

## **Urban green spaces and Car Free day: can parks help purify our air?**

*“Nitrogen dioxide decreased up to 54% on car-free day in the parks and on a busy boulevard, while particulate matter decreased up to 33% compared to a standard Sunday”*

*“Parks show the same trends in nitrogen dioxide as on a busy street, with peaks occurring during morning rush hour”*

*“Pollutants can accumulate and remain trapped within the parks, even on a car-free day, parks showed higher pollutant concentrations than on a busy boulevard”*

## **The Importance of Air Quality and the Day Without Cars**

Air quality plays a vital role in the overall health and well-being of urban populations. Clean air is essential for maintaining respiratory and cardiovascular health, especially for vulnerable groups such as children, the elderly, and individuals with pre-existing conditions. However, urban environments are often hotspots for air pollution, much of which is caused by traffic emissions. The day without cars takes place annually in Brussels, to promote and encourage its citizens to use more sustainable modes of transportation with the goal of reducing these emissions. This venture is of the utmost importance, as emissions in the city can reach consequential concentrations, harming our health and environment.

### **Traffic Emissions: What are we breathing?**

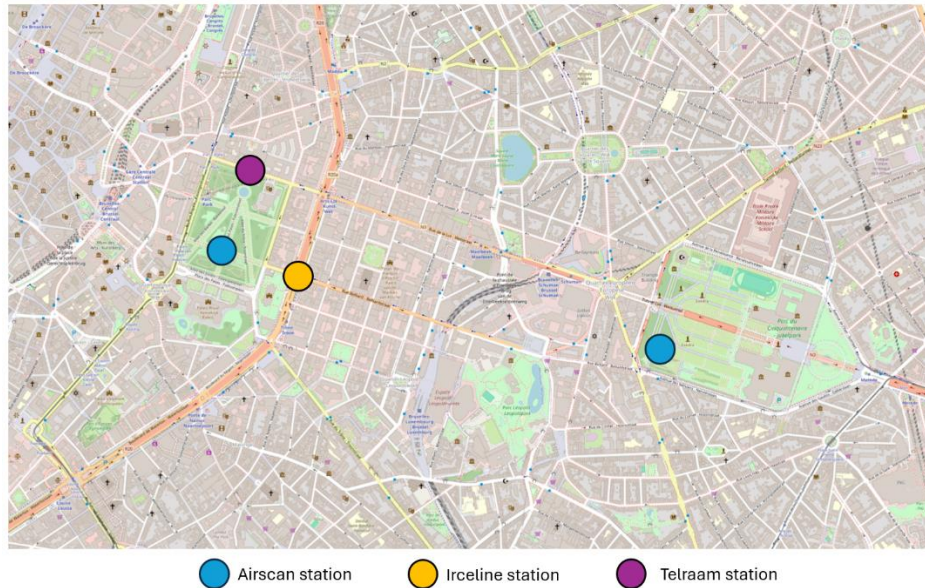
Traffic is a significant source of air pollution, contributing to the release of particulate matter (PM) and nitrogen dioxide (NO<sub>2</sub>) both of which have detrimental effects on human health. The two primary pollutants, PM<sub>2.5</sub> and PM<sub>10</sub> represent dust particles that can penetrate the lungs, while NO<sub>2</sub> is a gas that can inflame the respiratory system and aggravate conditions like asthma.

The challenge is particularly acute in dense urban centres, where cars, buses, and trucks release significant amounts of these pollutants. Green spaces, such as parks, are often seen as natural solutions to improve air quality by acting as buffers between traffic emissions and the lungs of urban residents. They can absorb pollutants, reduce heat and provide cleaner air for visitors. In Brussels, parks such as Parc Cinquantenaire and Parc Royale are central to urban life, attracting thousands of people daily, from vulnerable populations like the elderly and children to fitness enthusiasts.

But the question remains: can these parks significantly decrease exposure to traffic-related pollution, particularly during peak traffic hours?

### **Data: Measuring the Air We Breathe**

To understand the role parks play in mitigating traffic pollution, data on key pollutants was collected from two major parks in Brussels: Parc Cinquantenaire and Parc Royale.



**Figure 1.** Map of the placement of the different stations, the Airscan and Irceline station measuring  $PM_{2.5}$ ,  $PM_{10}$  and  $NO_2$  while the Telraam station measures the amount of passages by different modes of transport

The focus was on three pollutants:  $PM_{2.5}$  (particulate matter with a diameter of 2.5 microns or less),  $PM_{10}$  (particulate matter up to 10 microns), and nitrogen dioxide ( $NO_2$ ). These daily concentrations would be compared to those on the day without cars, if the concentration is stable than the conclusion is that green spaces do a good job in mitigating urban pollution.



