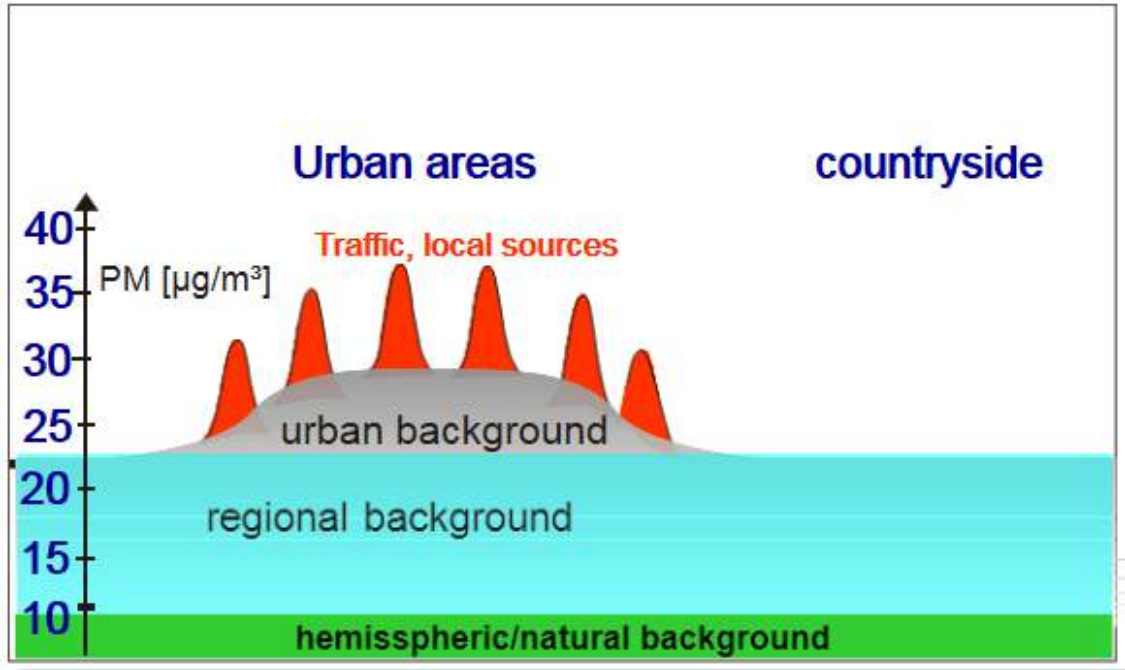
Cadastre d'émission de NOx sur le périmètre du SCoT et du département des Vosges (source : Air Lorraine)





Source : Surveillance et information sur la qualité de l'air en Ile-de-France en 2014, AIRPARIF, mai 2015

Emissions / Concentrations



Source : Martin Lutz, Sénat de Berlin

Pollutant concentrations are often broken down into the sum of ***background pollution and pollution of more local origin.***

Inhomogeneous concentrations, varying from day to day

Reactive pollutants	O_3	: a few hours
	NO_x	: 1,5 days
	SO_2	: 5 days
	Particles	: a few days
	COV	: 0,5 - 60 days
	CO	: 2 months
	CH_4	: 7 years
	CFC	: 7 - 150 years

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Emissions / Concentrations : influence of meteorological conditions

- **wind**

Absence of wind: concentration of pollutants
Moderate wind: good dispersion of pollutants
Strong wind: plume effect and localized pollution

- **rain**

Raindrops and fog droplets catch gaseous pollutants and particles and carry them to the ground

- **topography**

Natural obstacles, buildings or land and sea breeze phenomena on the coast can generate the dispersion of pollutants

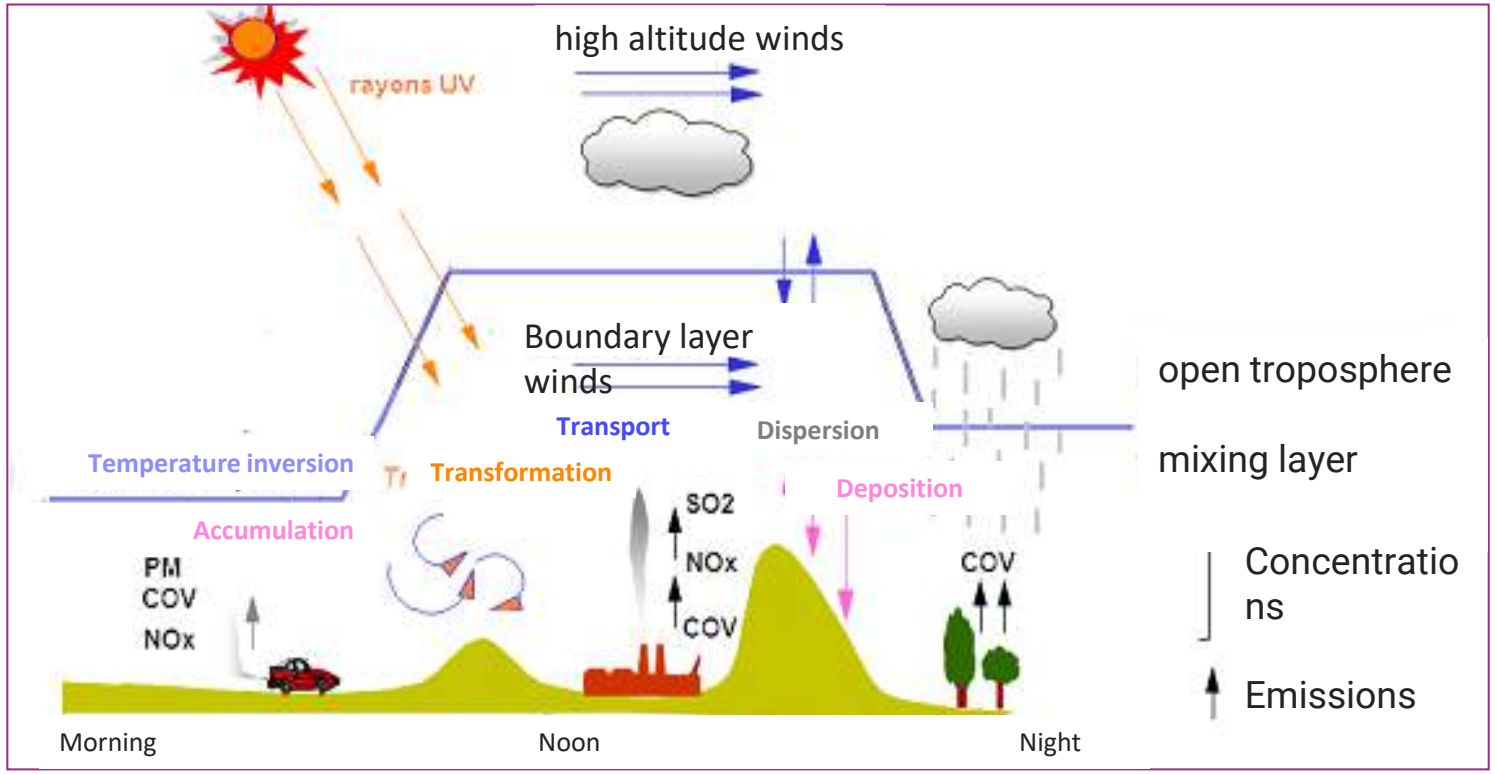

Illustration Airparif

Primary pollutants:

- Combustion
- Volatilization
- Mechanical process

Secondary pollutants:

- Chemical or photochemical reactions from primary pollutants
- Examples: ozone, secondary particles

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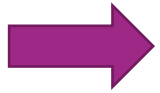
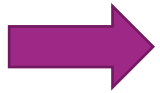
Greenhouse gases/air pollution: how to tell the difference?

- **Air pollutants**: composed of toxic gases or harmful particles, that have a direct effect on health and ecosystems.



Short term & local impacts

- **Greenhouse gases:** are responsible for climate change. They remain in the atmosphere for a very long time but have little direct effect on health (with the notable exception of ozone, which is also an air pollutant).



Long term & global impact

Air pollution and climate change

Pollutants

Main sources of pollution (climate and air):

- Short lived compounds (SLCs) including soot

Impact of climate change on air pollution

- Increased burden of ozone pollution
- Lengthening of the pollen season

Sources

Same origins

- With different contributions

https://www.atmo-nouvelleaquitaine.org

Action Plan

Research for synergies

- Reduction of energy consumption
- Behavior change (mobility and sustainable agriculture...)

Vigilance against actions with antagonistic effects:

- Energy substitution (diesel, combustion of wood, etc.)

Key role of cities: efficiency of bottom-up actions

- Local action = Positive local and global impact
- **Short-term benefits** for health and economy

3.2

What are the main pollutants and where do they come from?

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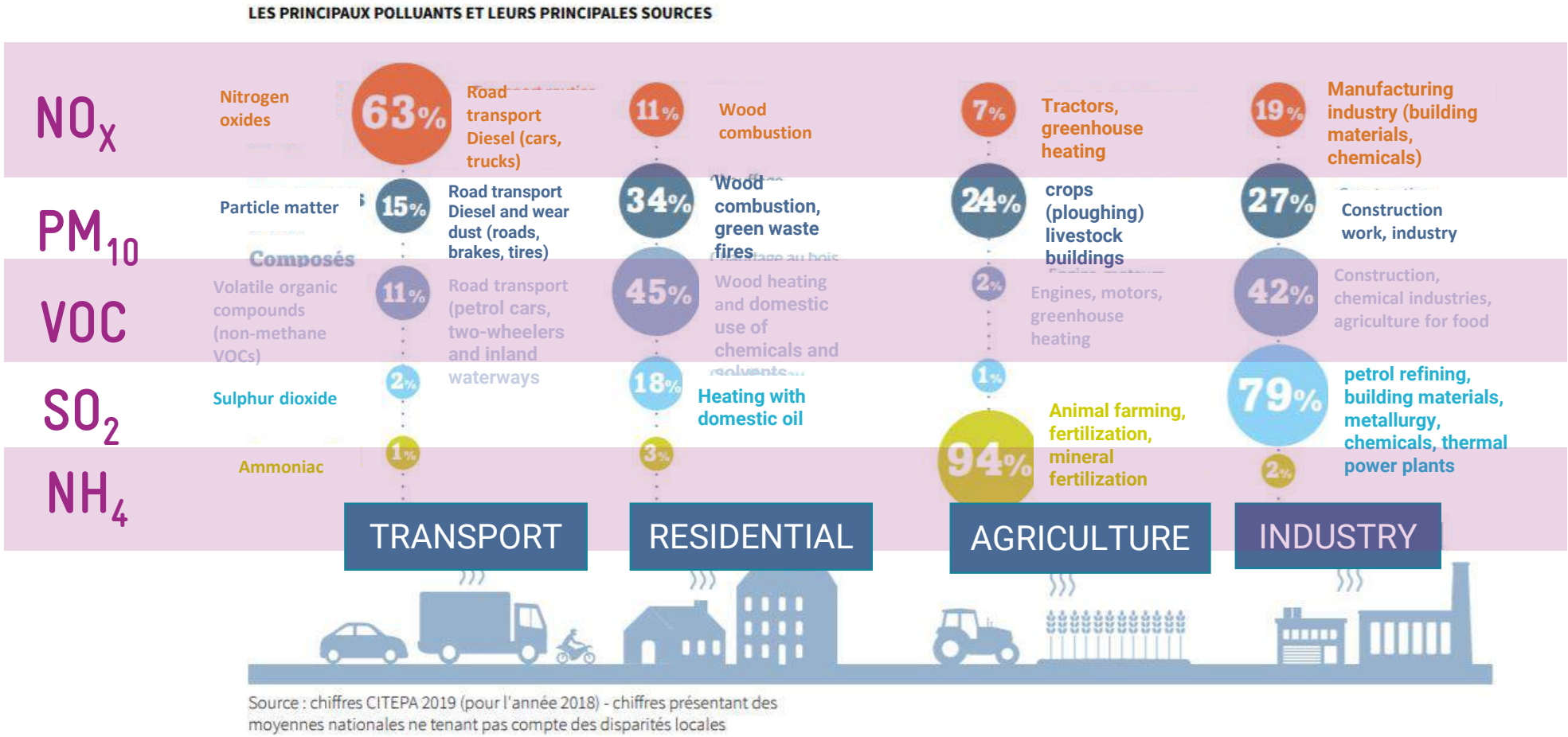
Main sources of pollution



https://www.ademe.fr/sites/default/files/assets/documents/guide-pratique-pollution-air-en-10-questions.pdf

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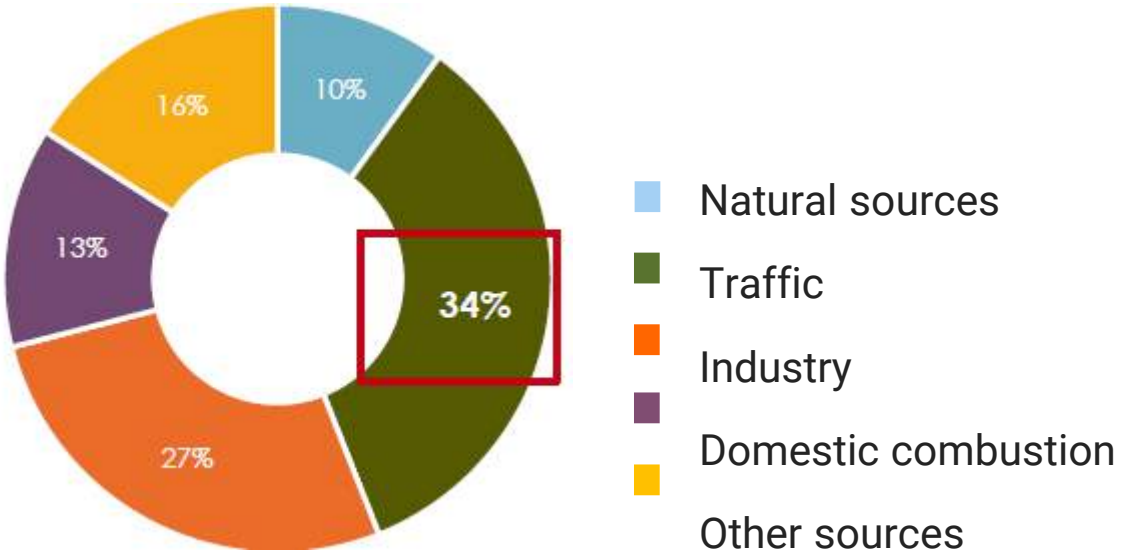
Main sources of pollution

Contribution of different sectors to $PM_{2,5}$ emissions

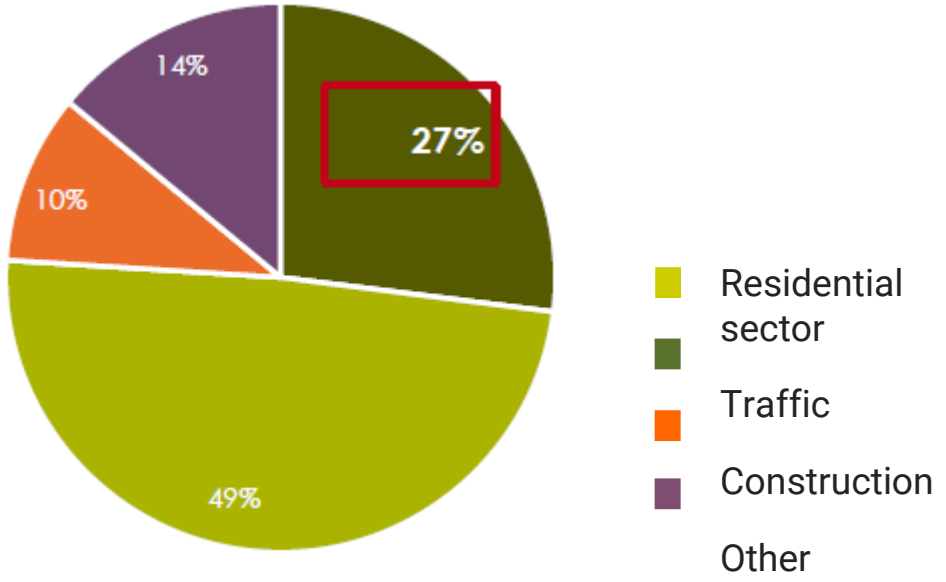
South Asia, 2015

Source : Karagulian et al. 2015



PARIS, 2015

Source : AirParif



https://www.ademe.fr/sites/default/files/assets/documents/guide-pratique-pollution-air-en-10-questions.pdf

