

Air4EU city assessment for Paris

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City:	Paris	
Research Partner	TNO	Menno Keuken, Martijn Schaap
City Partner	AirParif	Chris Roth and Olivier Sanchez
Other Partners		



1. Known air quality problems

AirParif prepares the Annual Air Quality Report for Ile-de-France region including the greater Paris metropolitan area. It contains the current status of air quality in Ile-de-France/Paris and a description of the main measures to reduce air pollution. The report basically contains two types of air quality maps:

1. background concentrations using monitoring data of urban background sites combined with 1x1 km² emissions data;
2. linear representation of street concentrations using traffic related emissions, geometry of roads and background concentrations as input data

In the case study in the framework of Air4EU, the activities are limited to Paris. Traffic is mainly responsible for high pollutant concentrations in Paris, while the Roissy Charles de Gaulle Airport has been identified as an air quality “hotspot” area near Paris. Especially, NO₂, PM₁₀ and ozone are of concern in Paris for air quality management. The results for 2003 are reported below:

Comp.	Comments	Problem
SO ₂	No exceedances in 2003	No
PM ₁₀	Daily average limits exceeded Yearly average limit exceeded	Yes Yes
NO ₂	Yearly average limit exceeded Hourly exceedances recorded	Yes Yes
Lead	No exceedances recorded	No
CO	No exceedances recorded	No
Benzene	Yearly average limits exceeded in 2003	No
Ozone	Monitored exceedances	Yes

PM₁₀, NO₂ and Ozone exceed limits at a number of monitoring stations, confirming that these pollutants are the ones for which an emission reduction strategy should be proceeded.

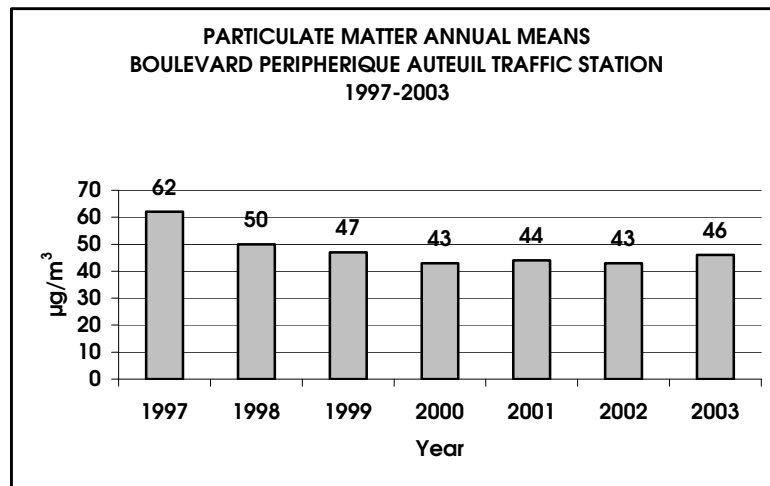


Figure 1 : PM10 yearly mean for one traffic station (200 000 vehicles per day)

