Collaborative science project
Analysis of air quality in Brussels between February and April 2019

May 2019

Les chercheurs d'air – Jose GONZALEZ – Pierre DORNIER

Table of contents

Summary

Les chercheurs d'air is a collaborative science project which aims to improve our understanding of and response to the issue of air pollution in Brussels.

This project was conceived following an observation that air pollution in Brussels is not appropriately monitored in terms of time and space. For instance, there are only five stations which measure the concentration of fine particle matter (PM2.5) in the air.[1] For a city of 160 km2 and with more than one million inhabitants, that is simply not enough. This is compounded by the fact that the measuring stations are not necessarily situated in areas where PM2.5 concentrations are at their highest or most representative.[2]

To make up for this situation, since February 2019, the *Les chercheurs d'air* project has provided citizens with *Luftdaten*[3] sensors which measure the concentration of PM2.5 and PM10 in the air in real time. Measurements are collected and displayed on an online map.[4]

It has been three months since we launched this project so we are now conducting an initial analysis of the PM2.5 data. As part of this analysis, the data are firstly compared with those of the Belgian Interregional Environment Agency (CELINE) in order to verify their validity. **The comparison between our measurements and those of CELINE shows very little difference which implies that our data are reliable.**

More in-depth analysis has since been carried out to identify the metrics related to air quality. This has shown that **21 addresses experienced, on at least one occasion, a PM2.5 air concentration of more than 25 µg/m3 over a period of more than 24 hours** and therefore exceeded the WHO recommendation[5]. It is also interesting to note that the mean concentration over the three months under study exceeds the annual concentration recommendation of the WHO (10 µg/m3).

It also emerges that there is a considerable geographical and time-related disparity in PM2.5 concentration. **At some locations, concentration peaks are much higher, with data exceeding 100 µg/m3 and concentrations above 25 µg/m3 lasting for prolonged periods**. This goes to show how important it is to establish more measuring points. At other locations, there is a strong variation in PM2.5 concentration throughout the day.

For the record, and as specified by the WHO[6], "small particulate pollution has health impacts even at very low concentrations – indeed no threshold has been identified below which no damage to health is observed."

---

1 https://environnement.brussels/etat-de-lenvironnement/rapport-2011-2014/air/qualite-de-lair-concentration-en-particules-tres-fines

2 https://www.fr.clientearth.org/le-gouvernement-bruxellois-sous-pression-suite-a-lavis-du-conseiller-de-la-cour-de-justice-de-lue/

3 https://luftdaten.info/

4 https://www.leschercheursdair.be/#carte

5 https://www.who.int/fr/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health

6 https://www.who.int/fr/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health

When you read this report, you should bear in mind that it is produced on the basis of limited resources and relies solely on the work of volunteers. With access to greater resources, it would be possible to further improve our understanding of the fine-particle air pollution in Brussels.

1. Introduction

1.1 *Les chercheurs d'air*

Based on a team of volunteers, which currently comprises 400 citizens, *Les chercheurs d'air* is a collaborative science project which seeks to improve our understanding of air pollution caused by fine particle matter (PM2.5 and PM10) in Brussels.

The particular objectives of this project are as follows:

- To raise aware among the general public of the problems of air pollution in Brussels
- To improve our understanding and therefore out response to the problem of air pollution in Brussels
- To push air pollution to the top of the political agenda

The *Les chercheurs d'air* project distributes fine particle matter sensors to the residents of Brussels to create an extensive network of air quality measuring points. These sensors have been developed by *Luftdaten*[7] in conjunction with Stuttgart university. Since February 2019, more and more of these sensors have been installed and the number of measurements is now sufficient to produce a preliminary analysis.

1.2 Objective of this report

The objective of this report is to present an initial analysis of the data on PM2.5 air concentrations in Brussels. These data were collected by *Luftdaten* sensors during the months of February, March and April 2019.

This report analyses the PM2.5 concentration readings of the *Les chercheurs d'air* project, their comparison with official measurements and their variation according to time and position of the sensors.

This report does not seek to explain these time-related and geographical differences; these aspects should be covered by a separate report. Subsequent analyses will be necessary, particularly with a view to ascertaining the origin of the PM2.5 pollution in Brussels.

[7] https://luftdaten.info/

2. Filtering and comparison between our measurements and those of CELINE

2.1 Selection of sensors

It should be noted that the data collected by the sensors have been filtered prior to use. Any sensors that appear to be faulty, either due to the fact that they produce anomalous data or operate outside of the conditions prescribed by the sensor's manufacturer, have been discarded from the analysis.

Details on this stage are provided in the Appendices, in section 6.2

2.2 Comparison with CELINE

To verify the data measured by the *Luftdaten* sensors, they are compared with official measurements. The Belgian Interregional Environment Agency has stations which measure PM2.5 concentrations throughout Belgium, including one in Molenbeek[8].

The dates of 28/03/2019, 23/03/2019 and 08/04/2019 were chosen for the comparison between our measurements and those of the CELINE station in Molenbeek. These dates relate to the monthly peaks observed during the period between February and April 2019.

The data of the CELINE network station in Molenbeek for 28/03/2019, 23/03/2019 and 08/04/2019 are illustrated on Figure 3, Figure 4 and Figure 5 respectively, along with the corresponding *Luftdaten* sensor data. The CELINE data were obtained using their opendata service[9].

Figure 3, Figure 4 and Figure 5 show that the measurements taken using the *Luftdaten* sensors are, on average, pretty similar to the measurements taken by the CELINE station in Molenbeek.