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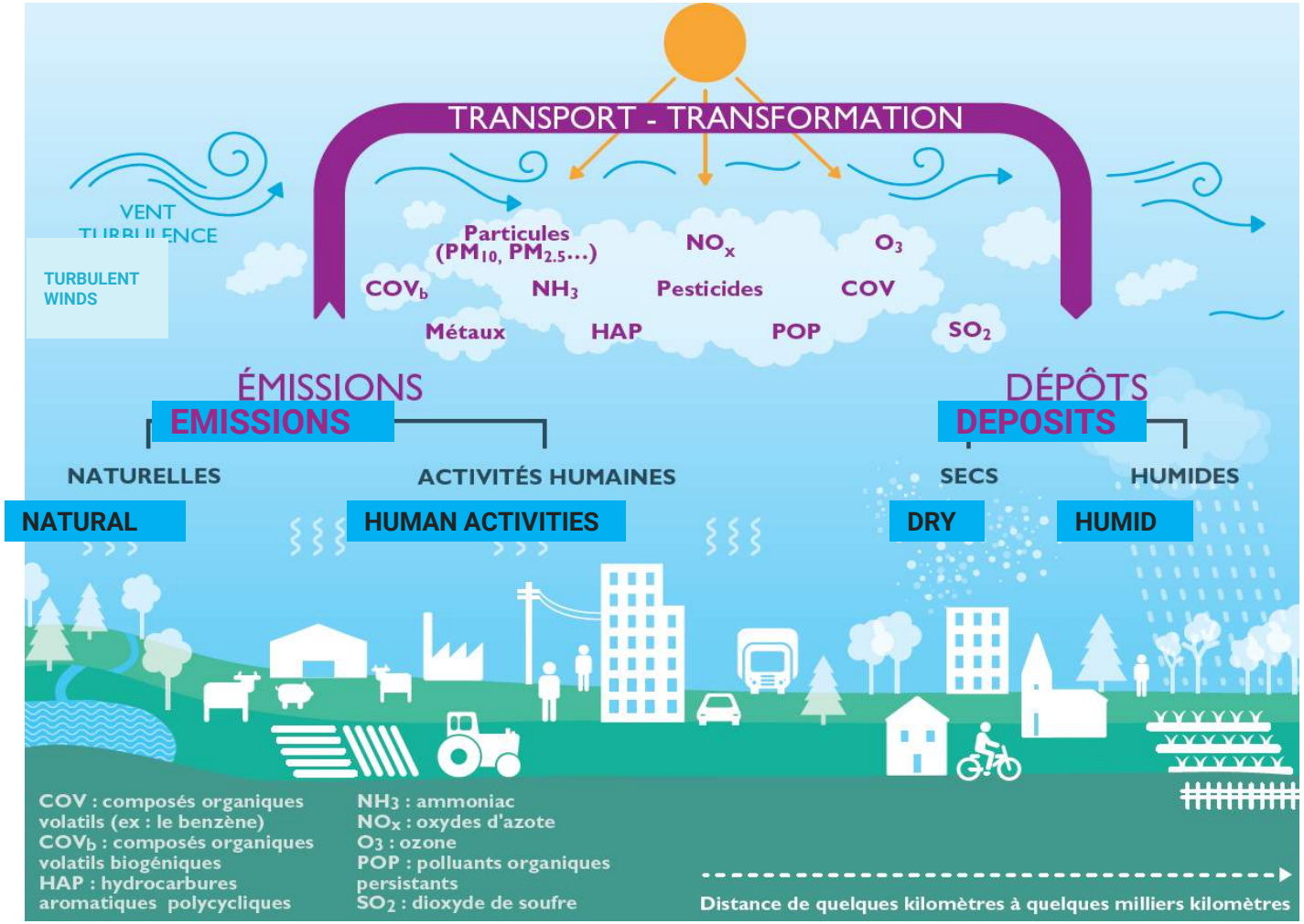
Impact of the environment on pollutants

http://www.ademe.fr/agriculture-pollution-lair



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3.3

Impacts of atmospheric pollution

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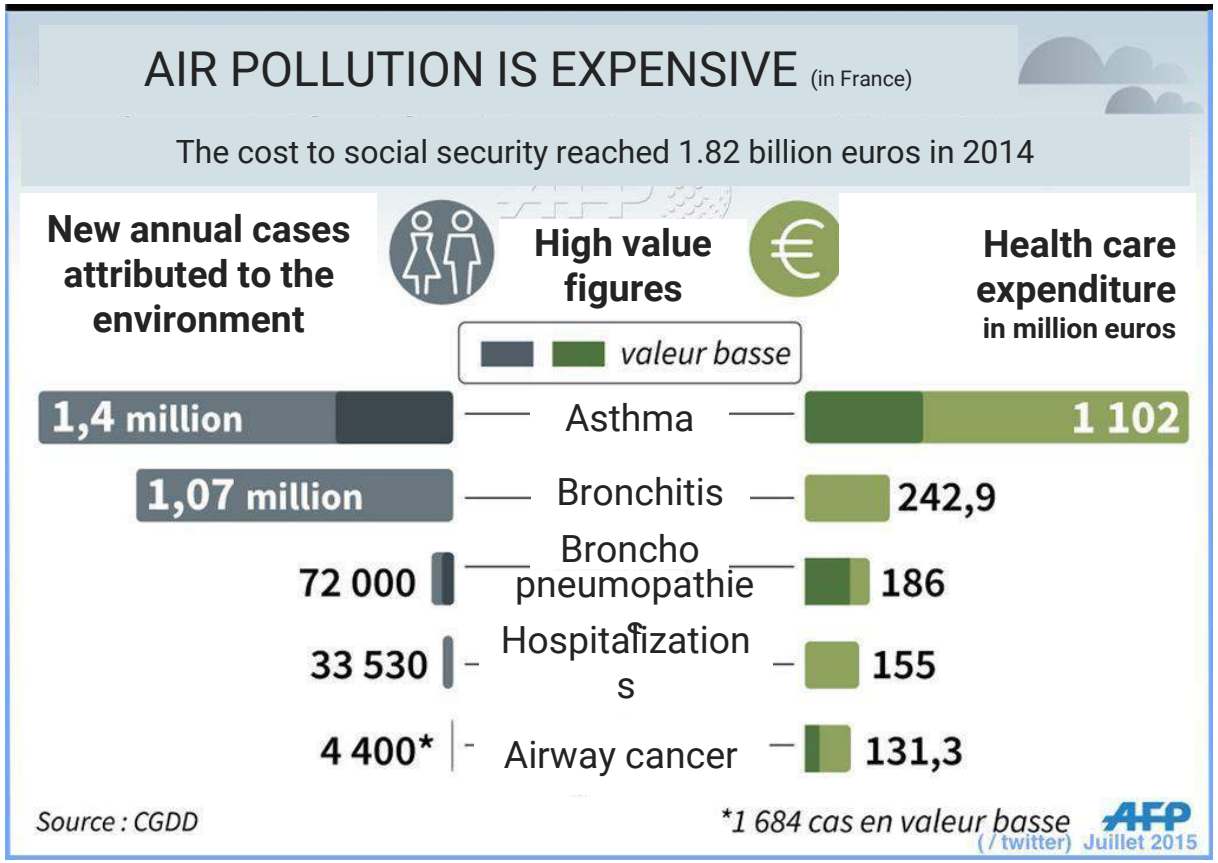
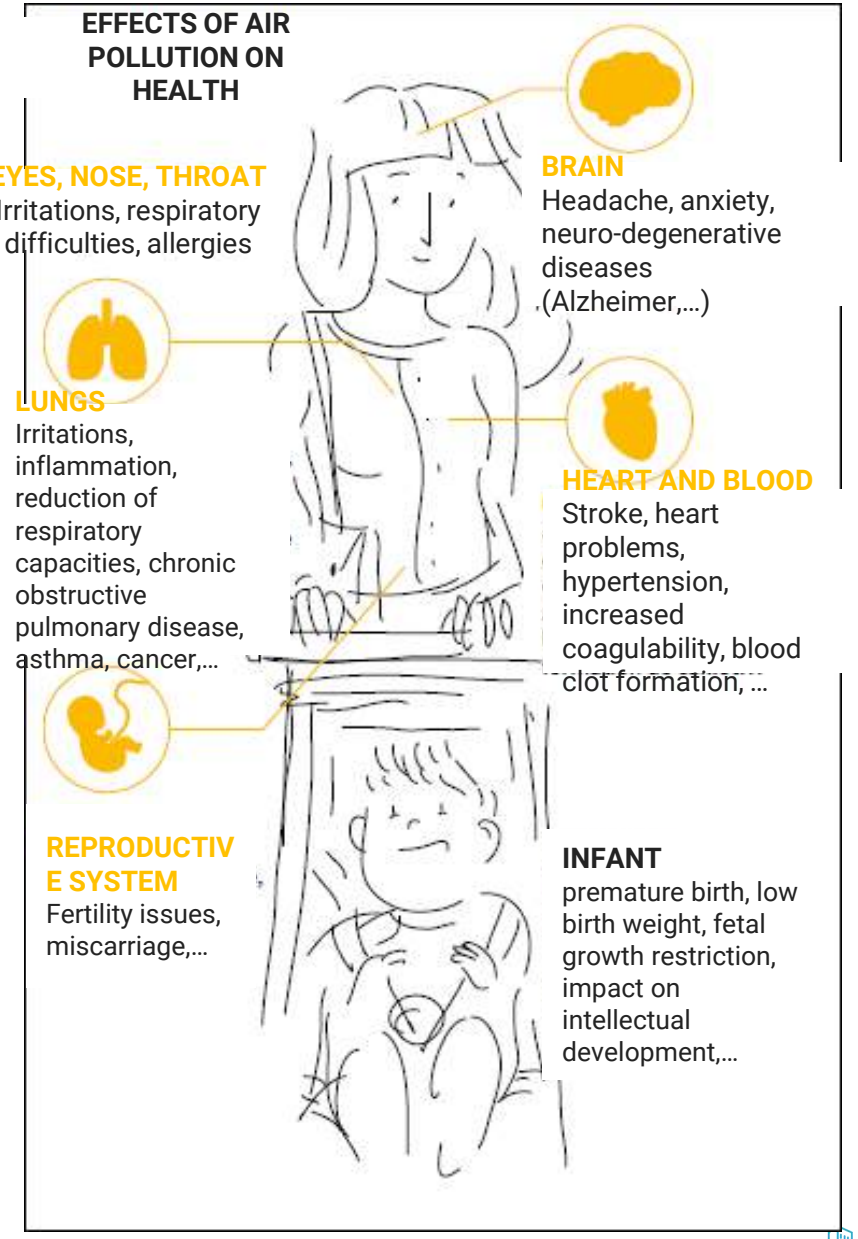
Impact on health

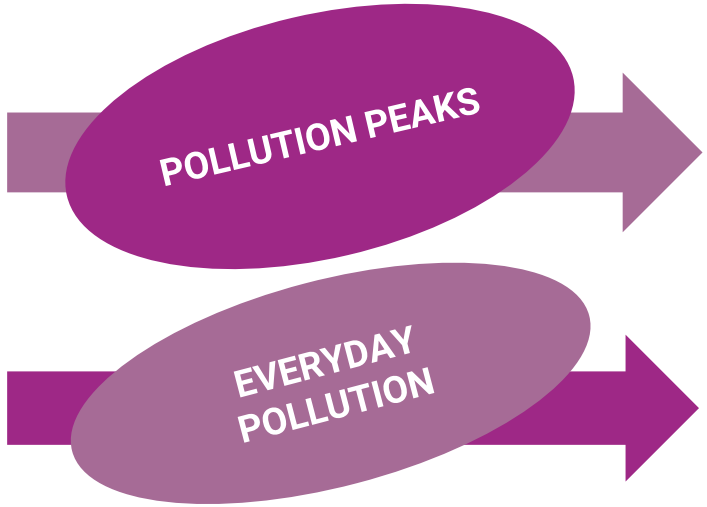




Air pollution in 10 questions, ADEME 2020

Impact on health

Exposition: from several hours to several days



Acute exposure,
so-called short-term

Exposition over several years

Chronic exposure,
so-called long-term

Chronic exposure to air pollution leads to the most significant health impacts for the general population

To act in a permanent way and not only in a punctual way (during pollution peaks for example)

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Other impacts

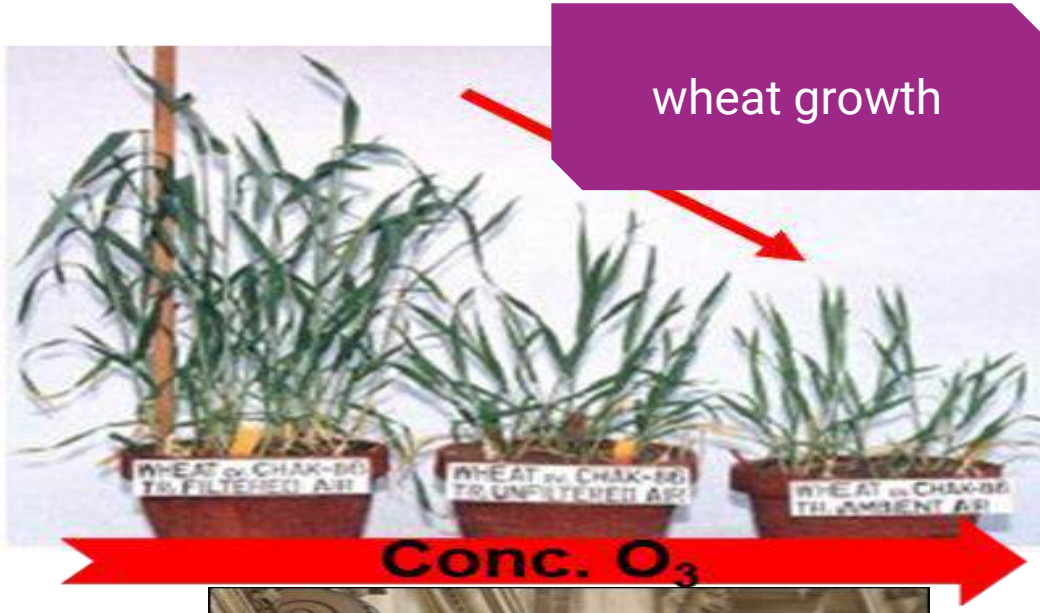
Environmental impacts

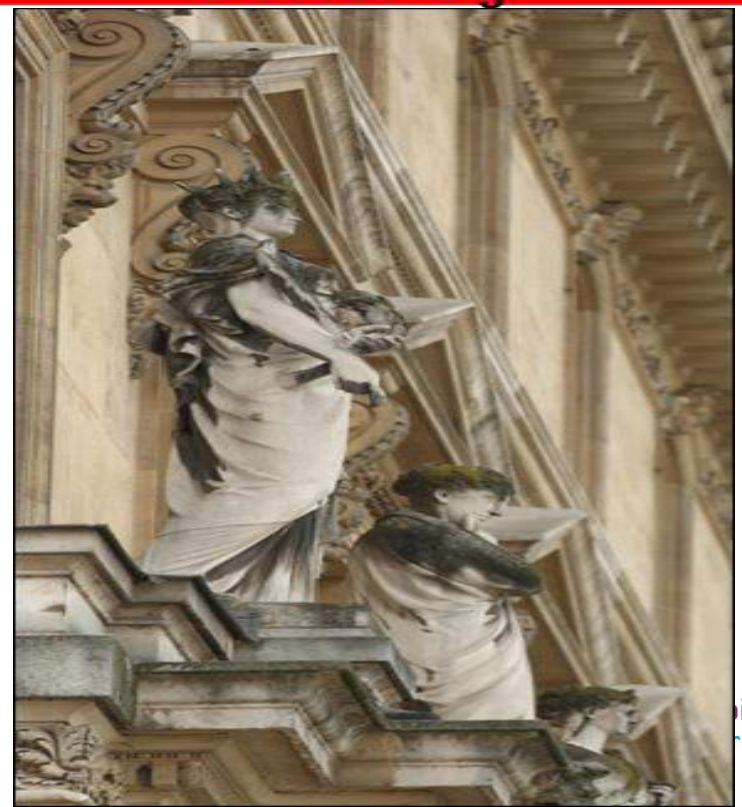
- Excessive nitrogen deposition
  - Acidification and eutrophication of environments
  - Nitrophilous species favored and species vulnerable to excess nitrogen regressed
  - Biodiversity
- Ozone excess
  - Decrease in agricultural, forestry and fish farming yields
  - Impacts on the quality of marketed plants
- Acid rain: NO_X, SO_2, NH_3
  - Acidification of wet deposits (rain, snow, fog, etc.)
  - Disruption of photosynthesis and mineral salt absorption
  - Acidification and loss of soil fertility
  - Death of trees

Impact on buildings: Air pollution dirties and degrades materials and buildings

- Formation of black crusts on facades (particularly by particles linked to the combustion of petroleum products)
- Dissolution of stones (especially limestone under the effect of acid rain)
- Corrosion (SO_2)

Damage is sometimes irreversible.