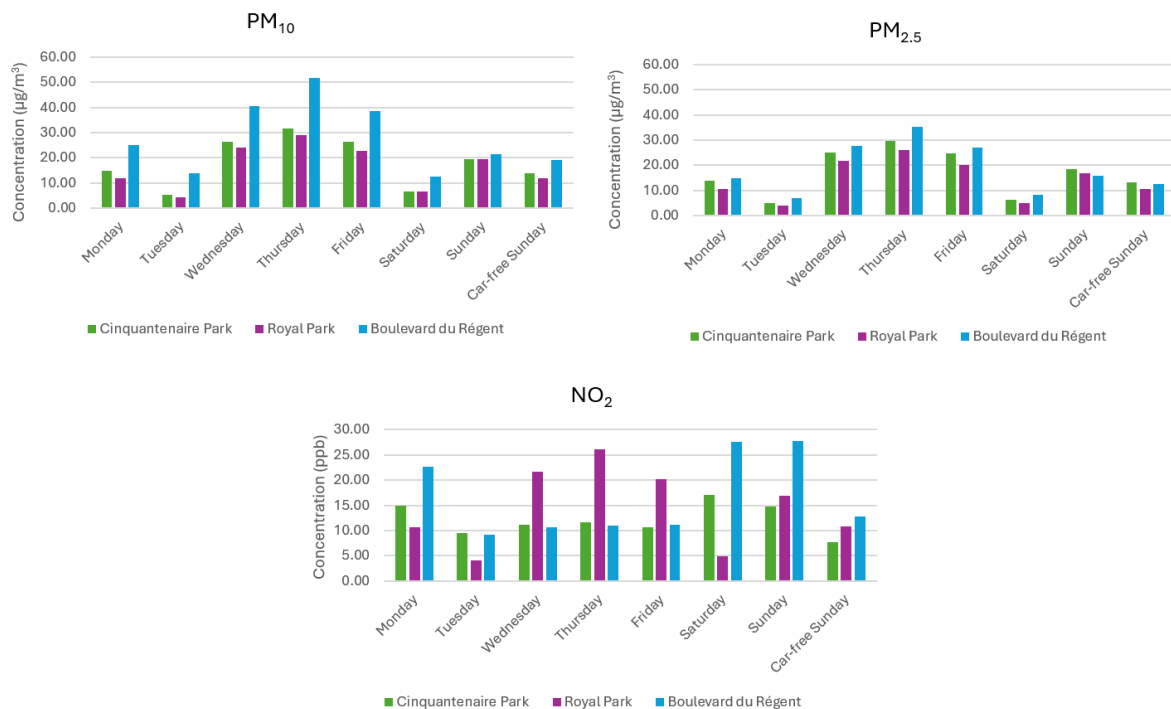
**Figure 2.** The installation of the Airscan sensor, measuring  $PM_{10}$ ,  $PM_{2.5}$  and  $NO_2$  inside the parks

According to the World Health Organization (WHO), the safe thresholds for these pollutants are as follows:

- $PM_{2.5}$ :  $5 \mu\text{g}/\text{m}^3$
- $PM_{10}$ :  $15 \mu\text{g}/\text{m}^3$
- $NO_2$ : 5 ppb

## Parc Cinquantenaire and Parc Royale: What the Data Says

Data from air quality devices fixed in both parks over the past week has shown variations in pollutant levels all throughout the week. This first figure (Figure 3) outlines the distribution of these pollutants over a week from three different sites.