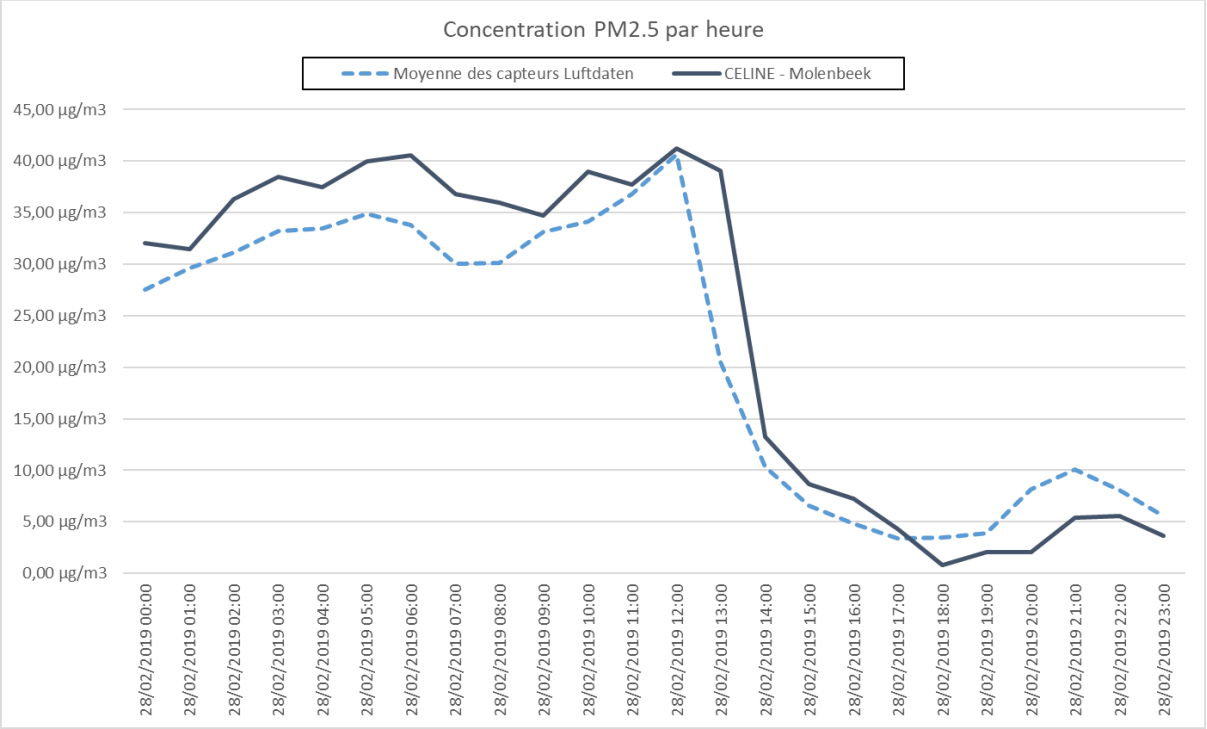

Figure 3 Comparison between Luftdaten and CELINE measurements for 28/02/2019

[8] http://www.irceline.be/fr/qualite-de-lair/mesures/particules-fines/pm25_24hmean

[9] http://www.irceline.be/en/documentation/open-data

Figure 3 shows that our measurements follow the same trend as the measurements of CELINE's Molenbeek station, especially the sharp decrease observed in the afternoon of 28/02/2019.

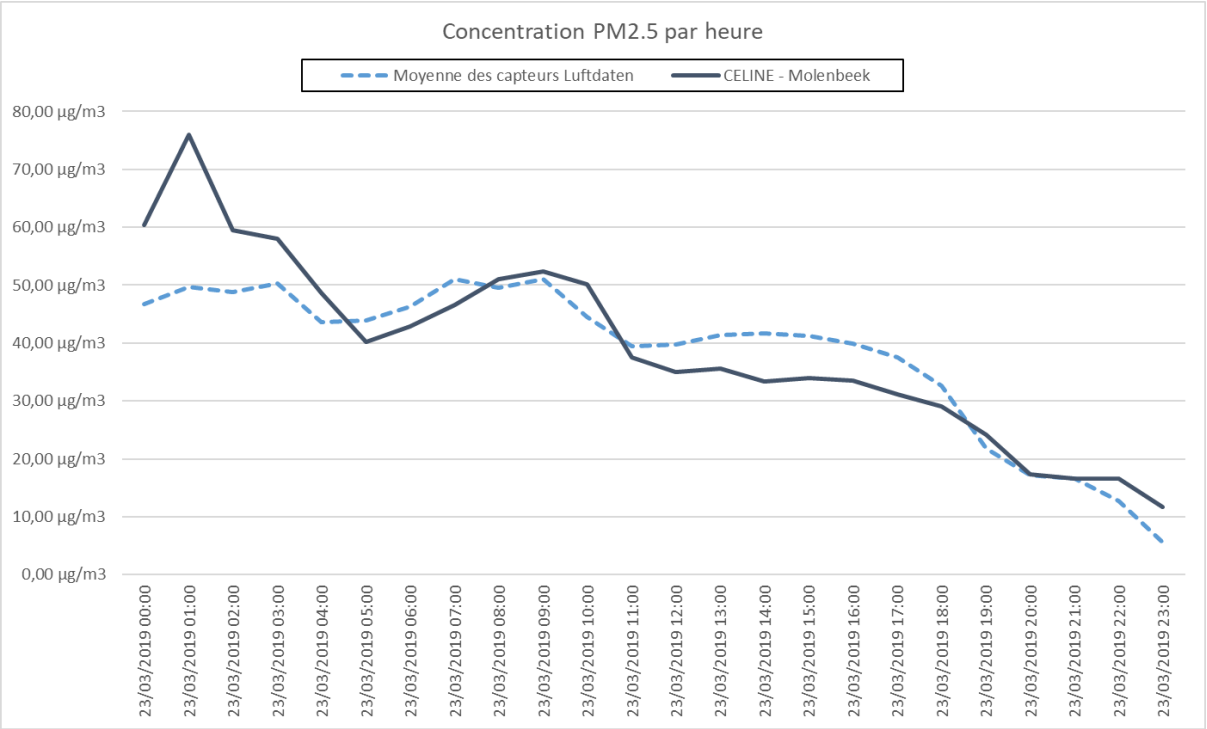

Figure 4 Comparison between Luftdaten and CELINE measurements for 23/02/2019

Figure 4 shows that our measurements follow the same trend throughout the day of 23/03/2019 as the measurements of CELINE's Molenbeek station, with a concentration above 30 µg/m3 virtually all day. It should be noted that our measurements relate to the mean of our sensors throughout Brussels, which is why the curve of our measurements is smoother.