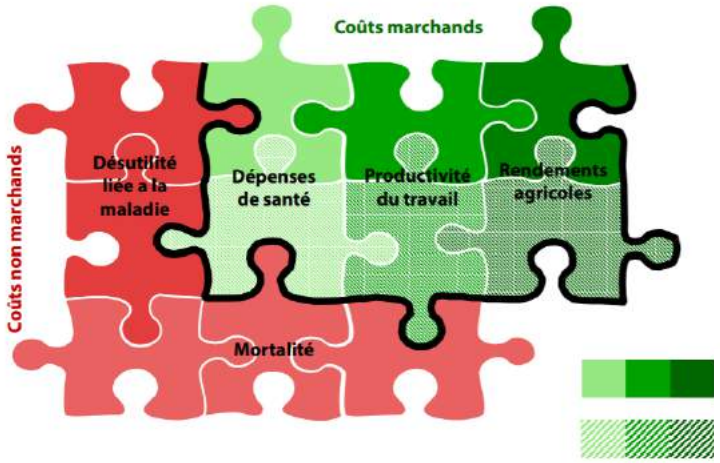




Other impacts

Economic impact

- €68-97bn in France (Senate, 2015)
- A progressive increase in overall economic costs, projected to reach 1% of global gross domestic product (GDP) by 2060. (OECD, 2016)



	OECD		World	
	2015	2060	2015	2060
TOTAL market impacts	90	390	330	3 300
Revenue share %	0.3%	0.5%	0.6%	1.5%
Per inhabitant (USD per inhabitant)	70	270	50	330
TOTAL non-market impacts	1 550	3 750 - 3 850	3 440	20 540 - 27 570
En part de revenu (pourcentage)*	5%	5%	6%	9 - 12%
Par habitant (USD par habitant)	1 210	2 610 - 2 680	470	2 060 - 2 770

Consequences-economiques-de-la-pollution-air-exterieur-essentiel-strategique, OCDE, 2016

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New WHO guidelines

Table 0.1. Recommended AQG levels and interim targets

Pollutant	Averaging time	Interim target				AQG level
		1	2	3	4	
$PM_{2.5}$, µg/m³	Annual	35	25	15	10	5
	24-hour[a]	75	50	37.5	25	15
PM_{10}, µg/m³	Annual	70	50	30	20	15
	24-hour[a]	150	100	75	50	45
O_3, µg/m³	Peak season[b]	100	70	–	–	60
	8-hour[a]	160	120	–	–	100
NO_2, µg/m³	Annual	40	30	20	–	10
	24-hour[a]	120	50	–	–	25
SO_2, µg/m³	24-hour[a]	125	50	–	–	40
CO, mg/m³	24-hour[a]	7	–	–	–	4

[a] 99th percentile (i.e. 3–4 exceedance days per year).
[b] Average of daily maximum 8-hour mean O_3 concentration in the six consecutive months with the highest six-month running-average O_3 concentration.

The average level for **PM2.5** (10 µg/m3) is exceeded by **70% of the measuring stations in Europe**
Air quality in Europe - 2020 report

Between 2009 and 2018, for **PM2.5**:

- **22% reduction in annual average concentrations,**
- **13% reduction in premature deaths linked to air pollution**

Air quality in Europe - 2020 report

WHO global air quality guidelines, 2021

Additional resources

- A 20-minute awareness-raising tool on air, climate and energy issues
- An online training tool on air quality
- An ADEME guide for the general public on air pollution
- A reference website: https://www.ccacoalition.org/en

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Case Study 1

Road transport and air pollution: the example of the Paris metropolitan

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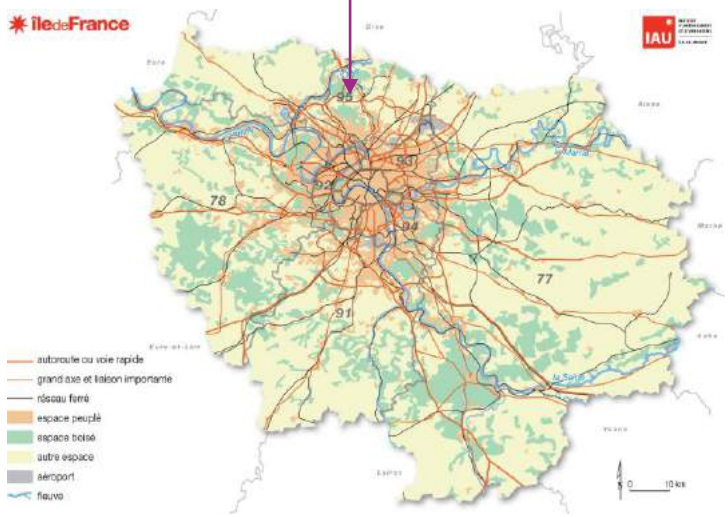
Paris and the Île-de-France region



Paris

- 1.2 million inhabitants
- 1st European megapolis in terms of **population density** (20,600 inhabitants/km2)
- High concentration of economic activities and **traffic**

Île-de-France

- 12 million inhabitants
- Attractive economic centre
- Increasingly dense road network towards the centre of the agglomeration
- 50% agricultural land, with many forests on the periphery

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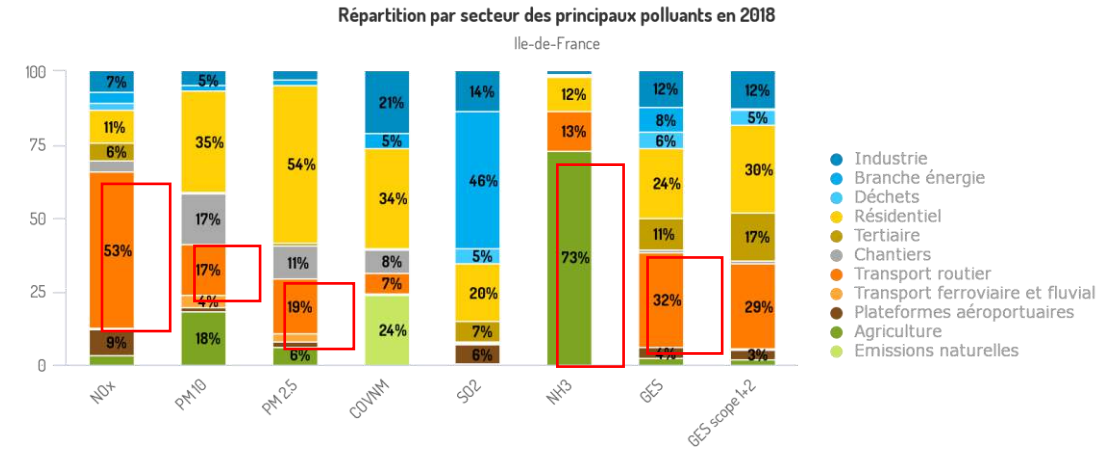
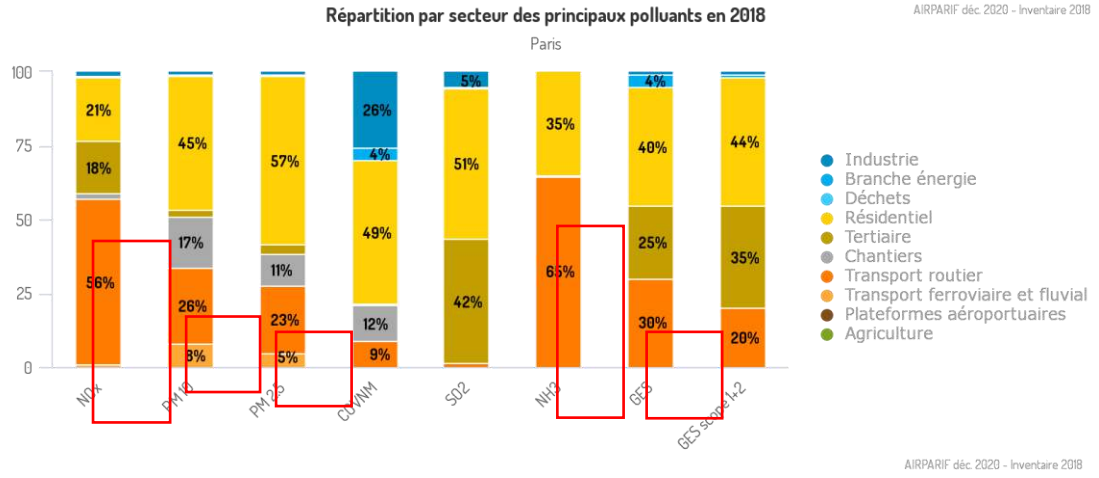
Emissions inventory: Paris vs Île-de-France – Road traffic





Transport sector: road traffic is by far the biggest emitter, ahead of rail and waterway transport and airports

Road transport :

- Primary source of NOx
- Secondary source of PM2.5

Different emission profiles depending on the territory:

- PM10: road transport 2nd source in Paris, 3rd in Ile-de-France (behind agriculture)
- Ammonia: 65% emitted by road transport in Paris, but 73% emitted by agriculture in Île-de-France

Links to climate change :

- 30% of GHG emissions from road transport

Evolution of road traffic emissions

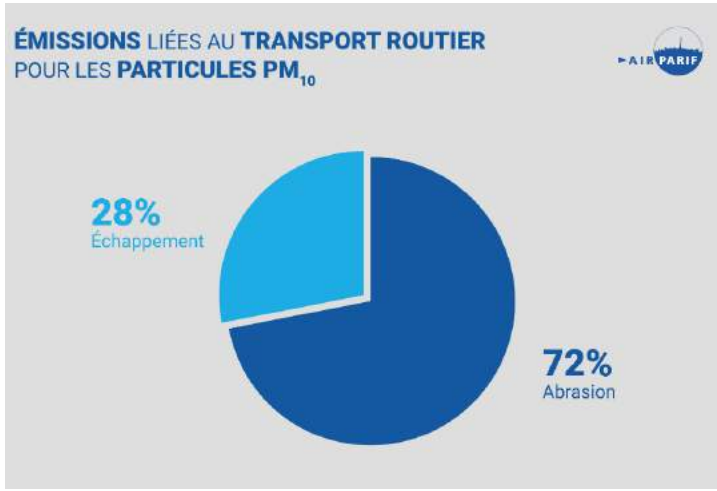
- **Clear downward trend (2005-2018) :**
  - NOx: -46%.
  - NH3: -52
  - PM10: -55%.
  - PM2.5: -65%.

- **Technological improvements and tightening of regulations (EURO standards)**

- **Abrasion particles**
  - With the decline in combustion-related particulate emissions (exhaust), the relative share of abrasion particles (tyres, brakes, roads) is becoming the majority.
  - Little impacted by the renewal or electrification of the fleet
  - Importance of good road and vehicle maintenance and eco-driving practices (to avoid sudden acceleration/deceleration).

NOx

NH3



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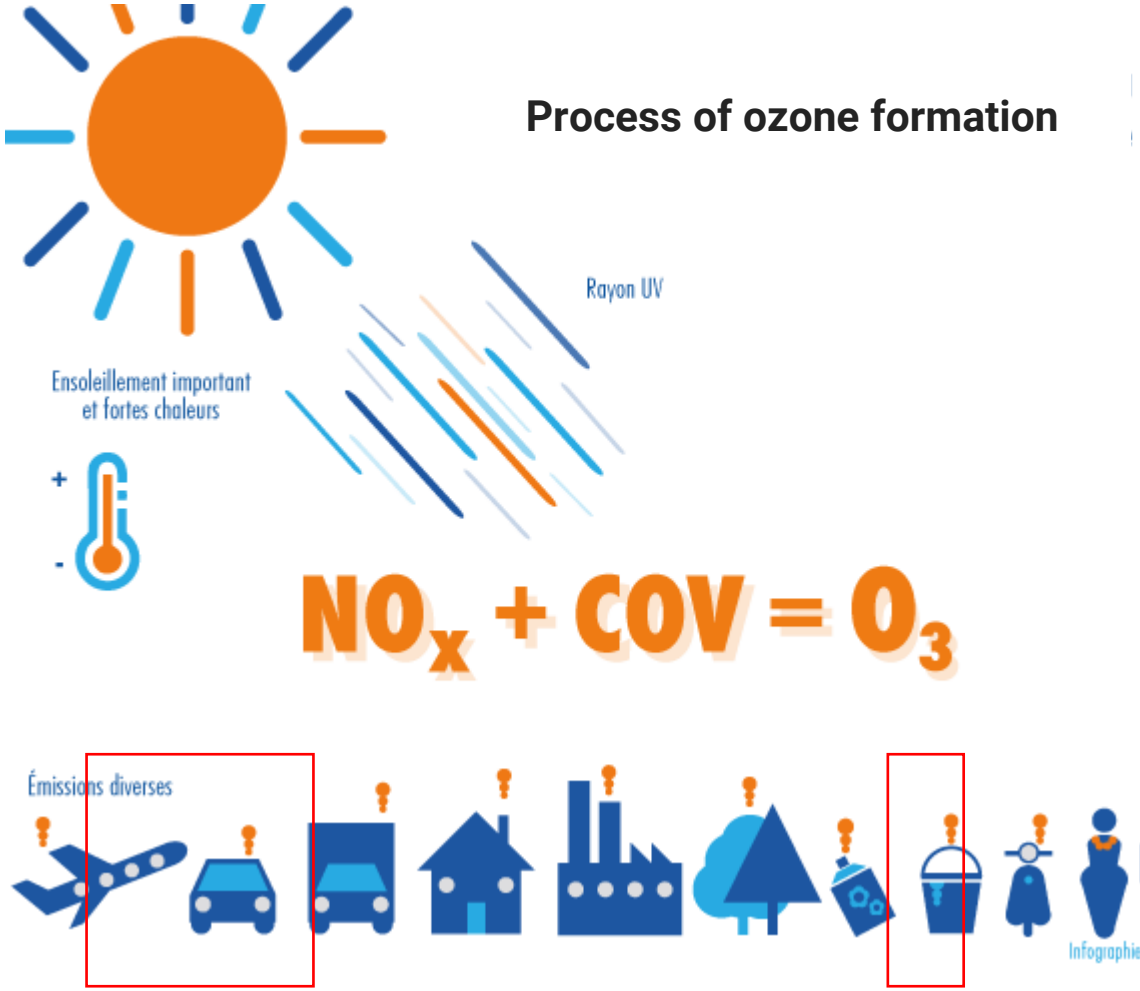
Ozone Formation

Nitrogen oxides and volatile organic compounds from road traffic:

- Precursors of ozone that contribute to its formation in the atmosphere.
- Only pollutant **on the rise** in Île-de-France