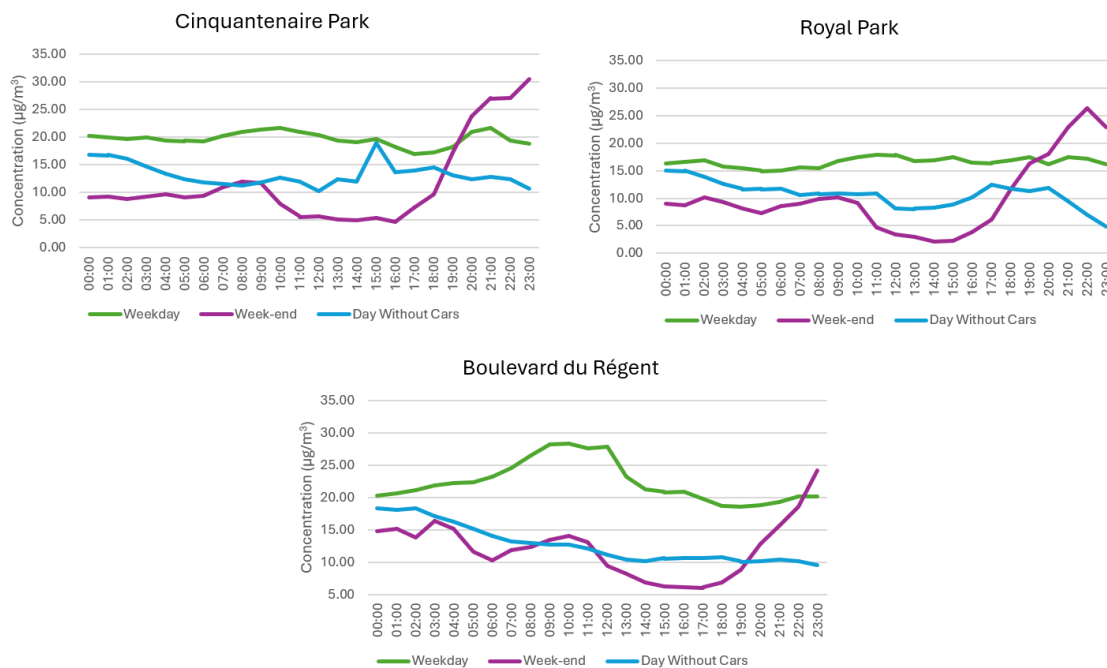


**Figure 3.** Graphs showing the average concentrations of all three pollutants, on weekdays, weekends and car-free Sunday for all three sites.

What is striking in this analysis are the average concentrations for nitrogen dioxide during the week which were higher in the parks. Park Royal and Park Cinquantenaire are bordered by many busy streets which may have contributed to these high NO<sub>2</sub> values. The increase in concentrations on the weekend on Boulevard du Régent could be due to lower temperatures (averaging at 11°C) encouraging more citizens to use their cars. For particulate matter a different trend is observed, which sees higher concentrations on Boulevard du Régent on all days of the week for both large and fine particles.

Car-free Sunday shows a decrease of about 33% for both PM<sub>10</sub> and PM<sub>2.5</sub> in the parks compared to an average Sunday, and a decrease of 20% is observed on Boulevard du Régent. For nitrogen dioxide the decreases in average concentrations were much more pronounced, with a 54% decrease on Boulevard de Régent and up to 48% in the parks.

If we take a closer look at fine particulate matter hourly trends, we obtain the following graphs for each of the devices (Figure 4).

