

CONTEXT

Since the end of 2019, Airparif has been monitoring the temporal variations of Ultrafine Particles (UFP) levels in central Paris (Les Halles garden) and is conducting a project to study the spatial variability of their levels across the Paris Region (Ile-de-France) in a variety of environments (urban and rural backgrounds, near road traffic and airport platforms). These solid airborne particles have a diameter smaller than 100 nanometers (nm) (smaller than a virus) and are not currently regulated, despite the fact that they pose a significant health risk due to their small size and ability to penetrate deeply into the respiratory system. Both the [WHO](#) and the [new European Directive for Air Quality](#), as well as [ANSES](#), the French Agency for Food, Environmental and Occupational Health and Safety, recommend to reinforce the long-term monitoring of UFP in order to define limit values and provide data for epidemiological studies.

Airparif launched a study on Paris supported by Breathe Cities and in collaboration with the City of Paris. The aim was to provide an overview of UFP levels measured near road traffic and in urban background sites in the French capital, for both winter and summer to have a better understanding of the level variability and emission sources, specifically road traffic and residential wood-burning. UFP levels in Paris were also compared with those in other European cities, including London, Amsterdam and Frankfurt.

KEY FINDINGS

Measurements carried out during the study pinpoint road traffic as a chronic source of ultrafine particles in Paris. Residential wood burning has also been found as a source of primary ultrafine particles in Paris during the winter season. Both winter and summer campaigns found that ultrafine particles are also made up of secondary aerosols, formed in the presence of precursor gases transformed in the atmosphere under specific meteorological conditions.

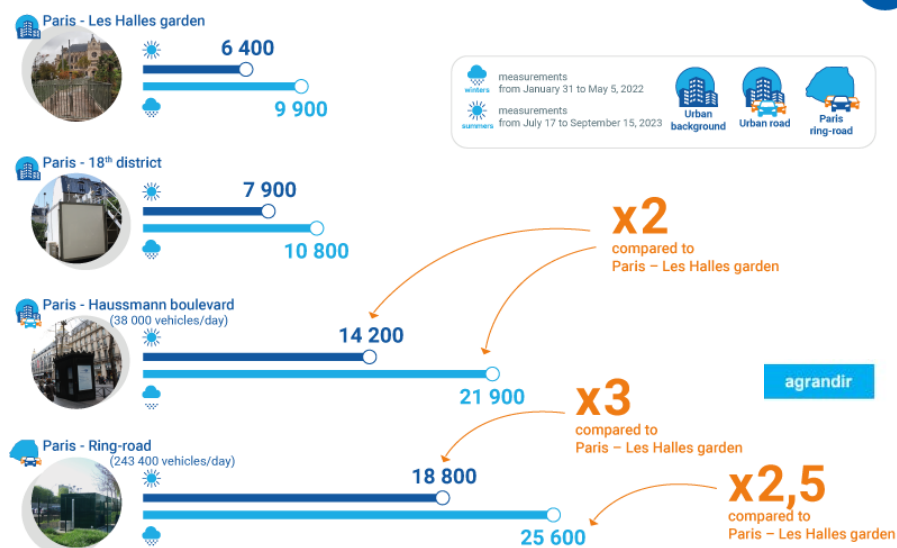
Paris ranks among the cities with the highest levels of ultrafine particles in Europe, both near road traffic and in urban background conditions.

The study highlights **3 sources of ultrafine particles in Paris:**

- **Road traffic** emits very small particles, the freshest of which can be smaller than 20 nm, measured in particular near the Parisian ring-road.
- **Residential wood-burning** emits ultrafine particles, the majority of which are found between 70 and 100 nm in size. The increase in the number of ultrafine particles correlates with the rise in black carbon concentrations, also known as soot.
- **Secondary particles**, resulting from transformations in the atmosphere, are also a source of ultrafine particle pollution throughout the year. Their nature differs according to the conditions of formation and local anthropogenic emissions.

AVERAGE PARTICLE NUMBER CONCENTRATION OF UFP IN PARIS

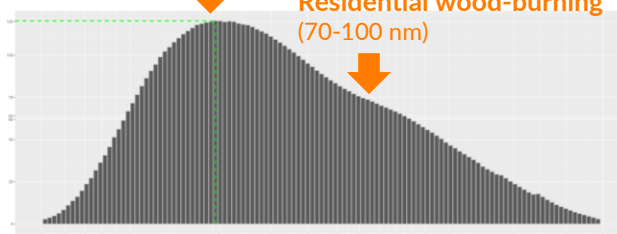
in particles/cm³



IDENTIFICATION OF EMISSION SOURCES

Road Traffic
(20-30 nm)

Residential wood-burning
(70-100 nm)



Each source of ultrafine particles is identified by their "major mode", which is the diameter of the majority of the number of particles.

The number of ultrafine particles is 2 to 3 times greater near Parisian roads than in the urban background in Paris. This difference varies throughout the day according to the intensity of emission sources.

A comparison of concentrations of ultrafine particles in Paris with those of other selected European cities shows that the **levels measured in Paris during the two campaigns are among the highest**, both near road traffic and in urban background conditions.