Tendancy over 10 years



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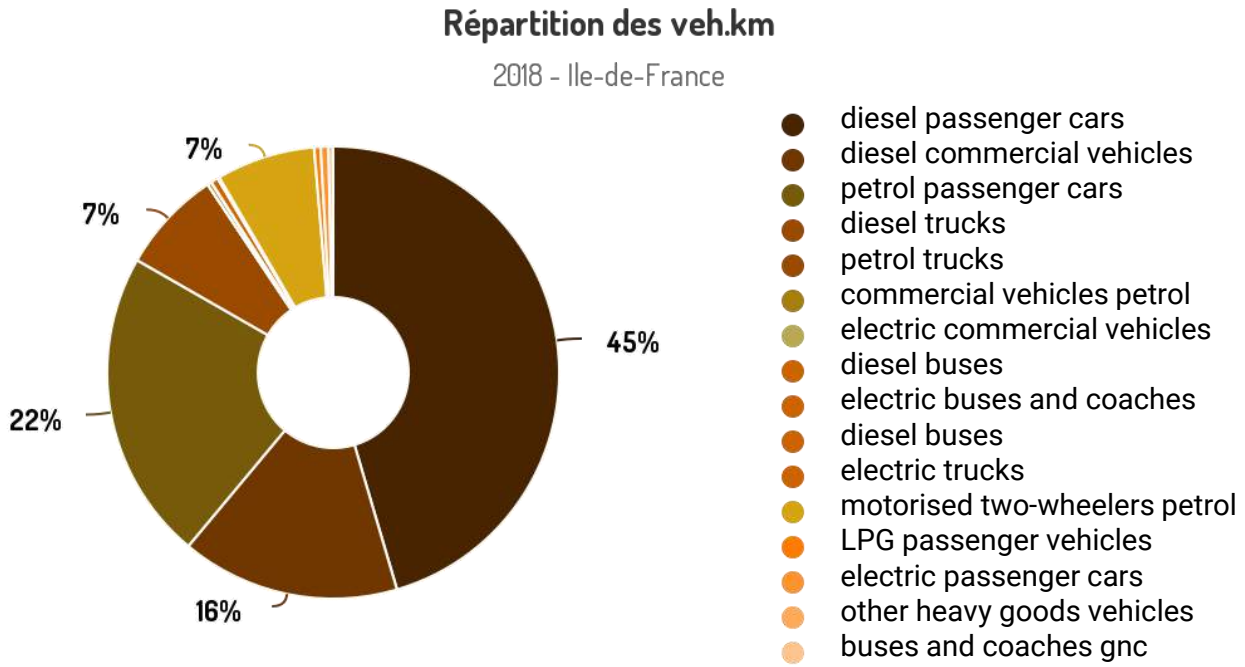
Conclusion on traffic emissions in Île-de-France

- **Emissions have fallen sharply** thanks to **technological developments** and increasingly strict **regulations** on vehicle emission standards.
- Traffic remains a **major source** of air pollution.
- **Health issues** *(IARC: particles and gases from diesel vehicles are classified as definite carcinogens; particles and gases from petrol vehicles as probable carcinogens).*
- And **climate** *(technological improvements in vehicles having little impact on their CO2 emissions).*

Factors influencing road traffic emissions: fleet composition, speed, congestion

- **Static fleet:** number plate file
- **Rolling stock:** kilometres travelled by vehicles according to their type
- Necessary to determine actual road traffic emissions

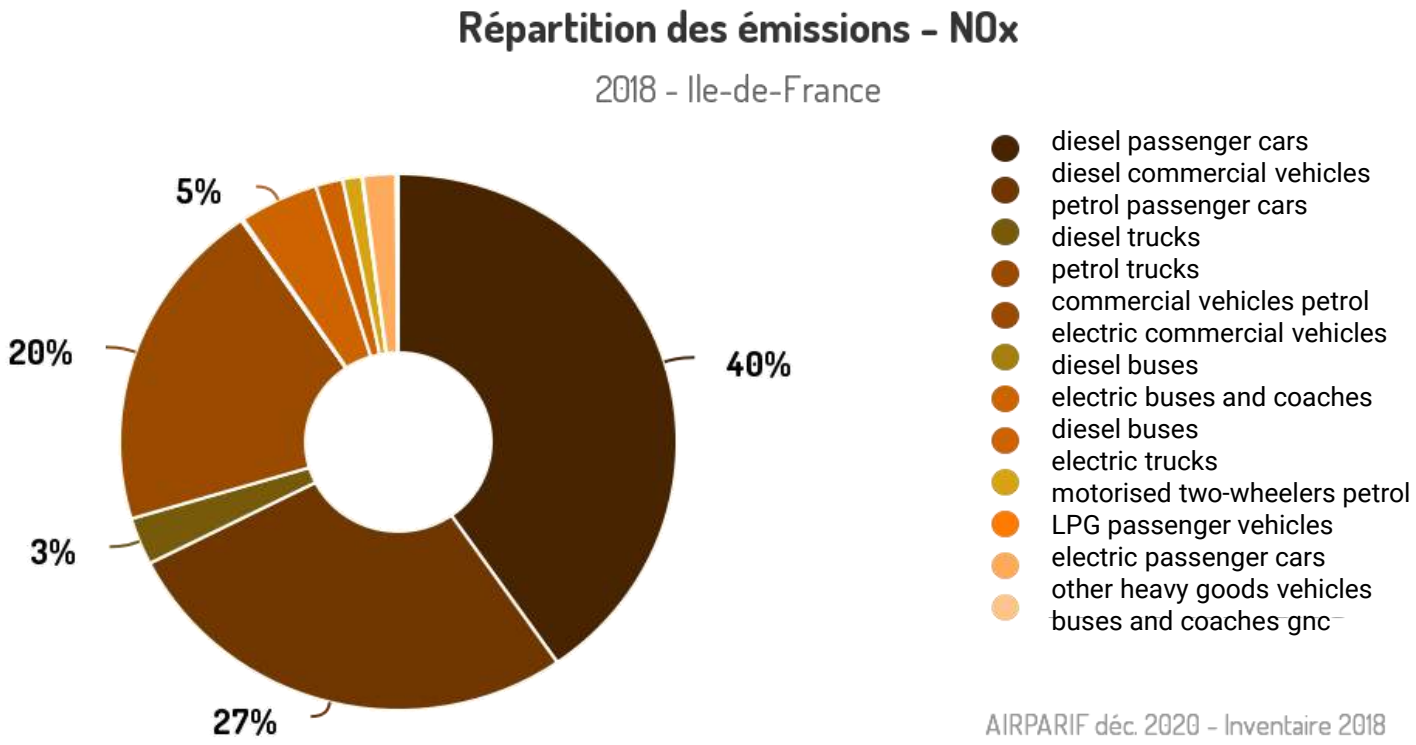


Factors influencing road traffic emissions: fleet composition, speed, congestion

Nitrogen oxide (NOx) emissions

Diesel vehicles (VP + VUL + PUL) :

- 68% of the fleet
- 87% of Nox emissions

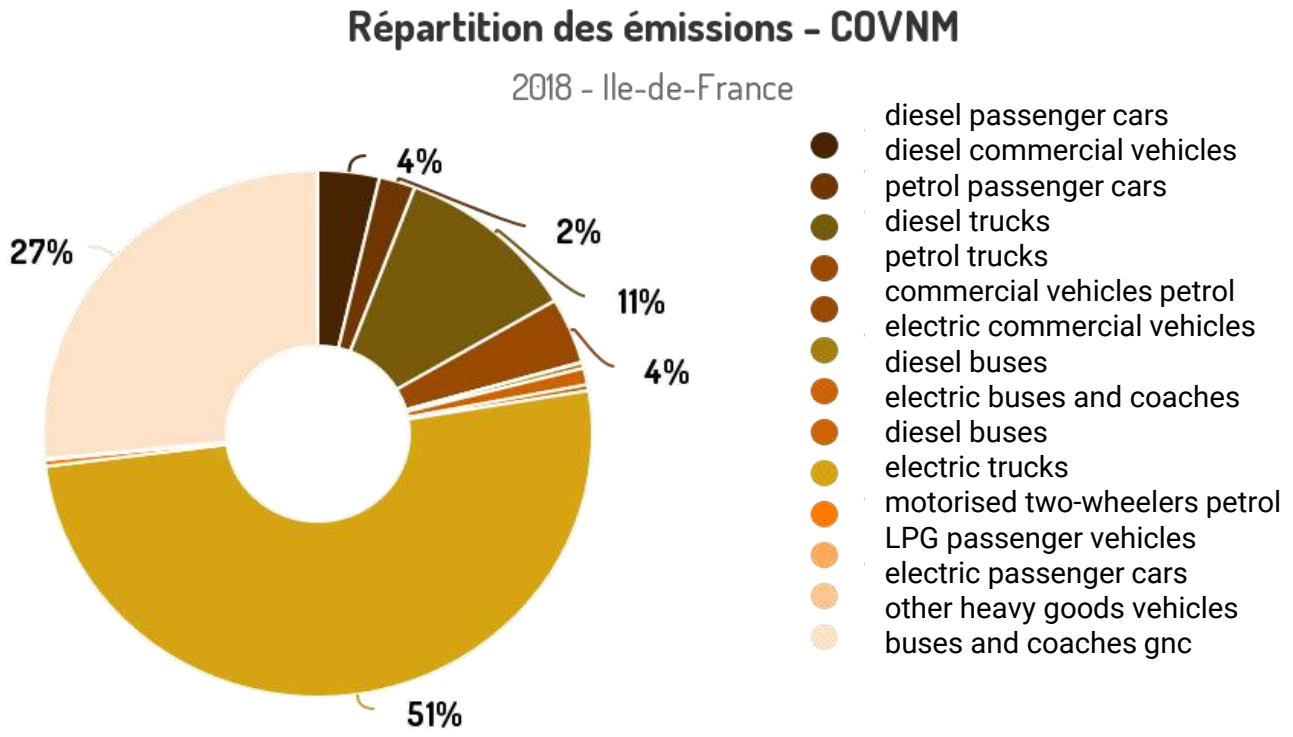


Factors influencing road traffic emissions: fleet composition, speed, congestion

Emissions of Volatile Organic Compounds

Motorised two-wheelers

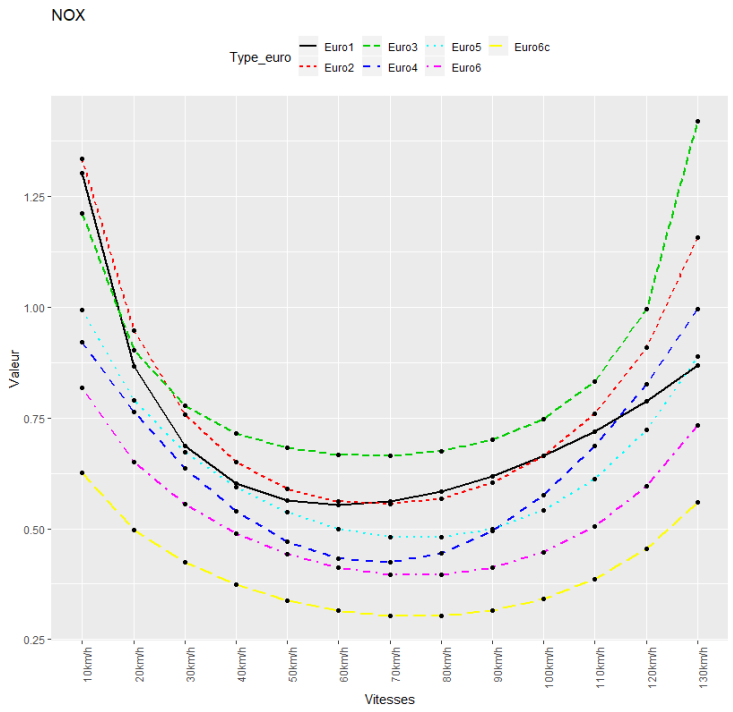
- 7% of the vehicle fleet
- 51% of NMVOC emissions (excluding evaporation)



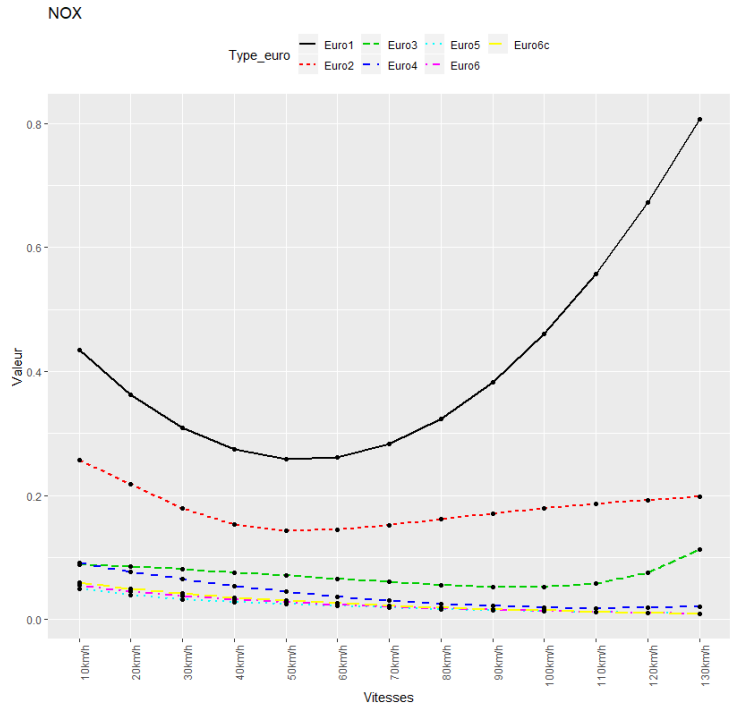
Factors influencing road traffic emissions: fleet composition, speed, congestion

Impact of speed on emissions (NOx)

- For diesel cars, speed impacts emissions in a bell-shaped pattern, with an optimum of around 75km/h :
- Between 130km/h and 70km/h, a decrease in speed leads to a decrease in emissions
- Below 70km/h, a decrease in speed leads to an increase in emissions
- For petrol cars, the bell-shaped profile is only found for the oldest vehicles (Euro 1); emissions from more recent vehicles are less affected by speed.



VPD



VPE

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Factors influencing road traffic emissions:

fleet composition, speed, congestion

Impact of congestion on emissions

- Less traffic flow leads to higher **emissions** of air pollutants (and GHG):
  - **Decreased speed** (from 75 km/h)
  - Increased **deceleration and acceleration** cycles
  - **Cooling** of engines...
- All these phenomena combine, and it is therefore **difficult to quantify precisely** the excess emissions linked to congestion.