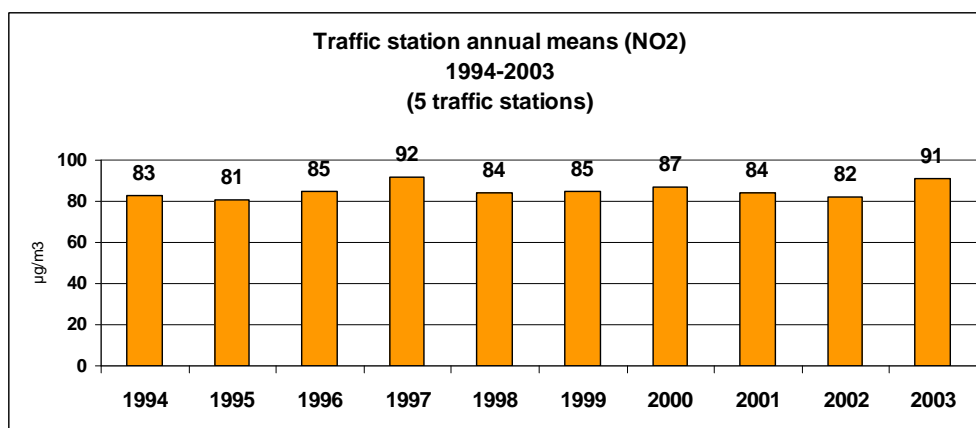
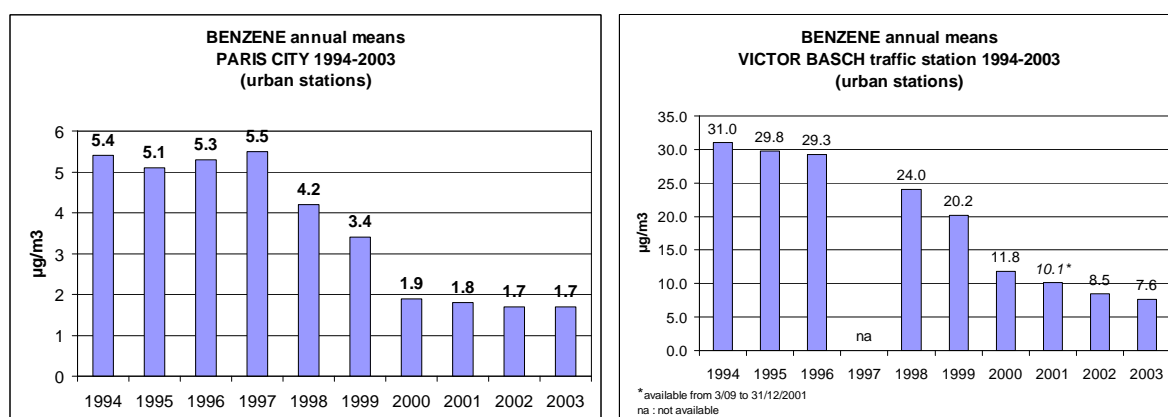


Figure 2 : NO2 mean yearly kerbside concentrations in Paris; average of 5 traffic stations



Benzene yearly mean : background levels

Benzene yearly mean : kerbside levels

Figure 3 : benzene concentrations in Paris

Benzene has been reduced in recent years, following the reduction of the proportion

of benzene in the locally used fuels. If the current trend continues, it is likely that the European limit values will be respected in 2010.<

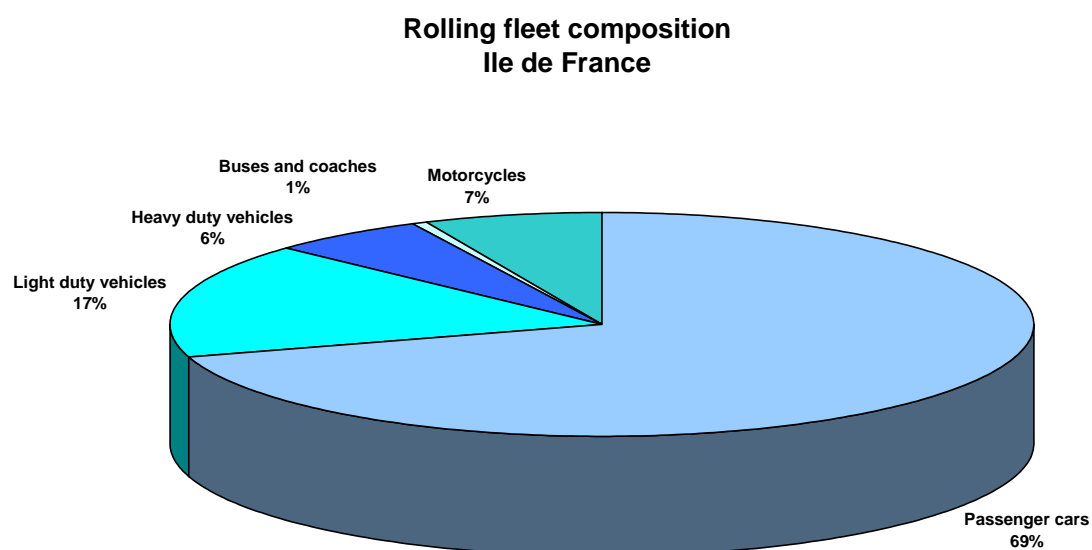


Figure 4: Fleet composition in Paris (2004)

2. Monitoring network

There are currently 46 automatic air quality monitoring stations in the Ile-de-France region around Paris. The stations are classified in accordance to regional, urban and street/traffic locations:

- “urban background” stations (25) are located in areas not directly affected by emissions (and in particular traffic) sources such as parks or green areas. They monitor pollutants such as CO, SO₂, NO_x, BTX, PM₁₀, PM_{2.5} and O₃;
- “suburban background” stations (6) are located in the suburbs of Paris and like the so-called urban stations are not directly affected by traffic sources.
- “traffic stations” (6) are located in areas with heavy traffic conditions. They monitor CO, NO_x, BTX, PM₁₀, PM_{2.5};
- “regional background stations” (8) are located outside the Paris metropolitan area, in the surrounding countryside. They monitor O₃, PM₁₀ and NO_x, and are devoted to the control of photochemical pollution.
- 1 so-called “observation station” is situated on the 1st floor (at 50m) of the Eiffel Tower

The monitoring network collects concentration data every hour. Data are sent to AirParif for validation and subsequently published on the Airparif web site. The map in Figure 5 shows for example the location of the ozone air quality monitoring network in Ile-de-France/Paris.

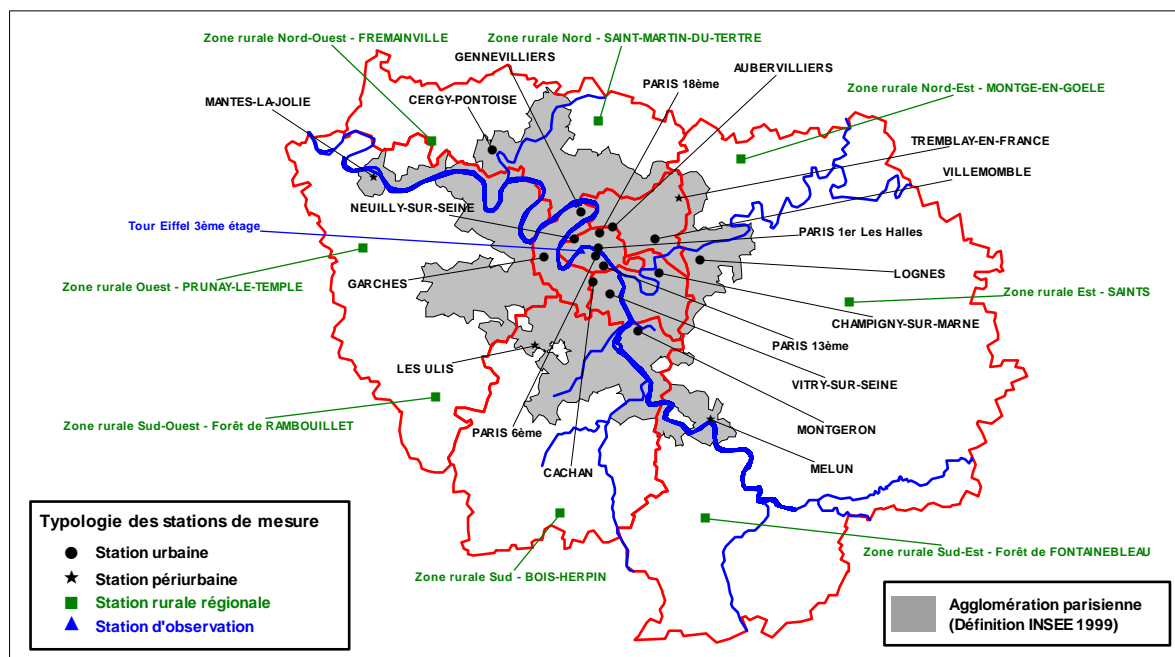


Figure 5: Existing Ozone monitoring stations in Ile de France.

In addition to the automatic monitoring network, AIRPARIF carries out monitoring campaigns with diffusion tubes and/or with mobile stations. For diffusion tubes, the sampling period is one or two weeks according to the pollutant monitored. The diffusive tubes are distributed across the whole urban area or particular parts of it and during different periods of the year. The sampling locations are defined according to the aim of the campaign: either in background locations or along busy streets when studying traffic problems. The pollutants monitored are benzene (toluene and xylene – “BTX”) and NO_2 and ozone in the summer time. Mobile stations provide the same type of hourly data as the fixed monitoring network.