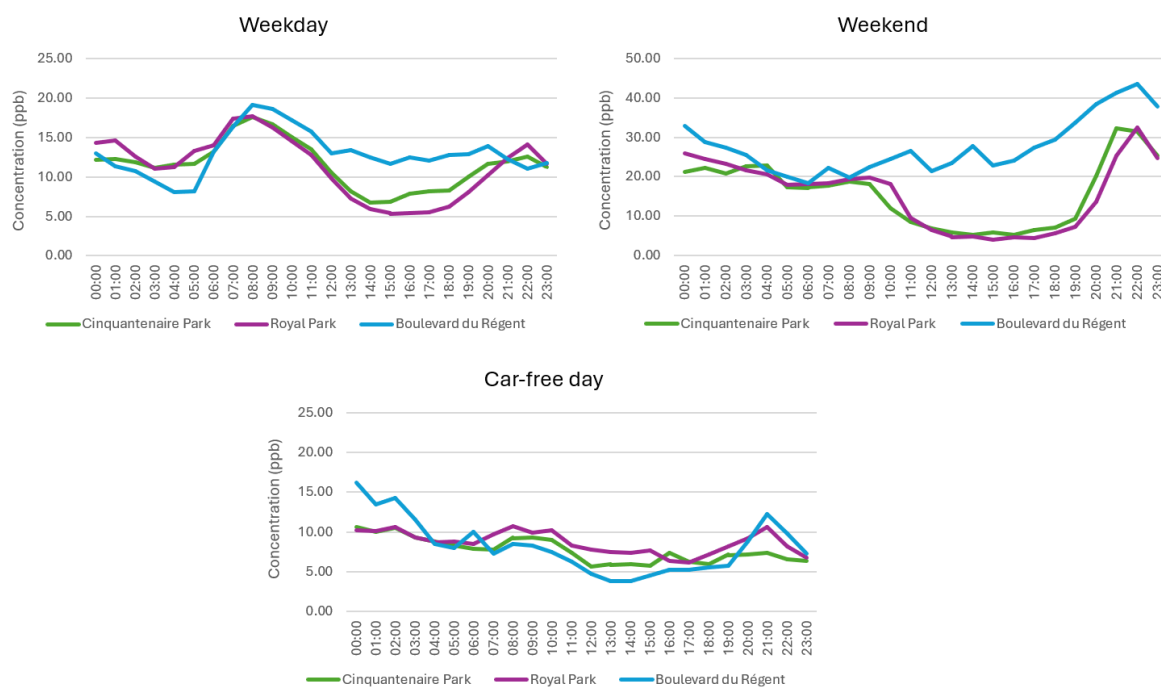


**Figure 4.** Hourly evolution graphs of  $PM_{2.5}$  for all three locations : the two parks and the busy street – showing trends on weekdays, weekends and on the day without cars.

The graphs consistently show higher concentrations detected on weekdays, with a peak of fine particulate matter in the morning on Boulevard du Régent. The two parks show a much more stable evolution of the concentrations during the week. On the weekends there is consistently an increase in the afternoon at all three sites which ends up reaching higher concentration in the evening in both parks than on the busy road.

Car-free Sunday took place between 9:30 and 19:00. Particulate matter is not proven to be completely mitigated as there were higher values detected on this day than on a standard weekend. This may be due to a large amount of re-suspended particles, or dust within the parks due to the high amount of visitors on this day.

To further analyse nitrogen dioxide, an hourly evolution plot was also made for the three sites in the following figure (Figure 5)



**Figure 5.** Hourly evolution graphs of NO<sub>2</sub> for all three locations : the two parks and the busy street – showing trends on weekdays, weekends and on the day without cars.

The figure above shows little differences between concentrations on weekdays and weekends within the parks – only with a sharp increase in the evening for both locations. On Boulevard du Régent, higher concentrations were detected on the weekend of the 14<sup>th</sup> to 15<sup>th</sup> of September than during the week leading to an interesting profile. All three locations show peaks appearing during rush hour in the morning, leading to the belief that parks cannot completely mitigate morning traffic.

Car-free day resulted in lower concentrations of nitrogen dioxide than on a normal weekday, and weekend. However, higher nitrogen dioxide concentrations were detected in the parks than on Boulevard du Régent on this day!

### The Influence of Weather

Several environmental factors also had an influence on air quality during the week, including rain, wind speed, and direction. There was very little rainfall during the week of measurements. Winds primarily coming from the southwest appeared to disperse pollutants, with highest measurements occurring on Tuesday and Wednesday (the 17<sup>th</sup> and 18<sup>th</sup> respectively). On the 18<sup>th</sup> leading up to the 19<sup>th</sup> foggy conditions seemed to trap the pollutants, causing temporary increases in particulate matter, leading to concentrations remaining above 30µg/m<sup>3</sup> for hours in the city. Finally, low temperatures on the weekend of the 14<sup>th</sup> and 15<sup>th</sup> of September (an average of 11 and 12°C) resulted in higher car usage and therefore peaks of nitrogen dioxide.

### Traffic Data: The Road Ahead

Traffic data from Telraam counter placed on Boulevard du Régent, in proximity to Royal Park, show that approximately 6,500 cars pass through this road daily. The hourly distribution of this passage can be found in Figure 6.