Source : ADEME 2014

Conclusion on the factors influencing emissions

- Traffic emissions in urban areas depend directly on the number and type of vehicles on the road, but also, in a more complex way:
- **The average speed**
  - This impact differs depending on the type of vehicle, the fuel used, and the pollutants considered.
- **Congestion**
  - It is difficult to quantify this impact because many factors come into play

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Exposure of the inhabitants

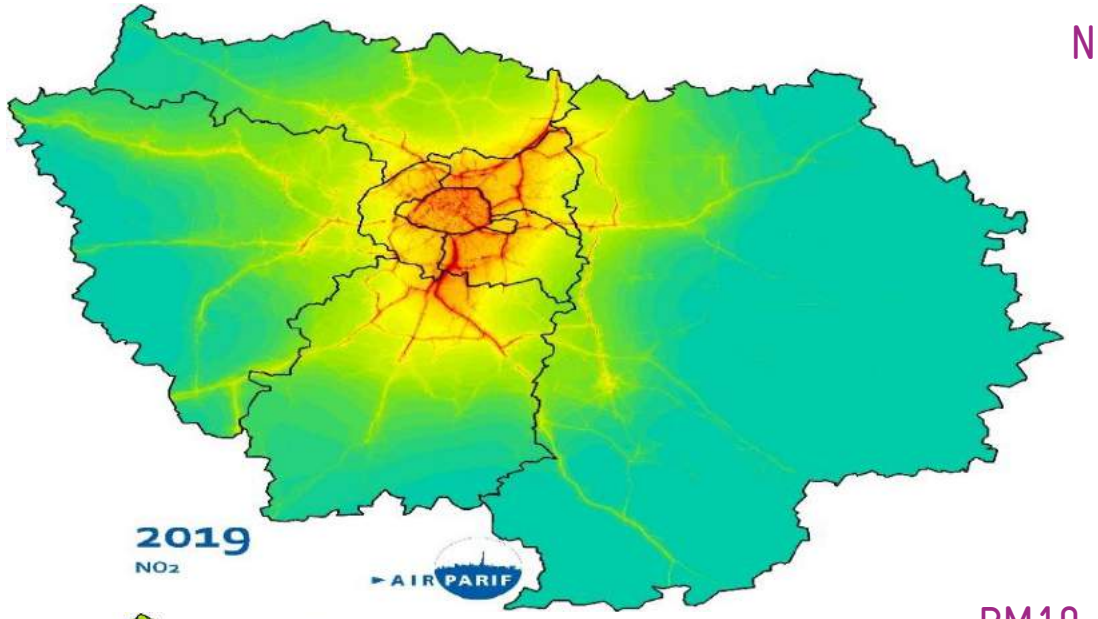
The road network stands out on the pollution maps:

- NO2 (tracer of road traffic)
- PM10 (even though there are many sources)

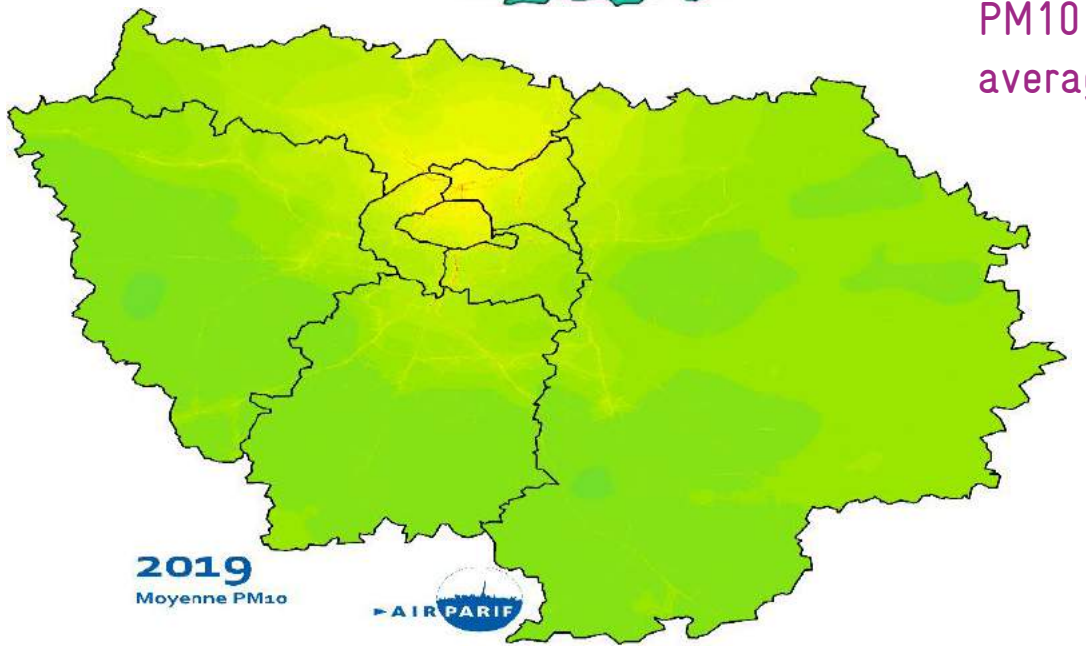
Near major roads, NO2 concentrations are 5 to 6 times higher than WHO recommendations.

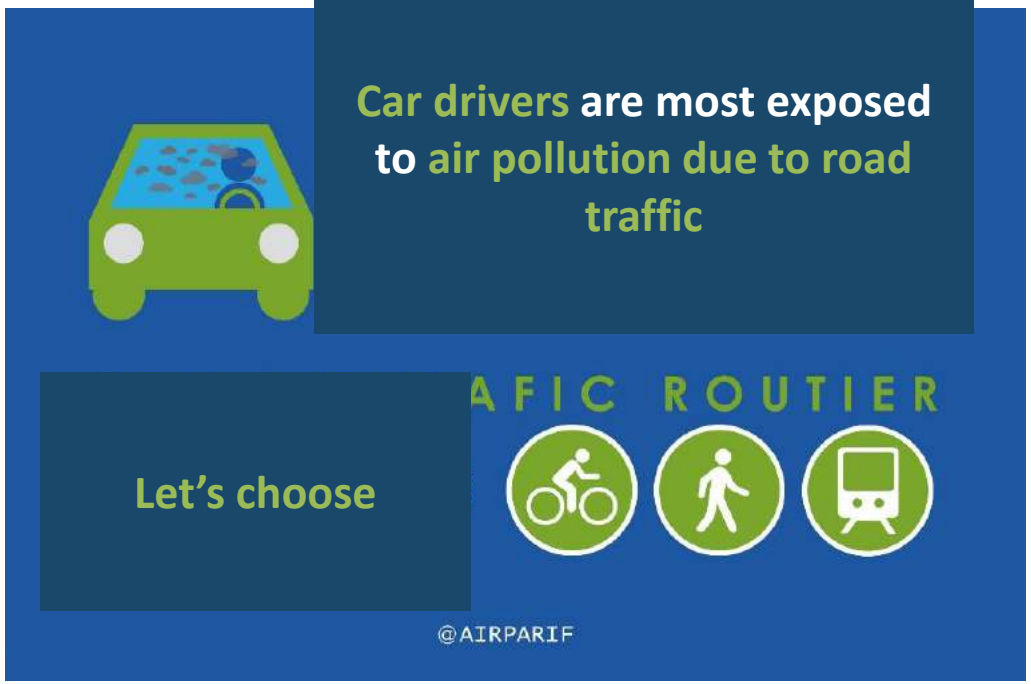
Some areas near traffic exceed the binding limit values (EU litigation).

NO2



PM10 average





Exposure of the inhabitants

Individual exposure varies according to where people live, but also according to the modes of transport used:

Car drivers are most exposed to both PM and NOx

Pedestrians and cyclists are more protected as they move away from the traffic flow

Particulate pollution issue in underground rail networks (metro).

Conclusion

- The contribution of road traffic to air pollution depends strongly on
    - The **number of vehicles** on the road
    - The **composition of the vehicle fleet** (type, fuel, age, etc.)
    - **Traffic conditions** (speed, congestion, etc.)
- The composition of the vehicle fleet leads to specific problems from one territory to another:
- Large proportion of **2RM**: issues related to **VOC** emissions
- Older vehicles, use of **sulphurous petrol**: issues related to **SO2, CO, benzene emissions...**
- **Accordingly, adapt air quality monitoring**

5

Break and Poll

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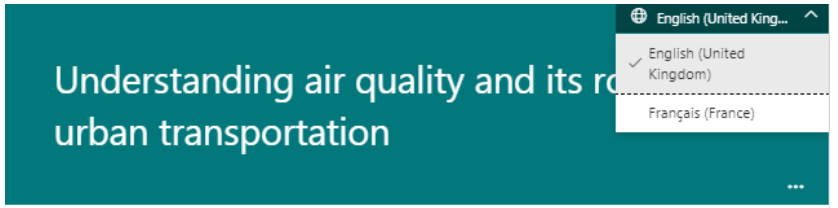
Break and Poll

- **Where are you from?**
- **Do you know if air quality is a priority for citizens in your context?**
- **Does your city monitor air quality?**
- **If not, will it become important in the future?**

→ Check the chat for instructions

Choose your preferred language in the top right corner of the form



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6

Air quality and transport

Data and tools for diagnosis

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Data and tools to be mobilised

To establish a diagnosis of air quality, different tools can be used with different advantages/disadvantages and degrees of reliability:

- Concentration data (pollution levels): spatial and temporal variability, hot spots, problematic pollutants...
  - Measuring stations
  - Modelling
  - Micro-sensors
  - Satellite data...
- Emissions data (discharges into the atmosphere): main emitting sectors -> which levers to use to improve air quality
  - Emissions inventory
- To know precisely the contribution of transport to pollution :
- Data on concentrations in the vicinity of roads
- Input data for the transport emissions inventory :
  - Fleet composition
  - Travel survey
  - Counting loops...

Monitoring air quality

High temporal and spatial **variability** of pollution levels and sources.

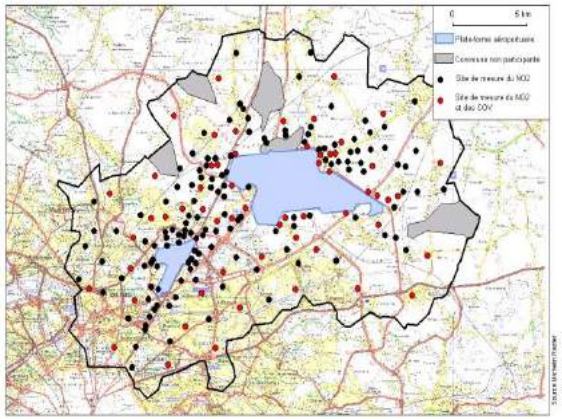
- A monitoring scheme should be able to characterise air pollution for :
- Different **environments**
  - Background pollution (far from sources) / proximity pollution (around roads)
  - Hot spots (transport infrastructures, industries, airports...)
  - Individual exposure
- Different **pollutants**
  - Pollutants regulated for their effects on health and the environment
  - Emerging pollutants (ultrafine particles, pesticides, etc.)

Monitoring system

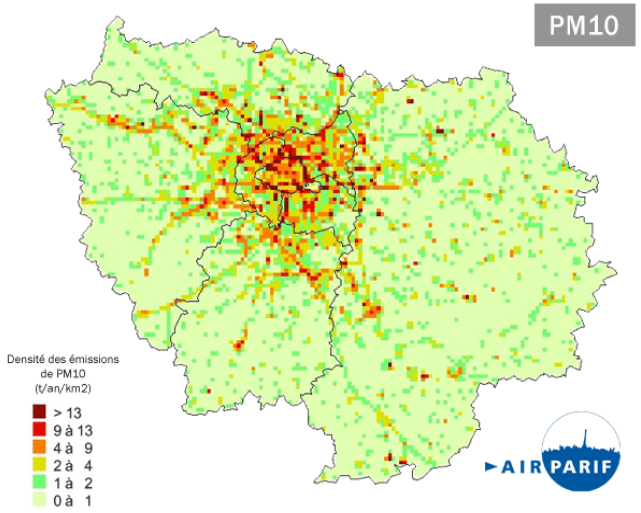
3 complementary tools for different environments and pollutants

Measure stations

Modelling and emission inventory



Measurement campaigns



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Monitoring system

Network of fixed stations

- Produce **baseline data** on pollution levels
- Monitor **pollutants of concern** in the territory
- **Several typologies** to characterise different environments:
  - **Background stations*** (urban, suburban or rural)
  - **Proximity stations*** (near road traffic)
  - **Industrial stations*** (near industrial/artisanal activities)

Network of Airparif stations

70 stations spread out over 12 000 km2

* European classification. Other classifications exist.

Monitoring system

Tailoring a measurement network according to the objective

The Airparif network is 40 years old... and has been built up little by little.

A few reference stations can constitute a solid base for a measurement network:

Representativeness of sites and typologies

Attention paid to equipment maintenance and data processing

Possibility of coupling fixed stations to other tools:

- Passive tubes (NO2, SO2): low-tech, low-cost and reliable tool
- Micro-sensors: in full development; not so low-cost, reliability issues (see below)
- Always using station data as reference data.

Passive tubes

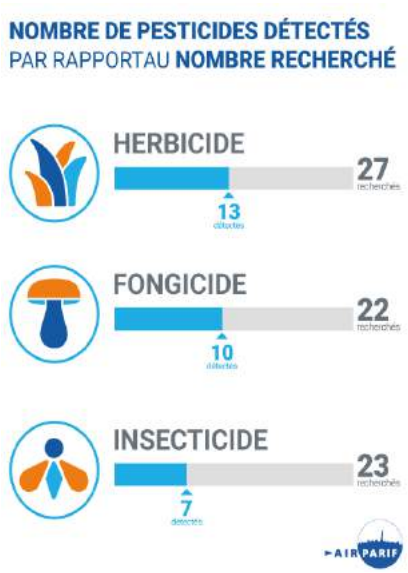
Mini-stations

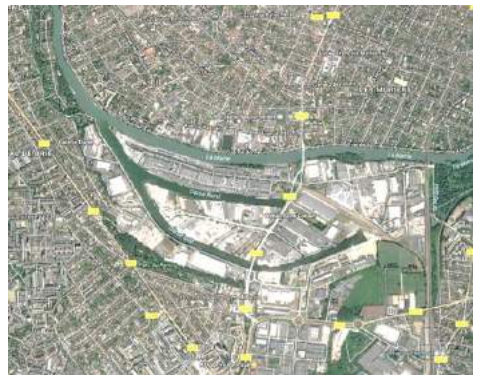
Micro-sensors

Monitoring system

Measuring campaigns

- Measuring **non-regulated pollutants** (e.g. pesticides)
- Assessing **individual exposure** (e.g. cycling)
- Assessing the impact of a road **infrastructure**, an **industrial site**, an airport platform, etc.
- Consolidate **models**
- Prior to the creation / extension of a network of stations to **validate the location of sites.**





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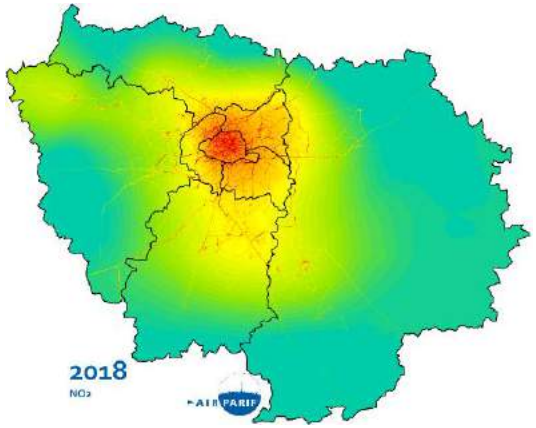
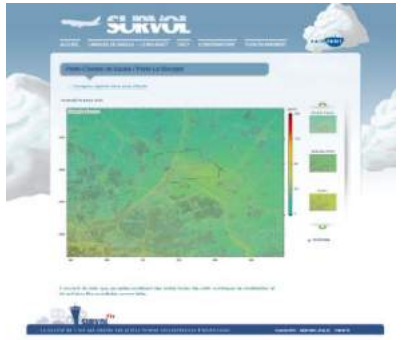
Monitoring system

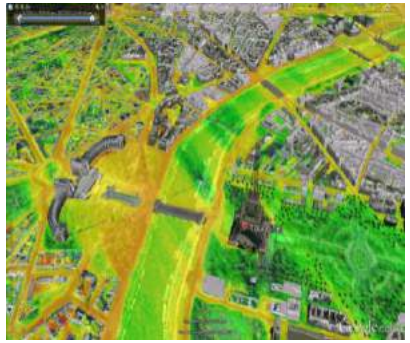
Modelling tools

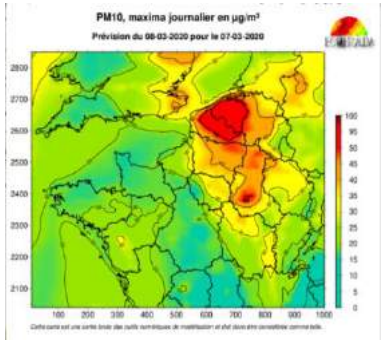
- Produce air quality **maps**
- **Forecasting** air quality (pollution episodes)
- **Assessing the impact** of projects or action plans
- Test **scenarios**
- **Different tools, scales, degree of accuracy, depending on the needs**

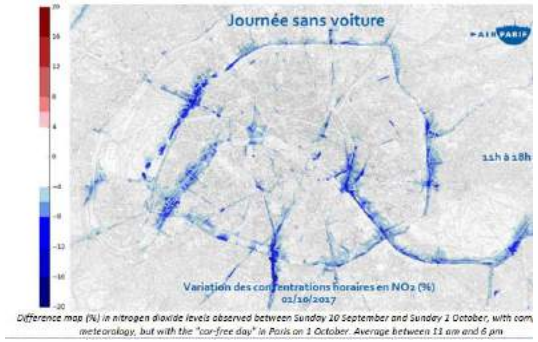


Hourly mapping of concentrations
25 x 50m grid









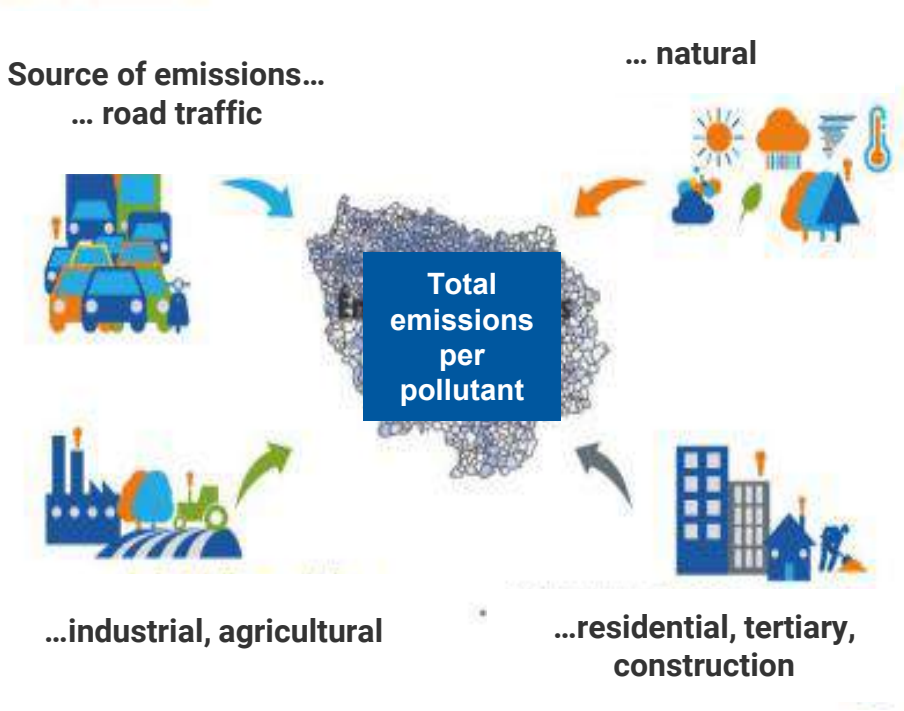
Impact of Car Free Day on NO2 concentrations

Monitoring system

Emissions inventory

- Determine the respective **contribution** of the sectors to pollutant / GHG **emissions**
- Identify priority **levers for action**
- **Evaluate the effectiveness** of public policies / regulations / action plans (e.g., fuel regulations, fleet renewal)

NB: the emissions inventory is an essential input data for modelling.