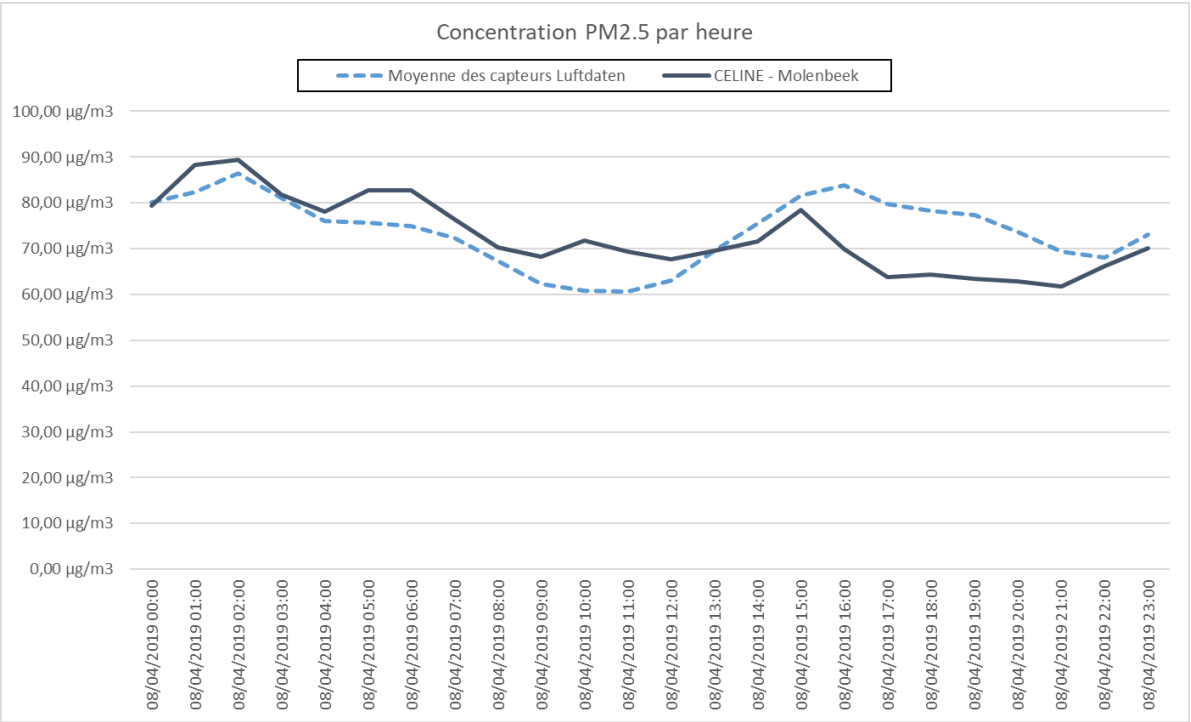

Figure 5 Comparison between Luftdaten and CELINE measurements for 08/04/2019

Figure 5 shows that our measurements follow the same trend throughout the day of 08/04/2019 as the measurements of CELINE's Molenbeek station, with a concentration above 60 µg/m3 virtually all day.

In a bid to produce a more overall comparison of the readings of the CELINE network and the *Les chercheurs d'air* network, Figure 6 includes the CELINE data (Molenbeek station) and our data for the whole period. Both sets of measurements follow the same trend, except for a number of peaks on our sensors at the beginning of February, as illustrated in Figure 6. On average, the difference between measurements is below 2 µg/m3.

It should be stressed that the data produced by the *Luftdaten* sensors have been filtered prior to use. Any sensors that appear to be faulty, either due to the fact that they produce anomalous data or operate outside of the conditions prescribed by the sensor's manufacturer, have been discarded from the analysis. Details on this stage are provided in the Appendices, in section 5.2

It can therefore be concluded that the measurements of the *Luftdaten* sensors are reliable.

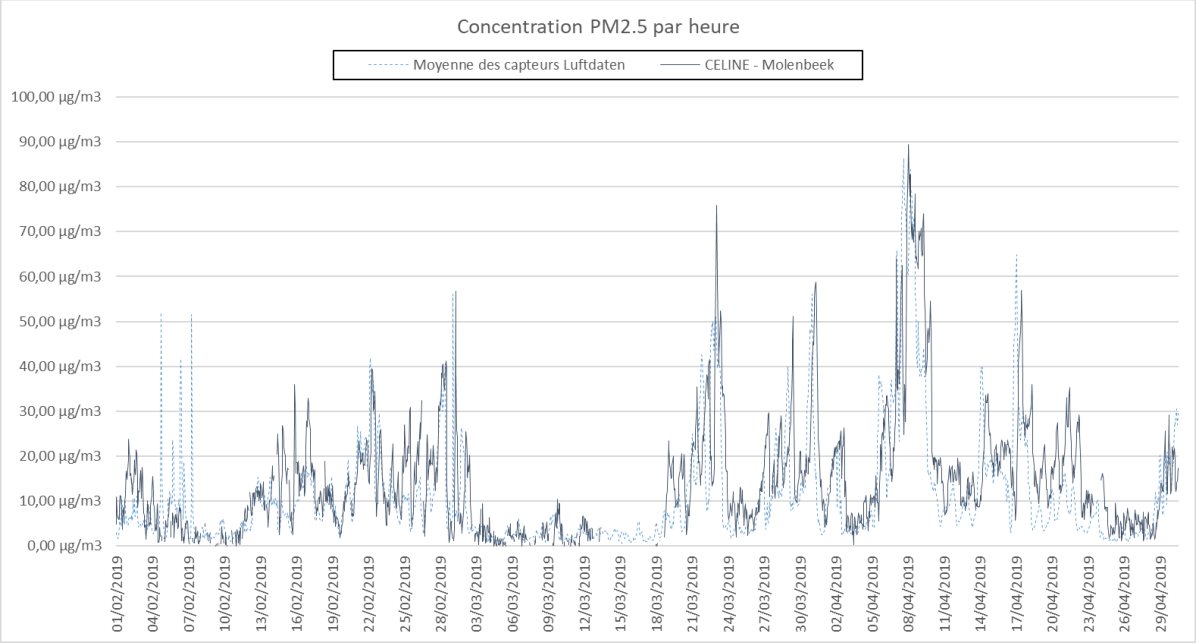

Figure 6 Comparison of Luftdaten and CELINE measurements for the whole period

3. Results for the whole period between February 2019 and April 2019

3.1 Overall values

Over the period under study, the mean concentration observed is 11.03 µg/m3, slightly above the mean value recommended by the World Health Organisation, which is 10 µg/m3 (on an annual basis) [10]. The recommended daily mean (25 µg/m3) was exceeded once or twice at the level of 21 sensors and several sensors recorded absolute concentrations in excess of 100 µg/m3. It should be noted

[10] https://www.who.int/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health

that there is a difference between the weekday mean and weekend mean, with the concentration being higher, on average, at weekends.