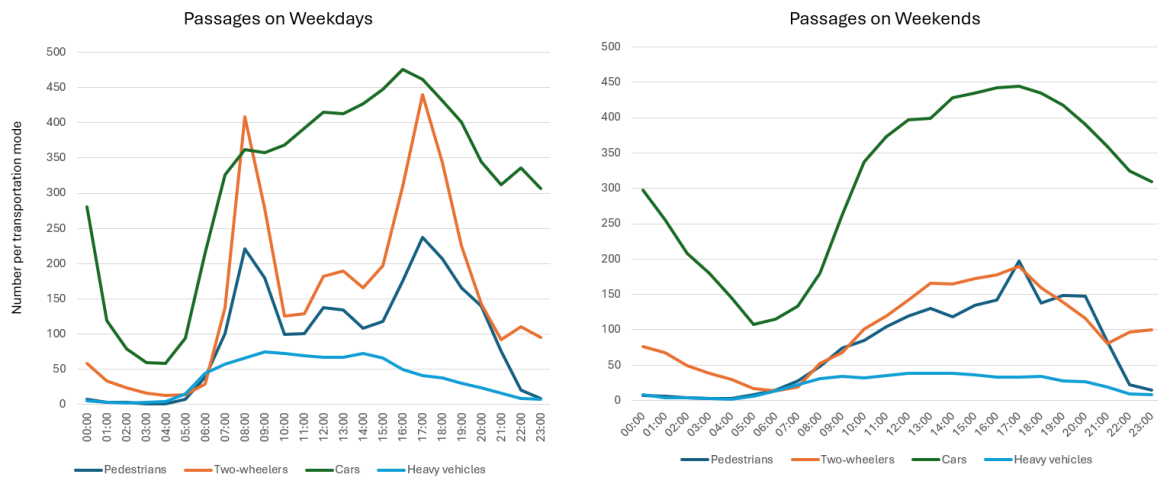


Figure 6. Hourly evolution graphs of passages of pedestrians, two-wheelers (such as bikes), cars, and heavy vehicles on weekdays (left) and weekends (right)

At peak hours the increase in pedestrian and bikes is much more marked, whereas cars seem to consistently increase throughout the day on both weekdays and weekends.

The percentage distribution of the modes of transport can be found in the figure below:

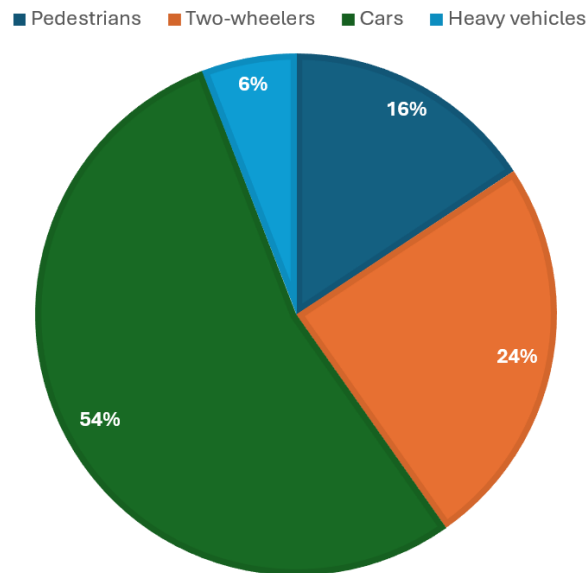


Figure 7. Percentage distribution of the different modes of transport on Boulevard du Régent

This high volume of vehicles is expected to contribute significantly to NO<sub>2</sub> and PM levels in nearby parks as it is seen in the increase in NO<sub>2</sub> during rush hour in Figure 5. It is important to keep in mind that this data is collected for one street bordering the Royal park over three months (01/05 to 01/09), there are a number of others contributing to atmospheric pollution in these areas.



### **The real question: How Much Can Parks Reduce Pollution?**

The following strategy was used to answer this question: install sensors in parks surrounded by heavy traffic, compare the daily concentrations of the different pollutants with the concentrations detected on car-free Sunday. If parks are successful in mitigating pollution, there should be a very minor difference in these concentrations, no? During the week, concentrations of particulate matter were up to 35% higher in the parks than on car free day. Nitrogen dioxide sees a similar increase with 33% higher during the week than on the day without cars. The figures above also show peaks occurring during rush hour in both parks – indicating that pollution infiltrates these green areas exposing all visitors to concentrations well above the WHO threshold.

Not even on the day without cars are we free of these pollutants, as once they infiltrate, they are trapped within the confines of the parks, leading to higher concentrations inside the parks than on a boulevard, where these pollutants can be dispersed and diluted by wind.

It is important to keep in mind the effects of traffic emissions, and how they can even enter our green spaces that we go to for “fresh air”. Parks are supposed to be a space to accommodate all forms of life, from children to the elderly. Athletes training breathe in the surrounding air at high rates – hoping that the air is pure. This study has shown that it is not always the case, parks showed the same increases in pollution as on busy streets, sometimes surpass them, and trap those pollutants – concentrating them. The next time you take your running shoes or picnic basket, keep in mind that parks amid a city may not be the less polluted spaces – and that a day without cars is only the beginning to mitigating traffic pollution in cities.