More or less extensive inventory:

- Spatial resolution
- Temporal resolution
- Sectors considered
- Pollutants considered
- Methodology used (tier 1/2/3, bottom-up / top-down)

Monitoring system

Micro-sensors

- Advantages: **cost of purchase, portability**, ...
- Attention to: **data reliability**, maintenance costs, lifetime, **skills** needed (metrology, IT...), ACT...
- **AIRLAB challenge**: test the performance of micro-sensors for different uses and environments.
  - Metrology tests (accuracy and reproducibility of data)
  - Field deployments
  - Results available online (http://www.airlab.solutions/fr/actualites/r%C3%A9sultats-du-challenge-airlab-microcapteurs-2021)

ADEME
AGENCE DE LA TRANSITION ECOLOGIQUE

AFD

AIRLAB
SOLUTIONS POUR NOTRE AIR

MICROSENSOR CHALLENGE EDITION 2021

To challenge and to compare different microsensors to help the choice for users, in complete independence

Test of microsensors in real conditions

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Monitoring system

Integrating microsensors into a monitoring network: recommendations

- First question: What use and what purpose?
- Choose the sensor according to its performance by use and by pollutant
- Do not disseminate data in real time (except for public awareness projects): data processing is necessary before use and publication
- Always have reference measurements (fixed stations, passive tubes) for functional tests

NB: in the current state, micro-sensors cannot replace a regulatory measurement network.

- Perform pre- and post-deployment tests (reference station, calibration laboratory):
  - Performance tests (at least on a sample) and identification of faulty devices
  - Calibration of the devices
  - Control of deviation over time
  - Access to raw data (for correction)

Monitoring system

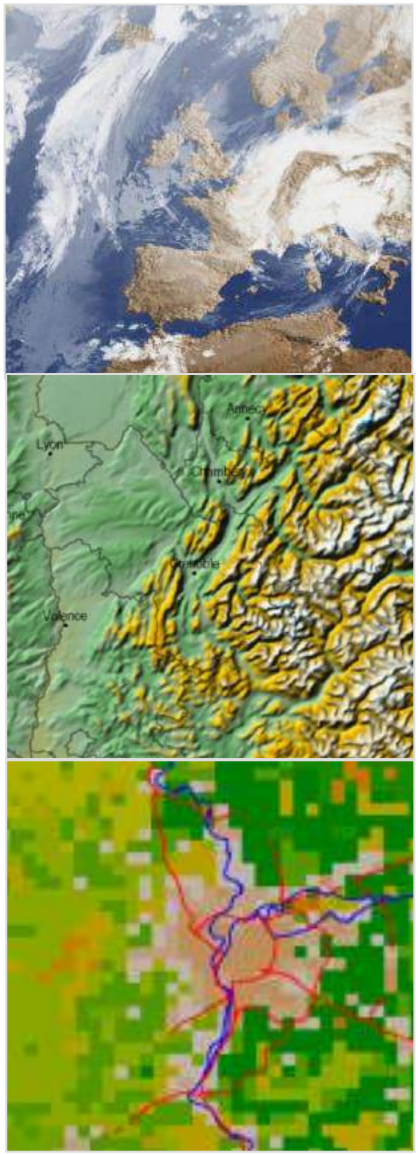
Satellite data

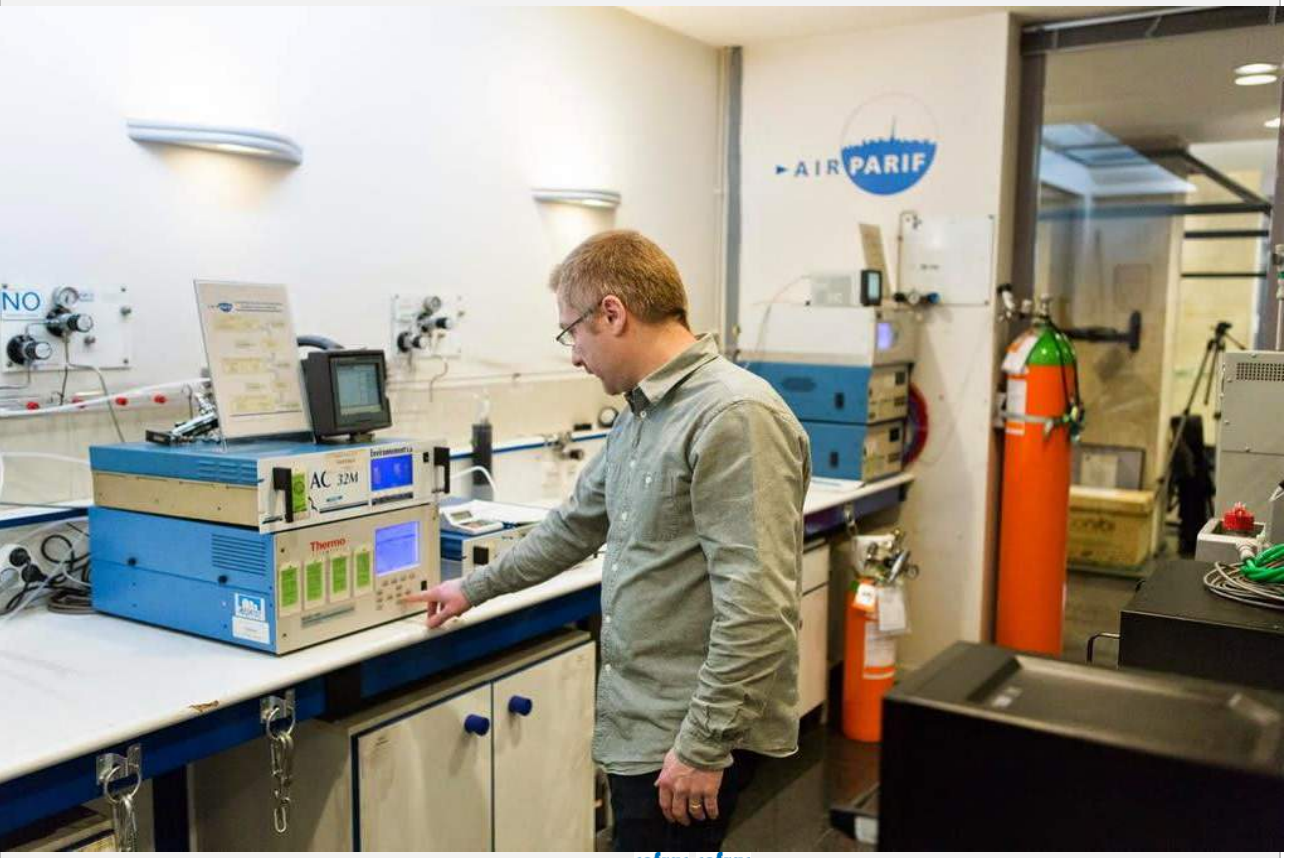
Available data:

- Input data (modelling): **weather, topography, land use**
- **Monitoring of smoke plumes** (volcanoes, forest fires...) and **specific sources** (shipping)
- Macro data: pollution **transport**, temporal **evolution**

Limits :

- **Spatial resolution** too large for urban application (several km)
- No **temporal continuity**
- Lack of **precision** (data integrates the whole atmospheric column)
- Problem of **cloud cover**
- **Cost** of data





Monitoring system

Data processing

The **reliability of the data** is crucial because it is used by all:

- Decision-makers (regulation, action plans, litigation...)
- Media
- Citizens
- Companies...

To guarantee reliable data:

- Calibration Laboratory
- QA/QC procedures & certifications
- Model evaluation

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Monitoring system

Communication and public information

Multiply the channels to make the data easily accessible to all:

- Media (TV, radio, press...)
- Social networks
- Website + mobile application
- Local relays (municipal notice boards)

Educate and raise awareness of air quality issues among residents to change behaviour.

International projects: Hanoi

Supporting municipal authorities

Developing local skills in the management of a measurement network:

- Sampling plan
- Typology of stations
- Pollutants measured
- Improvement of maintenance

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International projects: Dakar

Increasing the competence of the Air Quality Management Centre (AQMC)

Support the improvement / extension of the existing measurement network:

- Maintenance of equipment
- Validation of future station sites
- Integration of micro-sensors with calibration on reference stations

International projects: Sri Lanka

Technical Assistance for the Ministry of the Environment

Supporting the development of the Ministry's air quality management teams

- Deployment of a measurement campaign to prepare the extension of the network
- Training in data maintenance and management
- Support for communication on air quality data
- Support for the construction of an emissions inventory (Tier 1)

Conclusion

An air quality monitoring network is built step by step.

Several building blocks are essential:

- One/**reference stations** to produce reliable data and calibrate the rest of the network;
- A reproducible methodology to select **representative sites**;
- Solid procedures for equipment **maintenance** and **data validation/correction.**

Once these building blocks are in place, the network can be completed by additional tools depending on the objectives pursued:

- **Modelling** tools (mapping, forecasting, assessment)
- Emissions **inventory**
- **Micro-sensors...**

Case Study 2

Implementation of tools for air pollution control in Yaoundé, Cameroon

Communauté Urbaine de Yaoundé

DVDH

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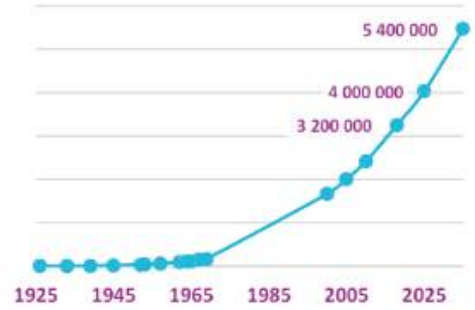
Yaoundé, a forward-looking metropolis



- Political capital of Cameroon
- Rapid population growth from 3.2 million in 2017 to 5.6 million in 2035
- At the crossroads of the country's main highways
- Mainly tertiary economic activities (central administration, headquarters, shops)

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The Sustainable Urban Mobility Plan (Diagnostic 2018)

An alarming observation...

The mobility system is inefficient:

①

- the majority of people travel by collective taxis or motorbike taxis, which are slow, and unreliable, and more or leprivate car and motorbike users are stuck in congestion;
- ss comfortable;
- many people are forced to make long daily journeys on foot on uncomfortable (or not) pavements.

Mobility is expensive for the user, and the government.

② ,

- and is not efficient from an economic point of view:
- trips in collective taxis cost 200 to 300 FCFA, in motorbikes 100 to 500 FCFA;
- STECY is loss-making, with very few buses to impact mobility;
- cars stuck in congestion consume a lot of fuel unnecessarily.

The mobility system is polluting and dangerous.

③

- it consumes a lot of energy and produces greenhouse gases (GHG)
- it pollutes the atmosphere and makes the inhabitants sick;
- It is not safe, especially for pedestrians and motorbikes.

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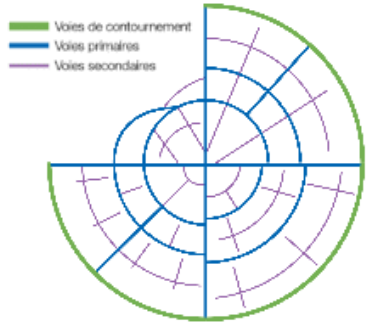
The Sustainable Urban Mobility Plan (Diagnostic 2018)



... which determines the strategy of the SUMP

① **Develop the road system, treat certain crossroads and create bus lanes** to improve traffic conditions, particularly

- taxis, which are the main mode of transport in Yaoundé, with more than 2 million trips per day
- walking, with the creation of safe pavements.

② **Reduce the cost of mobility borne** by households:

- redefine the public transport offer and achieve a small balance with a unit cost of the bus ticket at 200 FCFA;
- modernise the collective taxi sector by encouraging a switch to large taxis with greater capacity, greater comfort and less energy consumption per person transported;

③ This new mobility system will **improve the quality of life in the city,** with less dangerous roads, fewer accidents and less air pollution.

Mobilise Your City

The Sustainable Urban Mobility Plan (Outlook 2035)

Action plan

Business-as-usual scenario: foreseeable degradation

Alternative scenario: road development, hierarchical public transport network, improvement of junctions, professionalisation of small-scale transport, strengthening of governance

- 340,000 daily public transport journeys (compared to 140 without reinforcing the network)
- 25 min reduction in travel time compared to the run-of-river scenario
- 11% reduction in GHG emissions compared to the business-as-usual scenario

The Sustainable Urban Mobility Plan

7 major projects underway with 4 objectives

Improve traffic conditions

- Development of crossroads and bus stations (Yaoundé Cœur de Ville)
- Studies of the bypass road
- Project for the Development of Inclusive and Resilient Cities (PDVIR)

Develop the different transport offers

- TCSP TransYaoundé
- Informal transport reform

Improving the governance of mobility

- Capacity building of CUY agents in the framework of Yaoundé Cour de Ville
- ATCUDY: Setting up a Mobility Organising Authority, a mobility observatory and an urban planning agency

Reducing air pollution

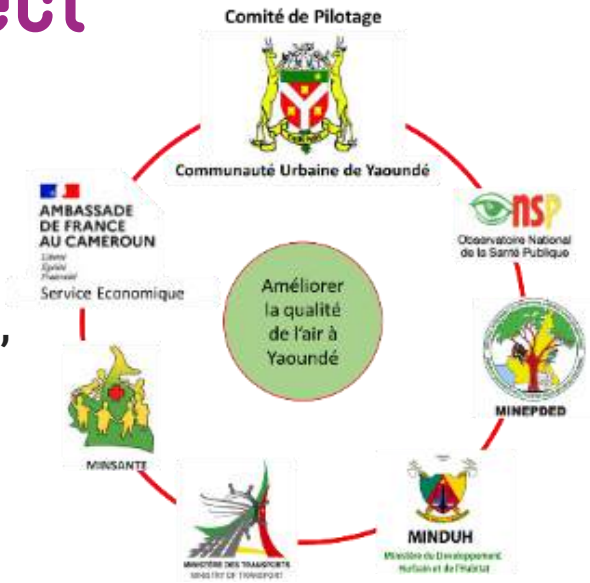
- Implementation of air pollution control tools

Partners: French Development Agency, World Bank, French Ministry of Economy, European Union

Organisation of the air quality project

One initiative

- From the **Communauté Urbaine de Yaoundé** (CUY),
- Financed by **French Ministry of Economy, Finance and Recovery (FASEP),**
- Piloted by an **interministerial committee** involving the Cameroonian ministries of health, environment, transport and urban development
- Implemented by a **group of French and Cameroonian experts**