Type of day	Maximum PM2.5 µg/m3	mean PM2.5 µg/m3
Weekday	120.10	10.92
Weekend	162.50	11.32
	162.50	**11.03**

Table 1 maximum and mean PM2.5 concentration per type of day

3.2 Mean PM2.5 concentration per day

Figure 1 shows the mean concentration per day measured by the sensors. The monthly peaks of February, March and April are highlighted. It should be noted that the whole country was concerned by a pollution alert on the days of 28/02/2019 and 08/04/2019[11].

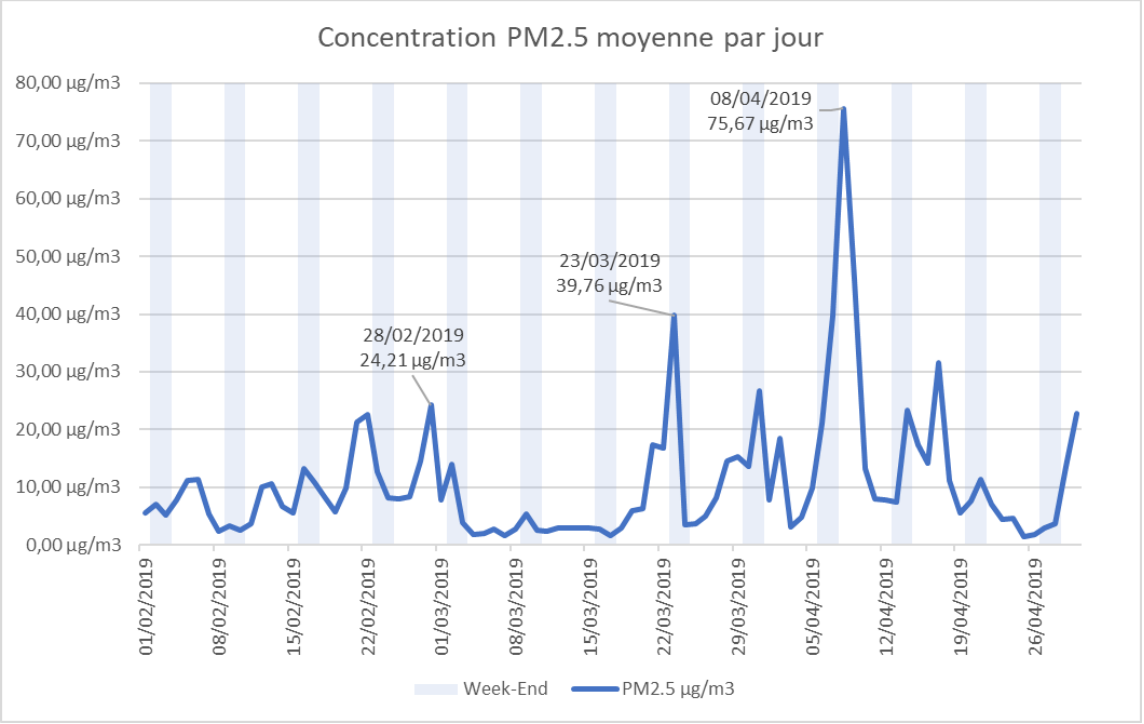

Figure 1 Mean PM2.5 Concentration per day

3.3 PM2.5 Concentration above the standard of 25 µg/m3 for a period of more than 24 hours

The World Health Organisation (WHO) recommends that daily mean PM2.5 concentrations should not exceed 25 µg/m3[12]. Over the entire period, some sensors recorded PM2.5 concentrations in excess of 25 µg/m3 for periods of more than 24 hours. Some of these situations took place around the period of pollution peak of 08/04/2019.

[11] https://www.lesoir.be/209421/article/2019-02-28/pic-de-pollution-aux-particules-fines-dans-tout-le-pays et https://www.lesoir.be/217146/article/2019-04-08/pic-de-pollution-aux-particules-fines-ce-lundi-dans-tout-le-pays

[12] https://www.who.int/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health

Table 2 shows all these situations, with the beginning (time at which the concentration exceeds 25 µg/m3), the end (time at which the concentration drops below 25 µg/m3), the duration of the event and the location of the sensor (restricted to the street for personal data protection purposes)

Start	End	Duration (h)	Address (Street)
07/04/2019 19:18	08/04/2019 19:29	24.20	Clos Albert Marinus, 1200 Woluwe-Saint-Lambert
07/04/2019 20:38	08/04/2019 21:33	24.90	Avenue Paul Deschanel, 1030 Schaerbeek
07/04/2019 21:36	08/04/2019 22:40	25.07	Rue Frédéric Pelletier, 1030 Schaerbeek
07/04/2019 19:59	08/04/2019 21:37	25.63	Stokkelsesteenweg, 1200 Sint-Lambrechts-Woluwe
07/04/2019 18:16	08/04/2019 20:22	26.11	Rue de la Vallée, 1000 Brussels
07/04/2019 18:49	08/04/2019 21:12	26.40	Avenue du Houx, 1170 Watermael-Boitsfort
07/04/2019 21:26	09/04/2019 00:46	27.33	Elzas-Lotharingenstraat, 1050 Elsene
07/04/2019 18:33	09/04/2019 00:15	29.70	Chaussée de Wavre, 1050 Ixelles
17/04/2019 04:24	18/04/2019 10:26	30.05	Chaussée de Wavre, 1050 Ixelles
17/04/2019 04:30	18/04/2019 11:02	30.54	Lindestraat, 1140 Evere
07/04/2019 18:25	09/04/2019 02:14	31.82	Chaussée de Wavre, 1050 Ixelles
07/04/2019 02:32	08/04/2019 21:26	42.89	Edouard Michielsstraat, 1180 Ukkel
07/04/2019 19:08	09/04/2019 18:46	47.64	Donkerstraat, 1150 Sint-Pieters-Woluwe
07/04/2019 21:26	10/04/2019 00:59	51.54	Poincarélaan, 1070 Anderlecht
07/04/2019 21:29	10/04/2019 01:02	51.55	Artesiëstraat, 1000 Brussels
07/04/2019 21:09	10/04/2019 00:45	51.59	Ernest Renanlaan, 1030 Schaarbeek
07/04/2019 20:57	10/04/2019 00:42	51.74	Avenue Jean Dubrucq, 1080 Molenbeek-Saint-Jean
07/04/2019 20:58	10/04/2019 00:53	51.93	Vanderborghtstraat, 1081 Koekelberg
07/04/2019 21:04	10/04/2019 01:09	52.09	Lindestraat, 1140 Evere
07/04/2019 18:09	10/04/2019 01:53	55.73	Defacqzstraat, 1060 Sint-Gillis
07/04/2019 18:45	10/04/2019 02:43	55.97	Avenue François-Bernard Verboven, 1160 Auderghem
07/04/2019 11:32	10/04/2019 01:11	61.64	Diepestraat, 1180 Ukkel
07/04/2019 00:49	10/04/2019 02:18	73.48	Rue Marguerite Bervoets, 1190 Forest