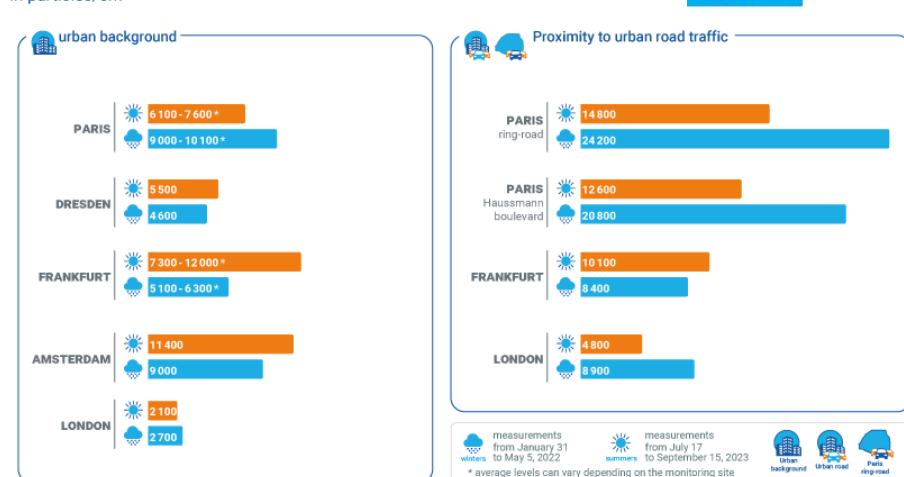
The impact of summer and winter seasons on ultrafine particle levels differs from city to city: Paris and London have lower ultrafine particle levels in summer, unlike the other cities. This may be explained by the greater or lesser impact of winter sources (residential wood-burning) and summer sources (secondary particles).

Particle size distribution indicates that Paris is more affected by small particles than cities such as

London and Dresden. The data used in the study do not allow the clear identification of factors explaining this difference. A more detailed analysis of sources (composition of vehicle fleet, residential heating equipment, ...),

as well as an analysis of long-term trends in ultrafine particles in relation to other pollutants are required to make a more fair and robust comparison between cities.

AVERAGE PARTICLE NUMBER CONCENTRATION OF UFP IN DIFFERENT EUROPEAN CITIES



DESCRIPTION OF THE CAMPAIGN

Two monitoring campaigns were carried out during this study, in order to analyze seasonal variability.

- **Winter-Spring:** Measurements from January 31 to May 5, 2022
- **Summer:** Measurements from July 17 to September 15, 2023

A total of 5 sites were instrumented in the French capital:

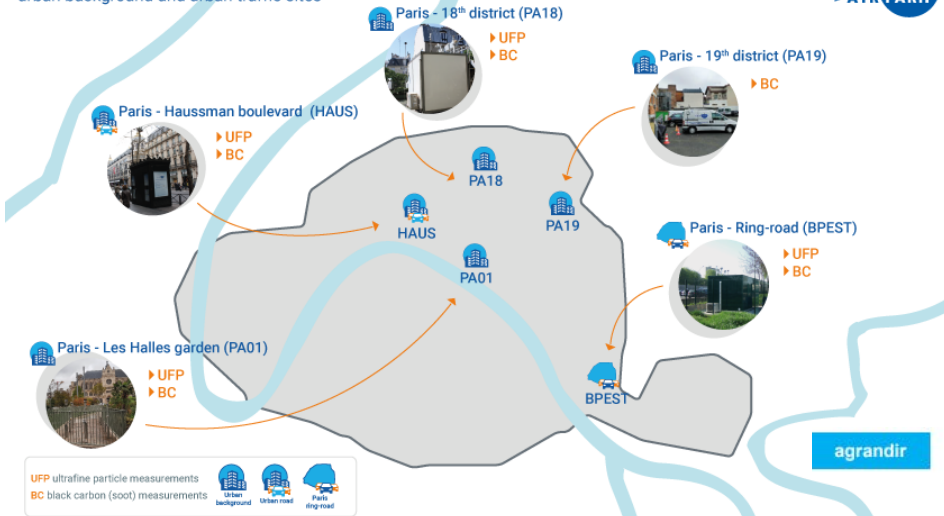
- **3 urban background sites**, including the permanent monitoring site located at Les Halles garden,
- **2 road traffic sites**, including one along the Eastern ring-road.

Each site was equipped with an MPSS (Mobility Particle Size Spectrometer) measuring every 5 minutes the number of particles by size between 5 and 400 nm, which gives the size distribution allowing the identification of emission sources.

The results are based on the number concentration of UFP (up to 100 nm), which represents approximately 90% of the total particle number count measured by the MPSS in the 5-400 nm range.

A study supported by Breathe Cities

LOCATION OF ULTRAFINE PARTICLE MEASUREMENTS IN PARIS



Additional black carbon (soot) measurements confirmed the impact of road traffic and residential wood heating at the various campaign sites.

PERSPECTIVES

Airparif continues the **permanent monitoring of ultrafine particles in central Paris** at the Les Halles garden site, **in order to improve the understanding of their sources**, including road traffic and residential wood heating. These long-term measurements are intended to provide input for the epidemiological studies needed to set regulatory limit values or WHO recommendations. A campaign to measure ultrafine particles is scheduled for summer 2025, aiming to complete the knowledge of background levels in the Paris Region (Ile-de-France). The study of the behaviour of ultrafine particles in Paris could be continued in a joint study with a similar European city, such as London.

FULL REPORTS (in French)

« Campagne de mesure parisienne sur les particules ultrafines – Volet N°2 Mesures estivales et Enseignements globaux de l'étude », Airparif (2025).

« Campagne de mesure parisienne sur les particules ultrafines – Volet N°1 Mesures hivernales-printanières », Airparif (2023).