DVDH
DES VILLES ET DES HOMMES

DVDH
Consultancy firm specialising in advising local authorities on sustainable land use and urban mobility

ATMOTRACK

AtmoTrack
Supplier of air pollutant microsensors and air quality monitoring systems

Inserm

INSERM
French public institute dedicated to biological, medical and human health research

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3-step Methodology

Diagnosis of the air pollution and health situation

- Deployment of sensors
- Interpretation of pollution measurements
- Identification of pollutant sources
- Health surveys

Action plan

- Development of an action plan
- Development of a decision-making tool
- Development of an information and awareness-raising tool for the general public

Implementation of the first actions and evaluation

- Tactical planning operation
- Evaluation of effects
- Sustainability
- Practical guide to replicability

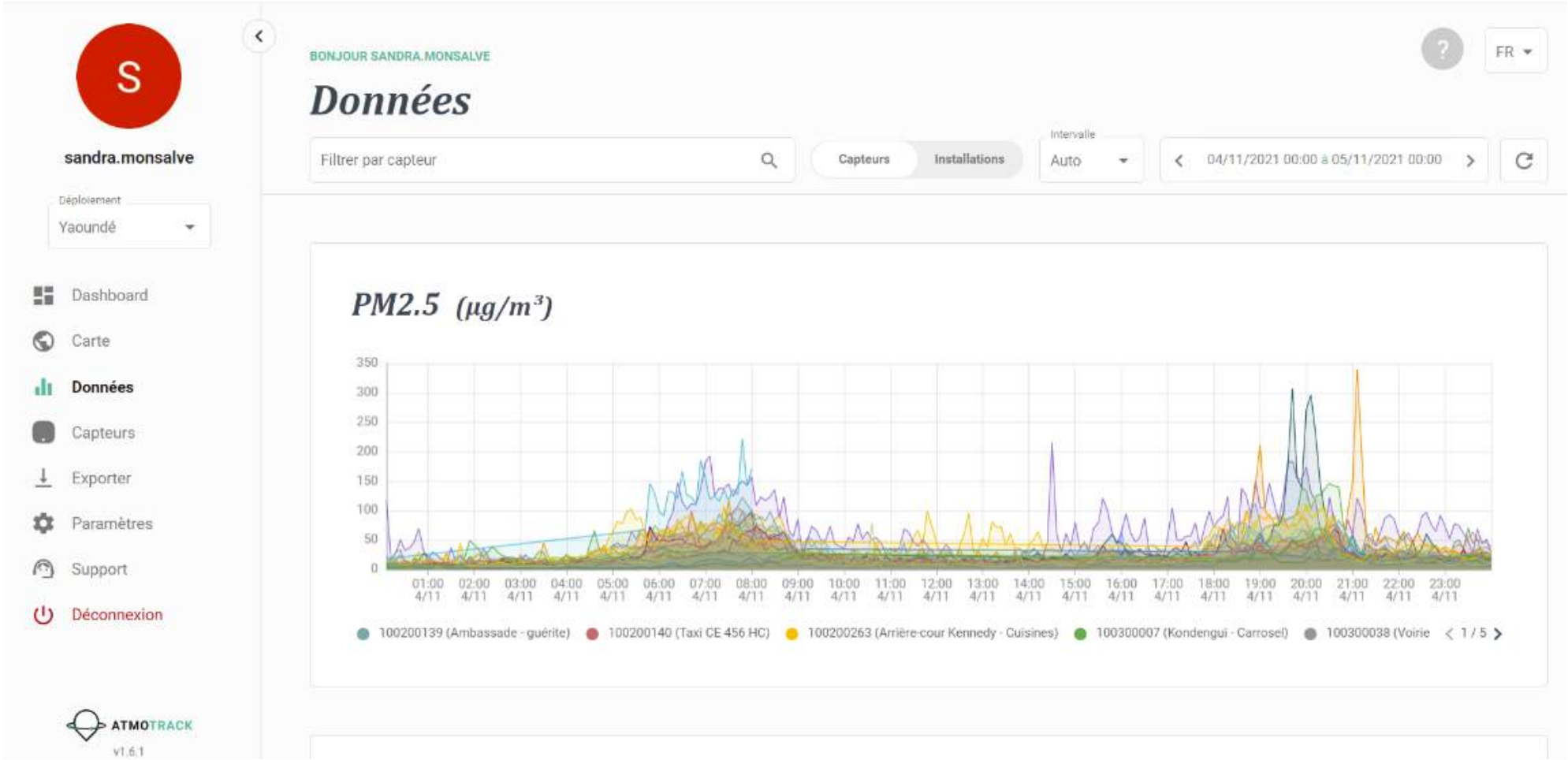
Equipment deployed in the field

Innovative fixed and mobile micro-sensors to form the city's first air quality measurement network:

- 29 Atmo01 (on buildings, taxis and minibuses) measuring PM2.5 and PM10
- 8 Atmo02 (on lampposts) measuring PM2.5, PM10, NO2 and SO2

+ a speciation study to determine the composition of the particles

Computer interfaces



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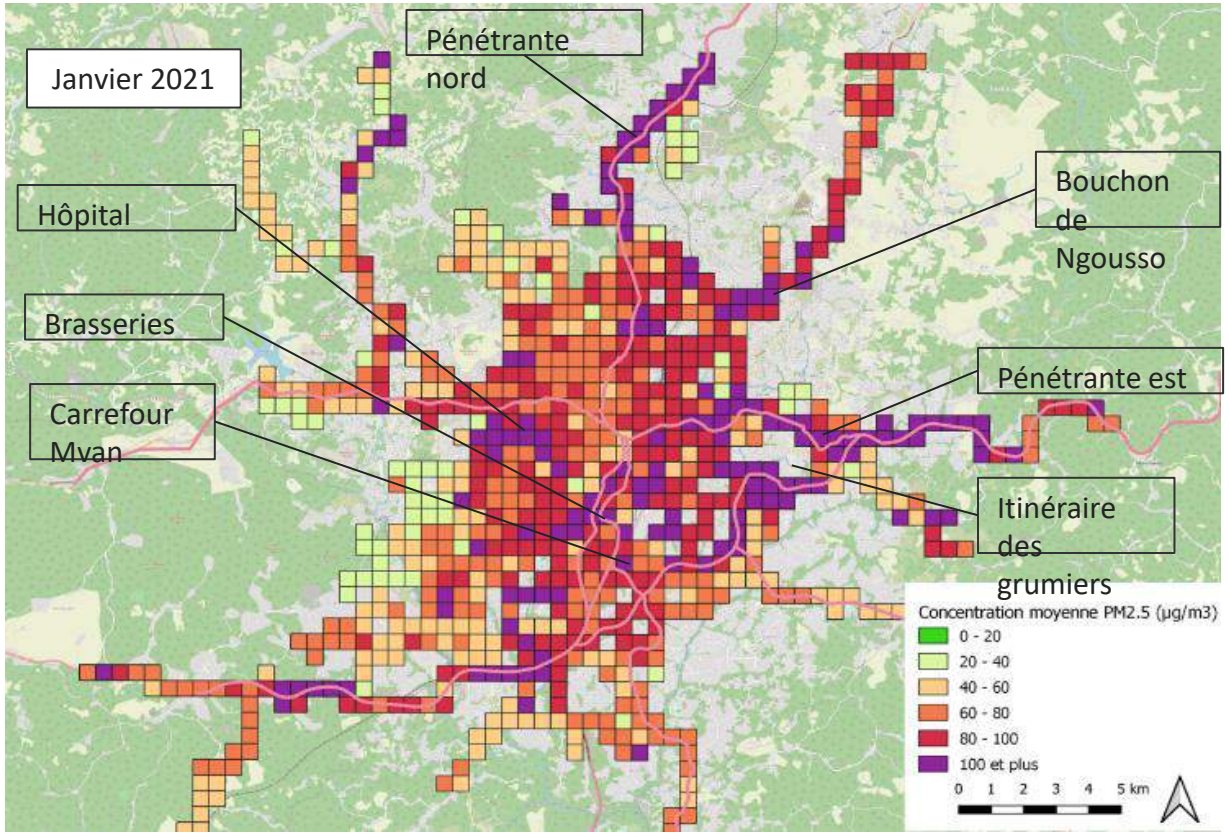
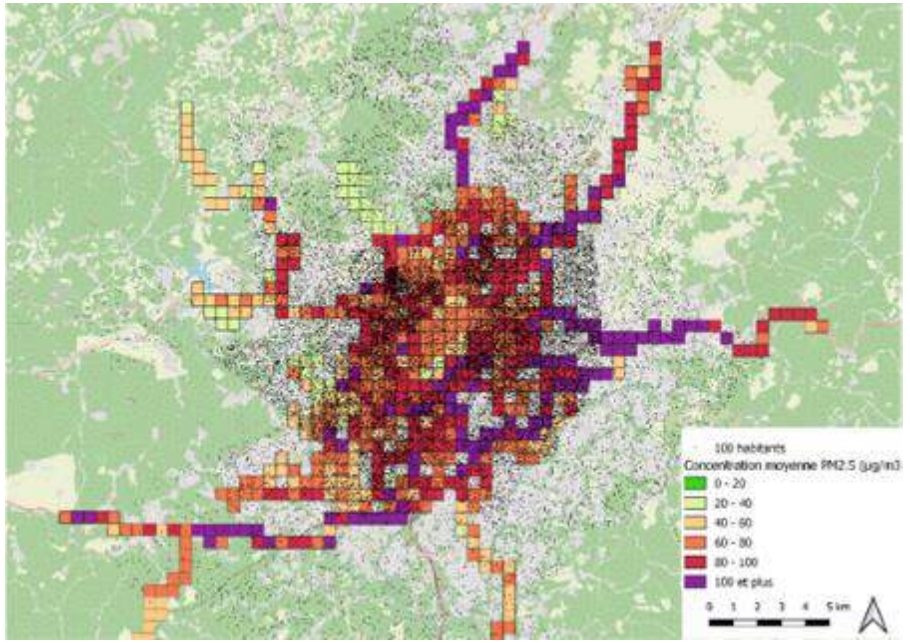
Data interpretation

Mapping of results averaged by period (month, week, etc.)



Cross analysis with other information such as road network, population density, waste collection, etc.



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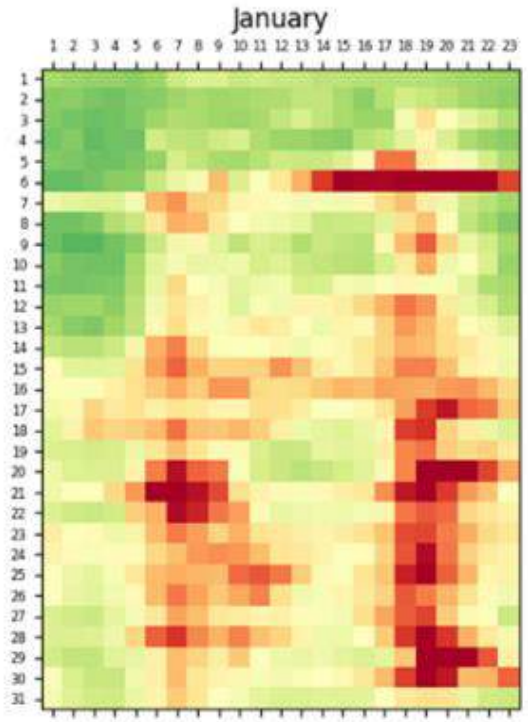
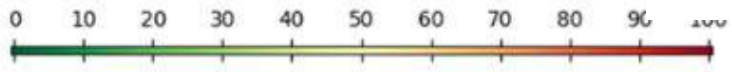
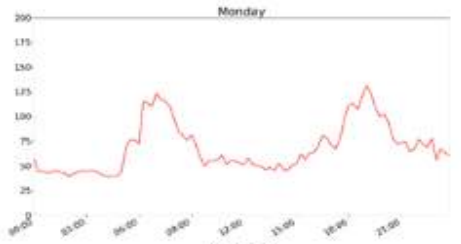
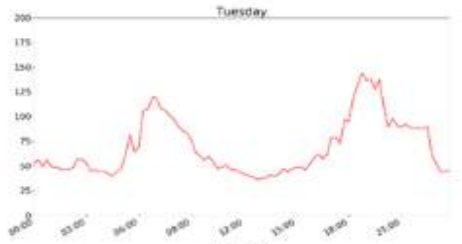
Data Intepretation

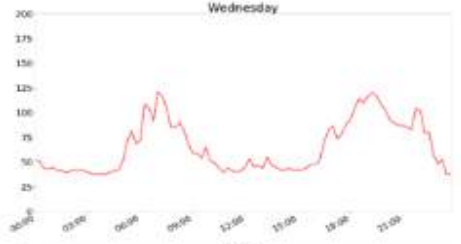
Strong correlation between peak traffic hours and the average fine particle level in the city

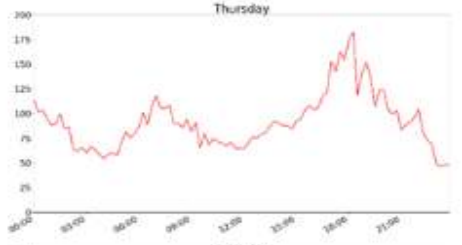


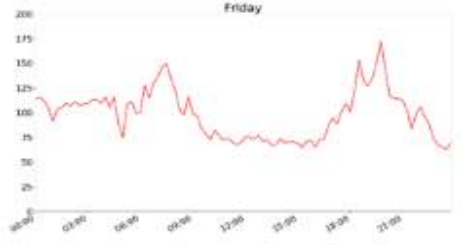


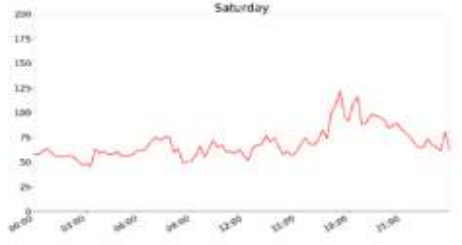


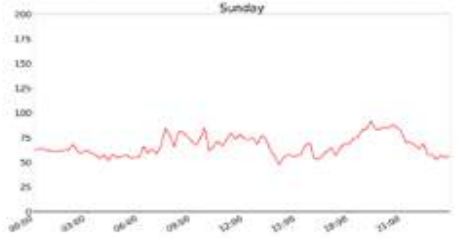












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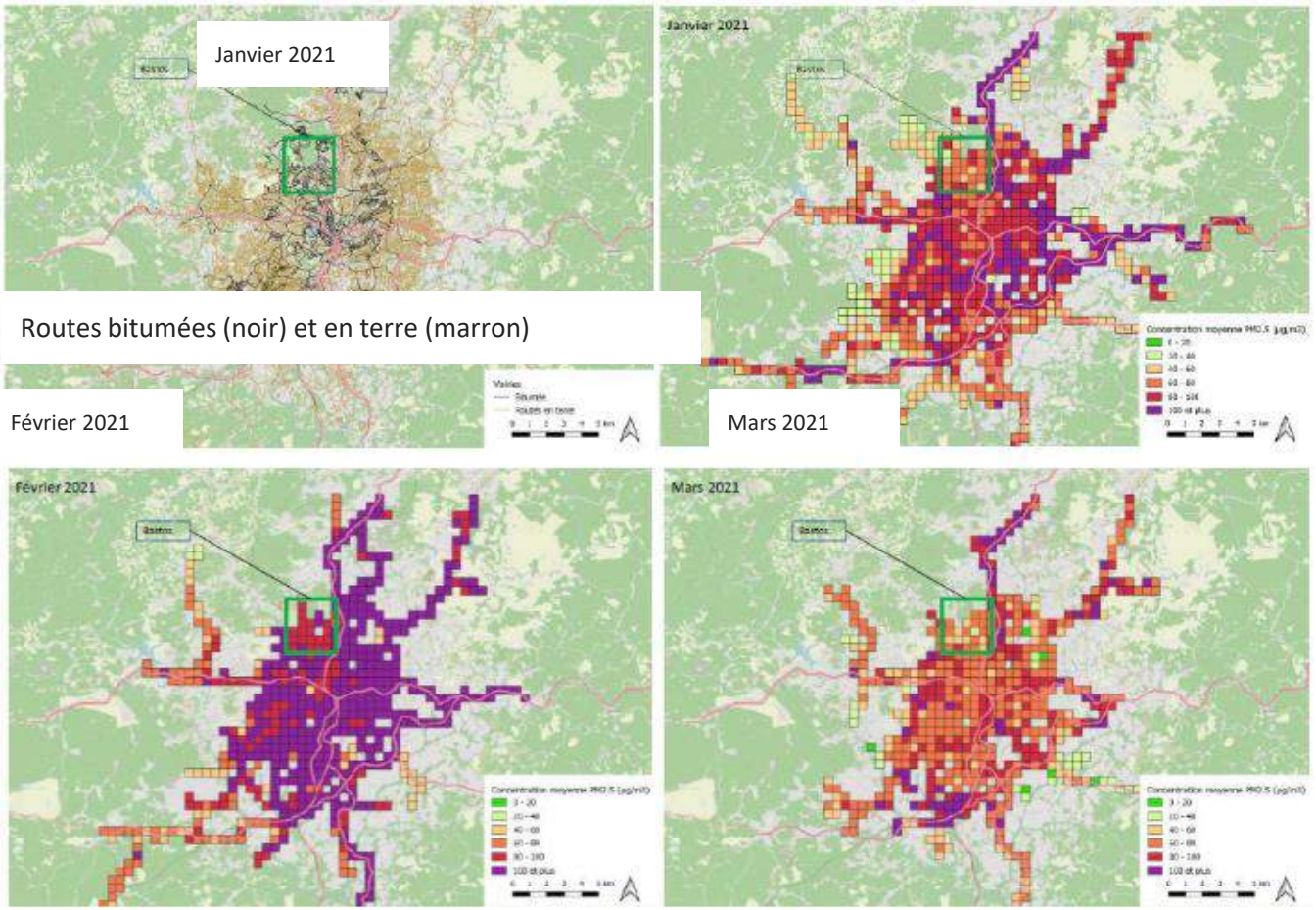
Data interpretation