Table 2 Situations lasting for longer than 24 hours with PM2.5 concentration in excess of 25 µg/m3

3.4 Locations with the highest maximum PM2.5 concentration

Figure 7 includes the address, restricted to the street, of the 10 sensors which recorded the highest maximum reading. The location of these sensors is represented on figure 8.

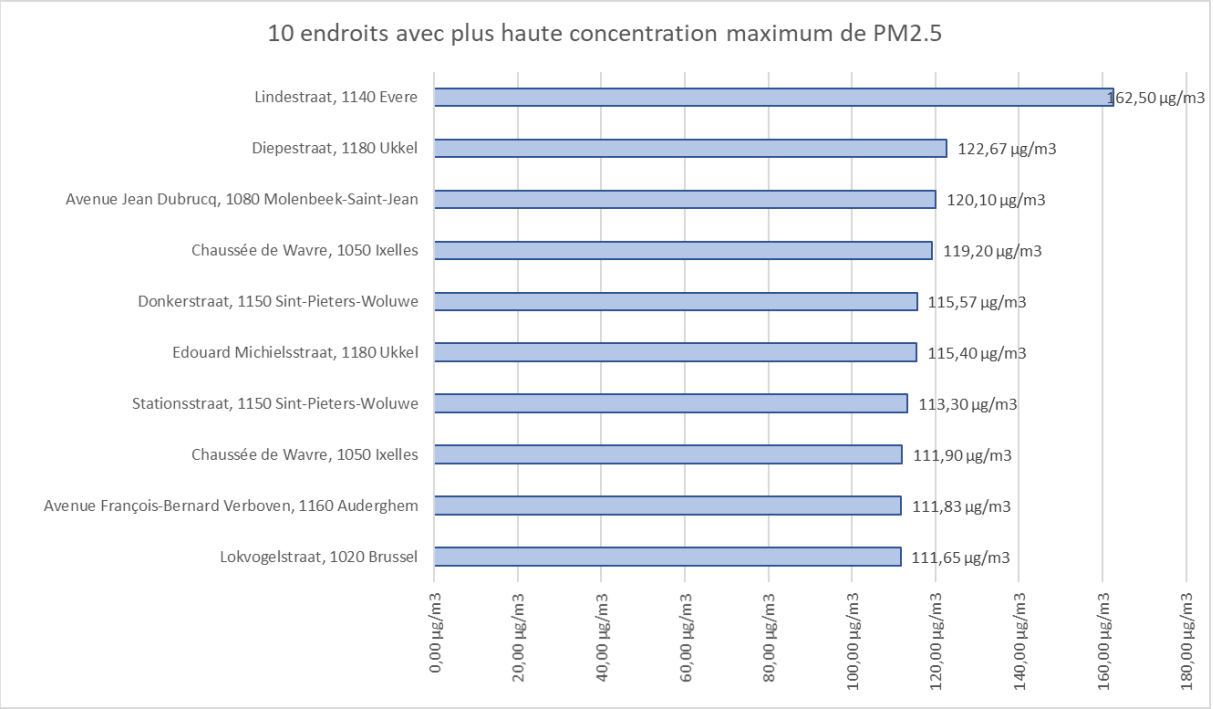

Figure 7 Top 10 areas with maximum PM2.5 concentration - February to April 2019

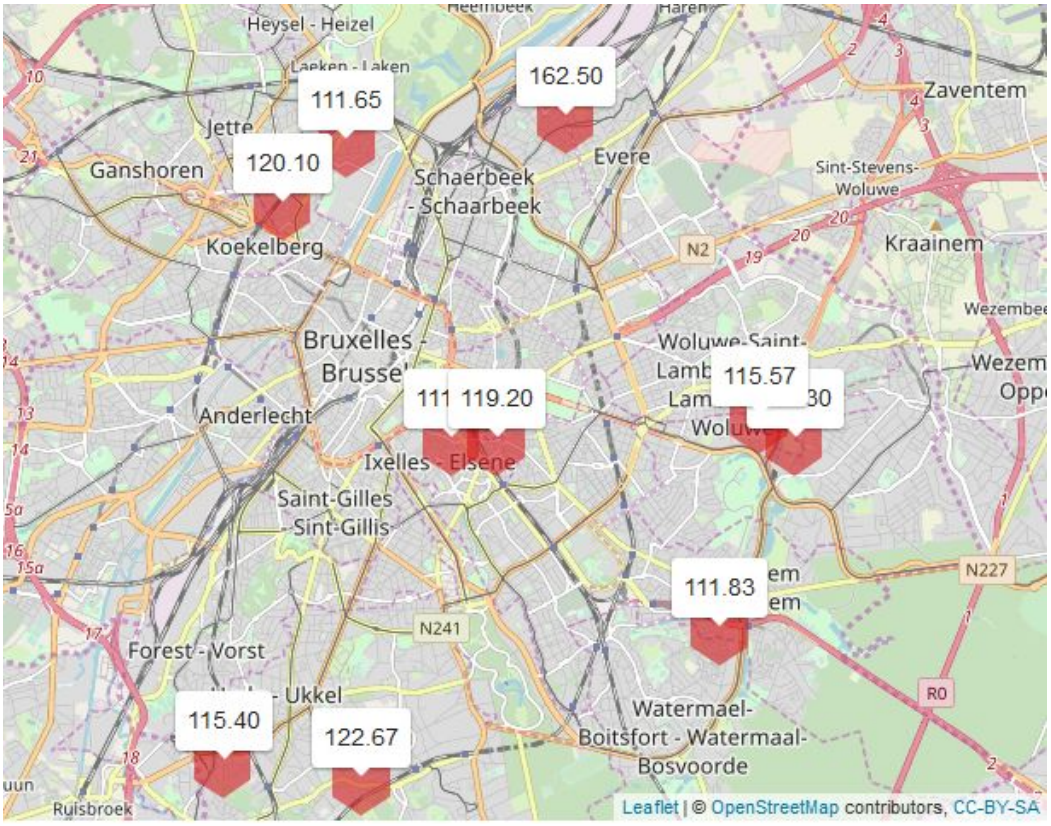

Figure 8 Location of the top 10 areas with maximum PM2.5 concentration - February to April 2019