3. Assessment of regional background

Regional background of PM_{10} , ozone and NO_x is determined by eight stations in Ile-de-France outside of the residential area of Paris.

In addition to regional monitoring, the spatial behaviour of the background concentration of NO_2 and ozone is assessed by a regional Chemistry-transport model: “CHIMERE” developed by the French research laboratories IPSL-LISA.

4. Emissions inventory

Air pollution in Paris is mainly related to traffic emissions. The traffic data collection is performed in quasi real time by the system developed under the framework of the HEAVEN European project. “Real time” traffic data are collected by the system and used as input to a traffic model in order to provide traffic information on the whole road network, that is about 35000 portions (or 10 650 km) of road throughout Paris and the Ile-de-France Region. This information is updated every hour. “Real time” traffic emissions are then calculated using the CORPERT III methodology and a detailed description of the fleet composition, specific of the Ile de France area.

6 emission categories have been defined for the Ile de France area:

1. Industries (thermal power plant, district heating, power plants ...) treated as point sources (297 point sources taken into account)
2. Residential, institutional emissions treated as area sources
3. Traffic emissions as line sources
4. Other mobile sources including Roissy and Orly international airports are treated as area and point sources
5. Agriculture and forestry as area sources
6. Biogenic sources as area sources

A 1 km² emission inventory is used as input for the CHIMERE chemistry-transport model.

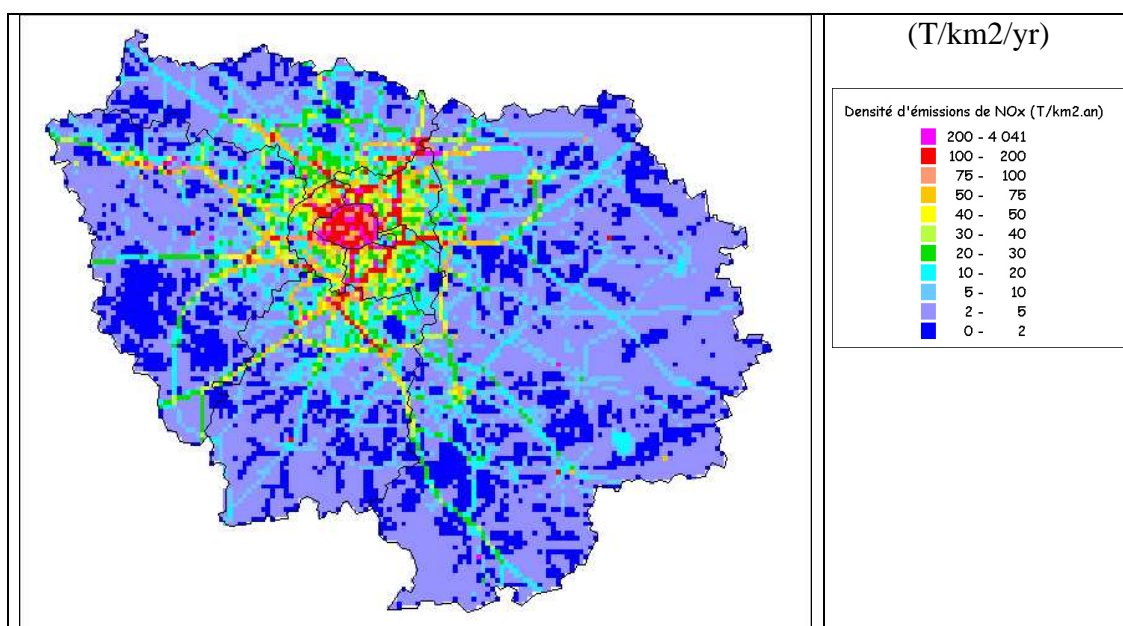


Figure 6: Annual NO_x area emissions (in tons) throughout the Ile-de-France Region

The emissions inventory was set up in the year 2000 and, as far as possible, is updated every year by AIRPARIF. The last update is from 2004.

5. Models

Chimere

The CHIMERE chemistry-transport model is used to model the dispersion of air pollution in the Ile-de-France region around Paris. It can treat emissions from point, line and area sources simultaneously, including road traffic, industrial and "background grid" emissions. It requires 3 dimensional meteorological input : the prognostic mesa-scale MM5 model is used to produce the required meteorological field forecasts. CHIMERE computes hourly backgrounds concentrations of carbon monoxide CO, NO₂, Ozone and PM₁₀ if the aerosol module is used.