Correlation between road type (dirt road or asphalt) and concentration of fine suspended particles

Mobilise Your City

Identified pollution sources and action plan

Regulatory, fiscal and governance measures

Traffic (emissions, wear and tear and resuspension)

- Improving fuel quality
- Measure vehicle emissions during roadworthiness testing
- Promote fleet renewal/retrofitting
- Traffic calming in the most vulnerable sites
- Invest in asphalt and road sweeping
- Implement the PMUS action plan

Other human activities: cooking, waste burning, industrial activities, weeding, slash and burn

- Promote less polluting cooking techniques
- Support recycling and improve waste collection
- Establish sectoral standards and monitor their implementation. Promote best practice.

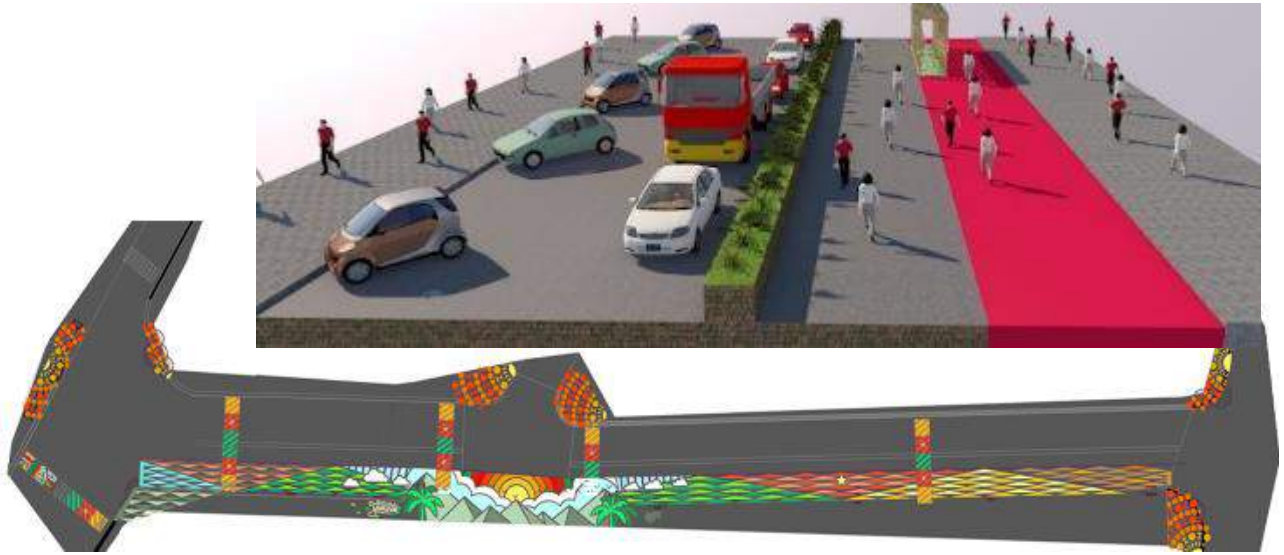
Regional natural phenomena: desert storms

- Create an air quality management unit
- Raise awareness and inform the population

Actors: CUY, ministries, prefecture, boroughs, residents' associations, etc.

Semaines de la qualité de l'air

Piétonnisation et embellissement de l'avenue Kennedy (centre-ville), communication, sensibilisation, consultations médicales



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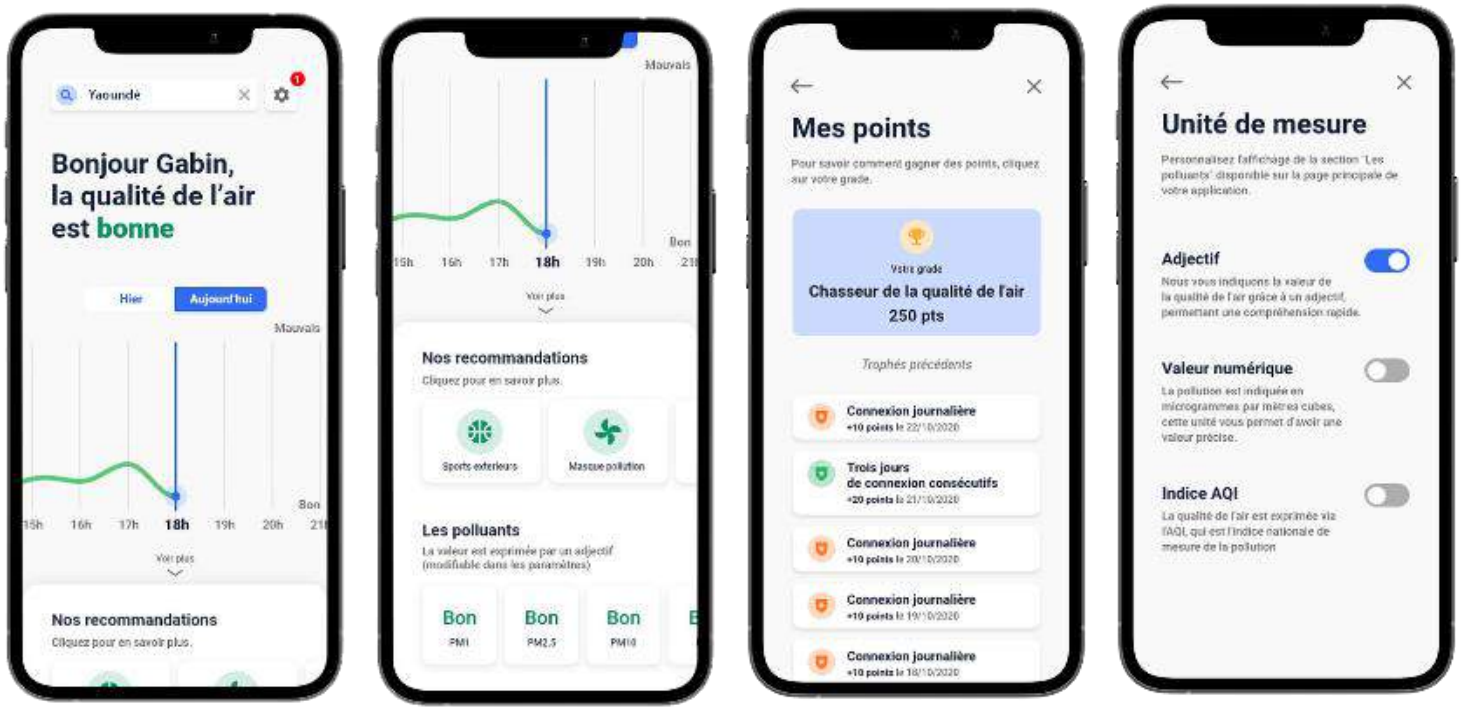
Sensibilisation grand public

caeli
BY ATMOTRACK



Application smartphone Caeli

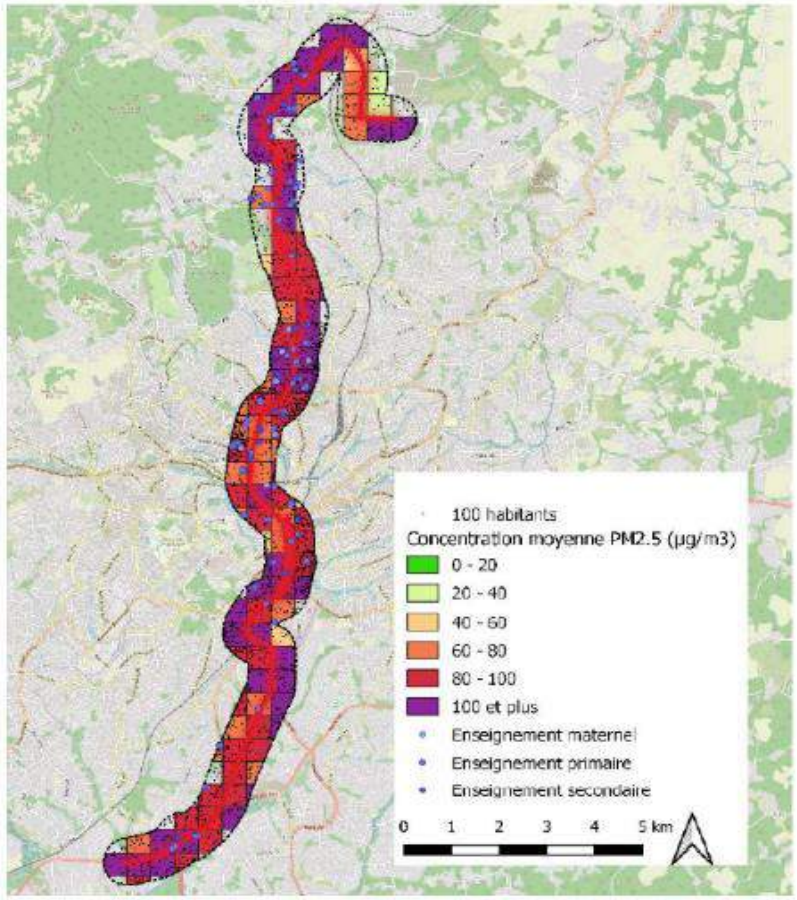
- indicateurs basés sur les mesures en temps réel
- conseils pour ajuster son comportement en fonction du niveau de pollution
- valeurs globales pour la ville, et par quartier

Objectifs : susciter une prise de conscience de la part des citoyens des enjeux de la qualité de l'air sur la santé

Mobilise Your City

Decision support: case study

Analysis of the current pollution level on the future BRT corridor



110,000 passengers per day in old-fashioned taxis -> one of the most congested and polluted roads

The system deployed made it possible to estimate that between January and February 2021, 80% of the population living within 500m of the future BRT was exposed to chronic fine particle pollution (PM2.5) greater than 80µg/m3.

100% of the schools within this perimeter were exposed to PM2.5 pollution above 60µg/m3.

The BRT project will help improve air quality by

- Reducing congestion,
- Providing users with a less polluting transport alternative,
- Contributing to infrastructure improvements along the corridor.

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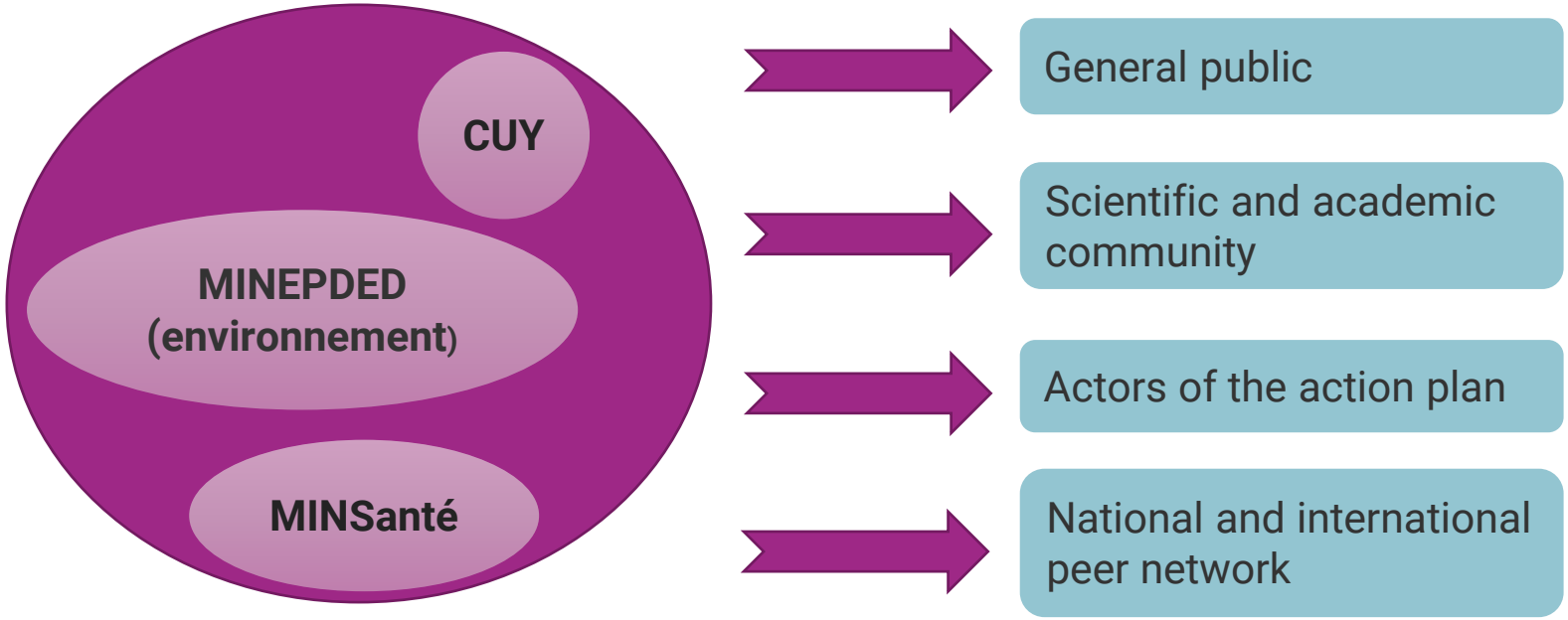
Interministerial Committee for the monitoring of air quality in Yaoundé

- Committee being created to ensure sustainability of the initiative at the end of the project (January 2022)
- Local staff trained in air quality monitoring tools and methods

Tasks

Manage the sensor network
Produce and disseminate data (monitoring the evolution of air quality indicators over time)
Supervise the implementation of the action plan



Questions, Feedback and Farewell?

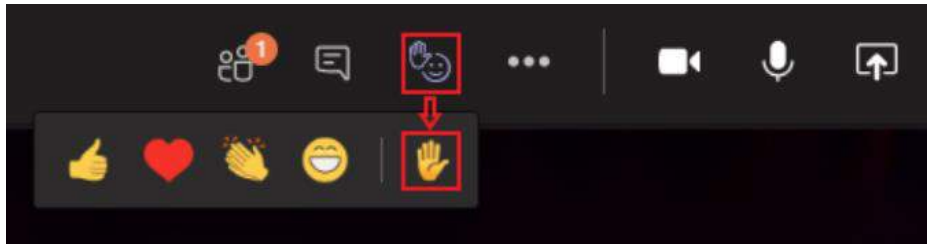
Q&A

Chat

→ Post your questions in the chat and we will include them in the Q&A

Speak

→ Select “Show reactions” in the meeting controls, and then choose “Raise your hand”. Everyone in the meeting will see that you've got your hand up.



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