These figures show maximums above 100 µg/m3

3.5 Locations with the greatest variation in PM2.5 concentration throughout the day

It is interesting to measure the variation in the PM2.5 concentration throughout the day, as it may indicate the source of pollution (mobility, weather conditions, heating, etc.).

The daily variation in PM2.5 concentration was measured as the difference between the maximum and minimum reading over a day. This value is then aggregated over the month using a mean value.

Figure 9 includes the 10 locations with the greatest variation in the daily mean over the period under study. This figure shows that, for these points, the variation is greater than 34 µg/m3.

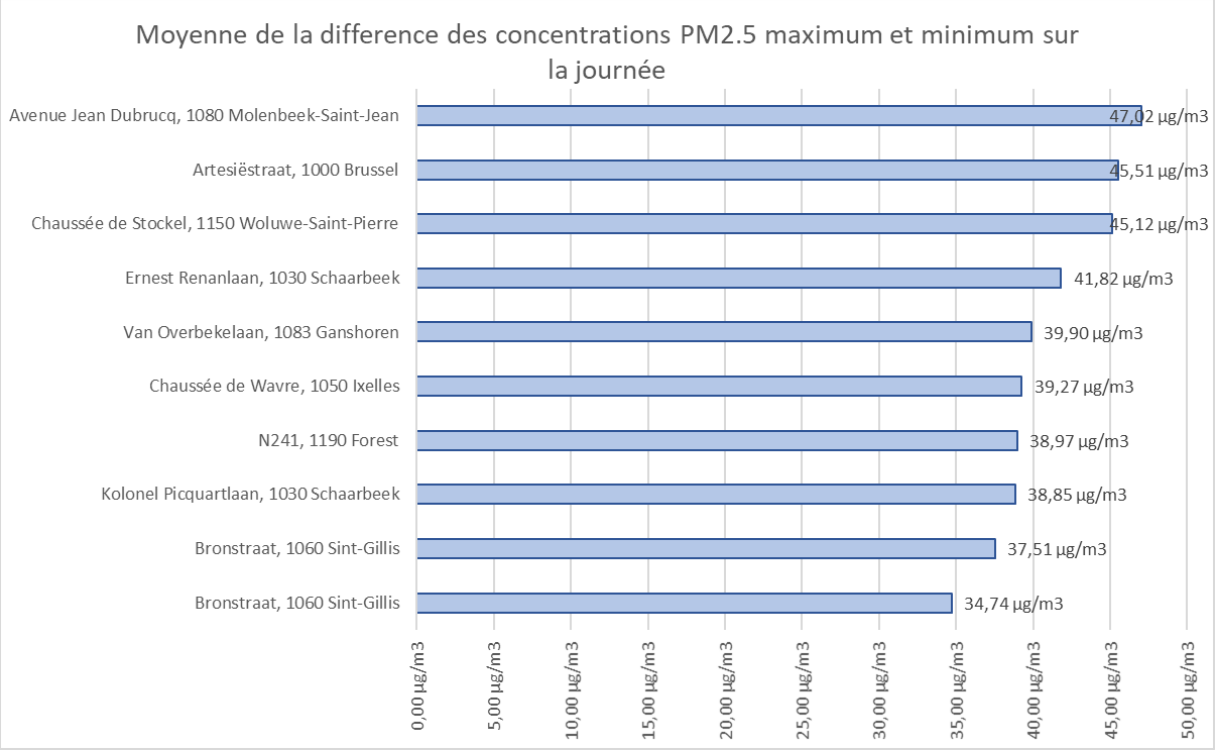

Figure 9 Areas with the greatest variation in the daily mean – - February to April 2019

4. Monthly Results

4.1 February 2019 Results

4.1.1 Overall values

In the month of February, after analysing the technical acceptability of the data, 44 sensors were used.

The mean PM2.5 concentration observed was 10.23 µg/m3 and the maximum value was 111.65 µg/m3.

Number of sensors	44
Mean PM2.5 concentration (µg/m3)	10.23
Maximum PM2.5 concentration (µg/m3)	111.65

Table 3 Summary of February 2019

4.1.2 Evolution of the PM2.5 concentration over the month

The following graph shows the evolution of the daily mean PM2.5 concentration. The maximum daily mean is reached on the last day of the month, i.e. 28/02/2019, with a value of 24.21 µg/m3. On that day, there was a pollution peak alert throughout the country[13].