CHIMERE uses a chemical mechanism adapted from the original EMEP mechanism.

Clear sky photolysis rates are attenuated using liquid water or relative humidity.

Dry and wet deposition are considered in the calculations.

The model is linked to external GIS and visualization tools and represents a comprehensive tool for tackling air pollution problems in cities and at regional scales.

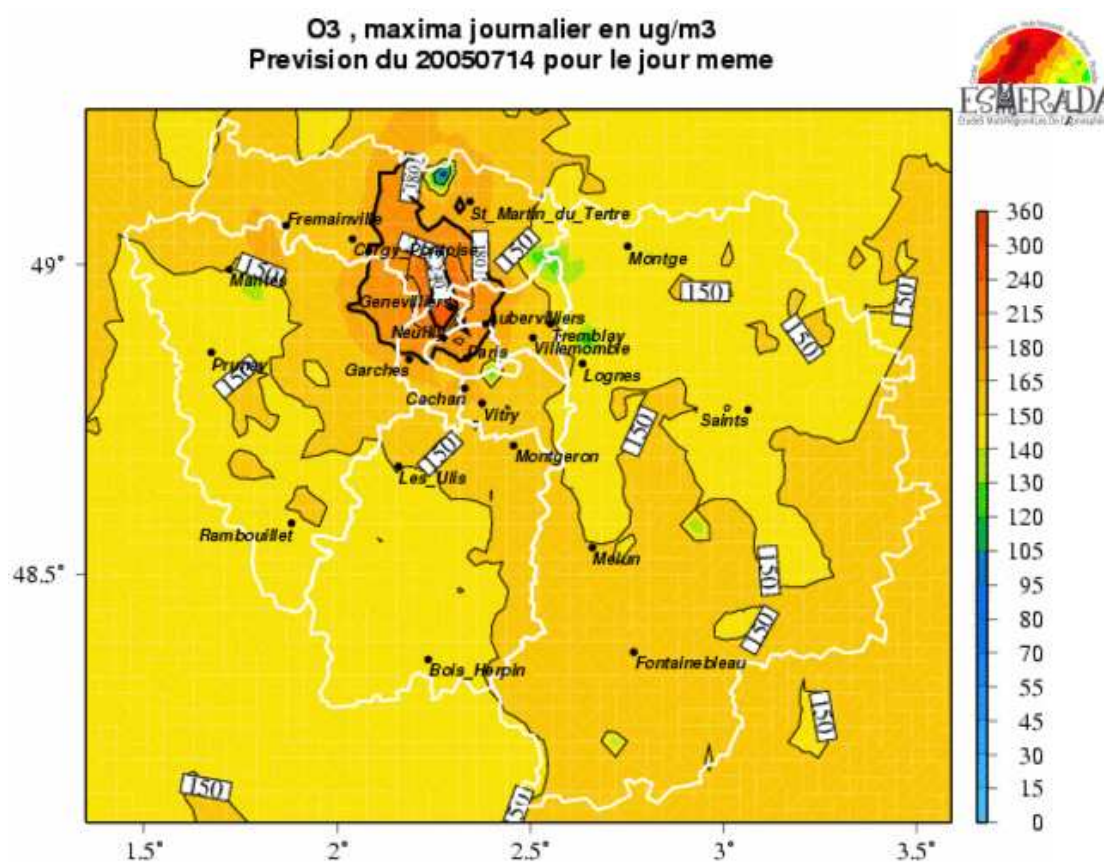


Figure 7: CHIMERE's O₃ daily maximum forecast (in $\mu\text{g}/\text{m}^3$) throughout Ile-de-France for July 14th 2005.

Meteorology

The MM5 model is a mesoscale meteorological model distributed by NCAR (National Centre for Atmospheric Research from the United States). It can simulate or predict mesoscale and regional-scale atmospheric circulation. The spatial resolution could be from 200 meters to 100 kms.

In the operational forecast/analysis modelling system developed by AIRPARIF, the output of the NCEP global forecast/analysis system is used as input for the MM5 model that is run by AIRPARIF. The global forecast model resolution is almost 1 degree.