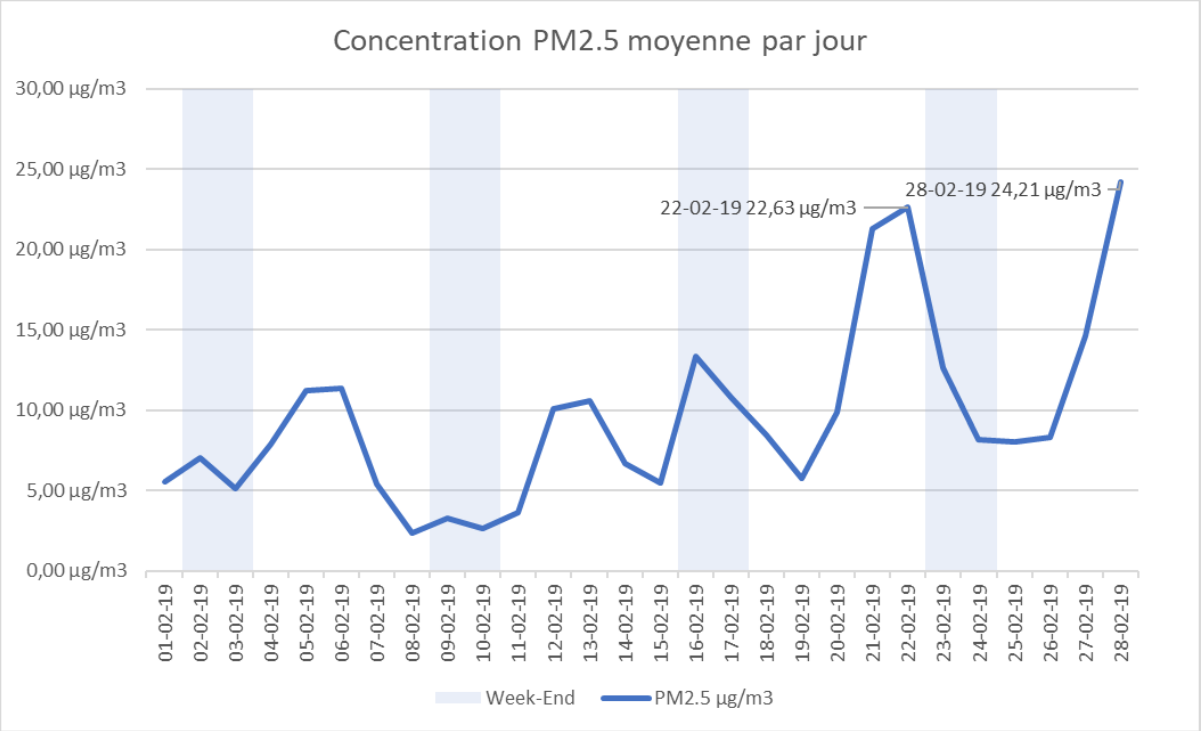

Figure 10 Evolution of the daily mean PM2.5 concentration

Figure 11 provides the maximum PM2.5 reading per day during the month, with all sensors considered. The absolute maximum of the month was obtained on 24/02, with 111.65 µg/m3

[13] https://www.lesoir.be/209421/article/2019-02-28/pic-de-pollution-aux-particules-fines-dans-tout-le-pays

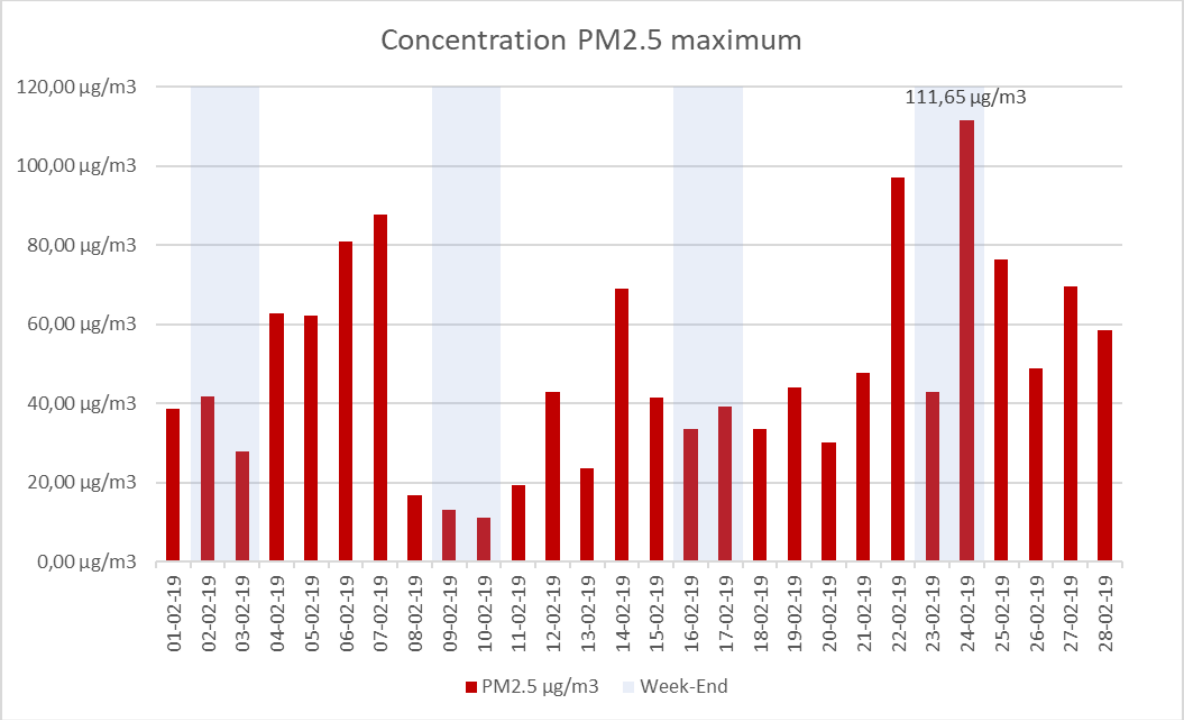

Figure 11 Maximum PM2.5 concentration observed per day - February 2019

4.1.3 Locations with the greatest mean PM2.5 concentration

Figure 13 includes the address, restricted to the street, of the 10 sensors which recorded the highest mean reading. The location of these sensors is represented on figure 14.