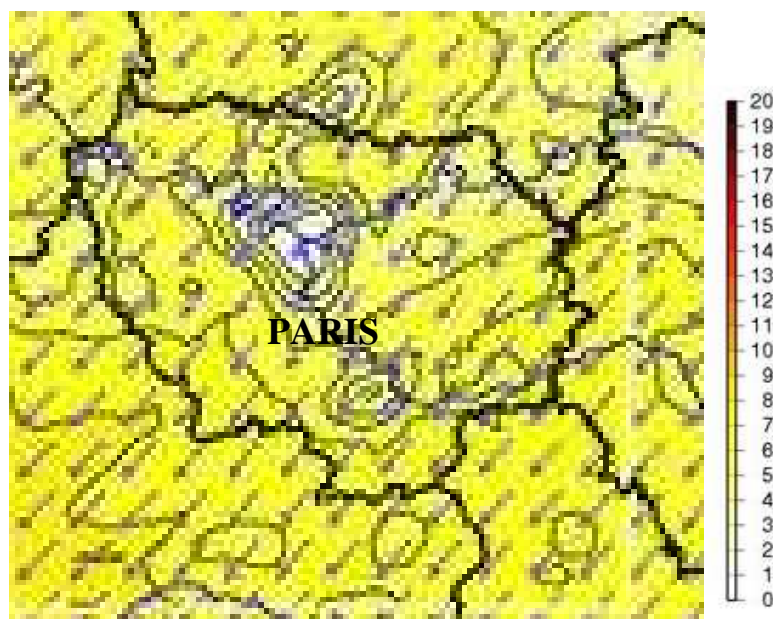


Figure 8: Results of MM5: wind field forecast (in m/s) – throughout Ile-de-France for midday on December 13th 2005. July 14th 2005.

6. Assimilation methods

In Paris, data assimilation methods are applied to produce O₃ and NO₂ concentrations maps and “AQ-index” maps (taking into account O₃, NO₂, SO₂ and PM₁₀ as pollutants). AIRPARIF applies three different data assimilation techniques:

1. for ozone, optimal interpolation;
2. for NO₂, kriging; and
3. for the AQ index, geostatistical methods on the basis of outputs from the “CHIMERE” model and the emissions inventory.

In the three methods, the measurements made on urban or rural background monitoring stations are considered. For O₃ et NO₂ assimilation, both hourly and daily maximum values are used. For AQ index, O₃, NO₂ and SO₂ daily maximum values, and for PM₁₀ daily average values are applied.

7. Gaps, needs and focus areas

The following is a list of gaps and focus areas for a better understanding of air quality problems in Paris and the Ile-de-France area.

- Effect of traffic measures on kerbside and background air pollution levels?
- Simple street canyon model as a “screening tool”?
- Consequences of the PM_{2.5} limit value for Paris?
- Trend analysis of air pollution: NO₂ and PM₁₀?

8. Suggested case studies

Paris would like to improve 1.) the quality of air quality information delivered to general public, 2.) the presentation of maps with roadside and background data and 3.) the assessment of exposure of the population. Data assimilation is regarded an useful instrument to achieve these objectives. The final result of the case study is to

demonstrate the ability to run data assimilation in order to provide information on near real time pollution situation and population exposure on the AIRPARIF website (see for example the Real Time Urbis system on the DCMR website which may serve as inspiration on which a Paris equivalent could be based).

9. Actions for implementation of case studies

AIRPARIF prefers to focus the case study on the following:

- improve air quality information towards the general public and local authorities by near real time air quality information (with emphasis on high pollution episodes) based upon measurements and modeling information (data-assimilation). The information is provided by high resolution maps with hourly concentration fields of NO₂ and ozone and daily AQ index. In addition, annual statistics data are required. The maps are available on the website of AIRPARIF. *This activity will result in a procedure to initiate the development of this website based upon an appropriate data-assimilation method.* Subsequently, air quality assessment in Ile-de-France/Paris against the objectives of AIRPARIF will be assessed *and* initial recommendations by Air4EU will be discussed. Also, the questions raised by the different city partners may be addressed. Based upon this assessment a procedure may be developed to establish the required website at AIRPARIF supported by Air4EU.
- Annual Map of O₃, NO₂ and PM₁₀ for 2004 and 2005