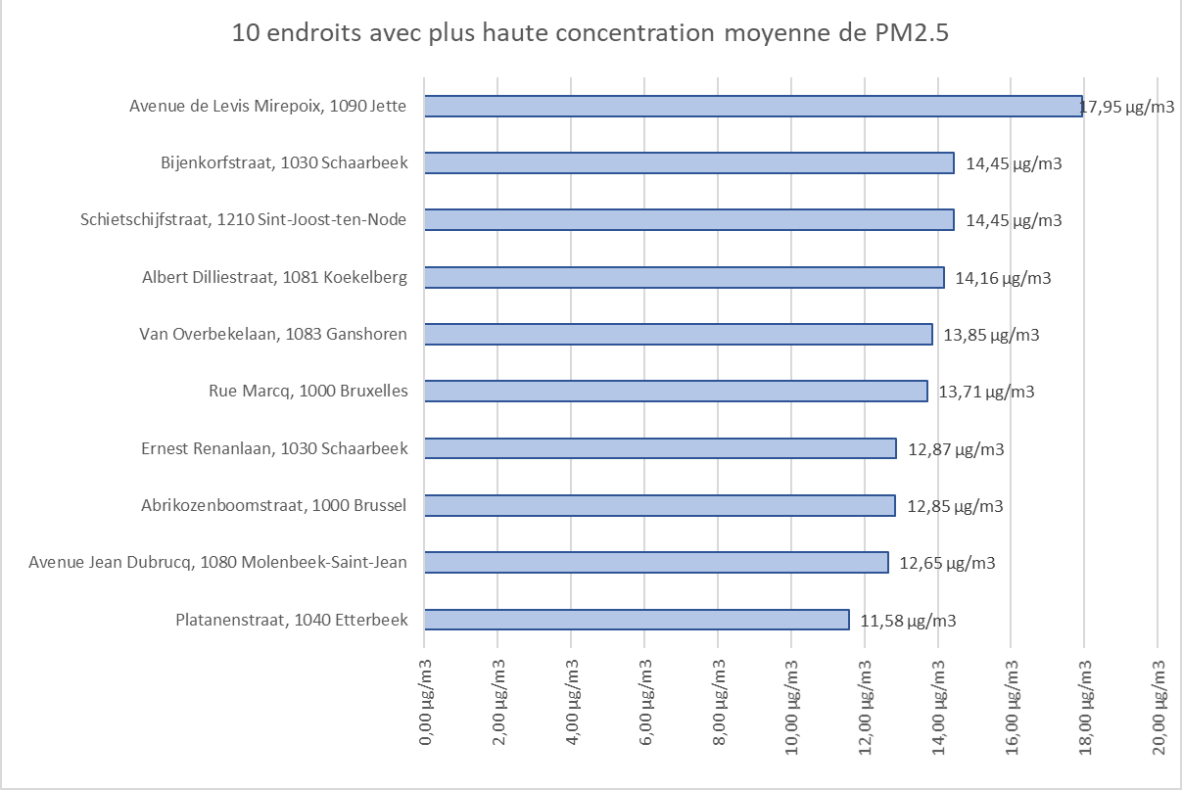

Figure 13 Top 10 locations with the highest mean PM2.5 concentrations - February 2019

For information purposes only, the recommendation of the World Health Organisation (WHO) relating to the PM2.5 exposure limit is 10 µg/m3 based on an annual mean[14]. The measurements for the sensors above show that they are all above 10 µg/m3. When the data have been collected over a period of at least one year, it will be necessary to check whether the annual mean remains above 10 µg/m3.

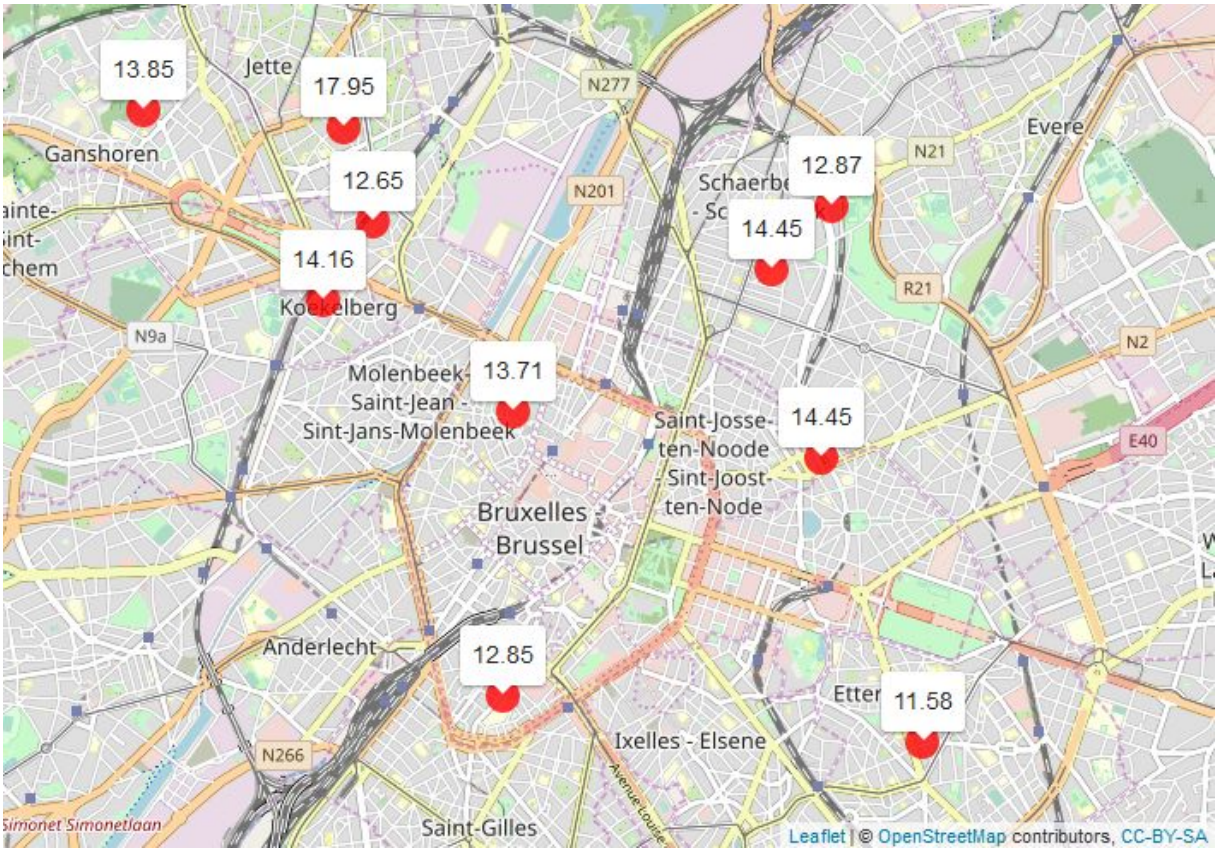

Figure 14 Location of the top 10 areas with the highest mean PM2.5 concentration - February 2019

4.1.4 Locations with the highest maximum PM2.5 concentration

Figure 15 includes the address, restricted to the street, of the 10 sensors which recorded the highest maximum reading. The location of these sensors is represented on figure 16.

[14] https://www.who.int/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health

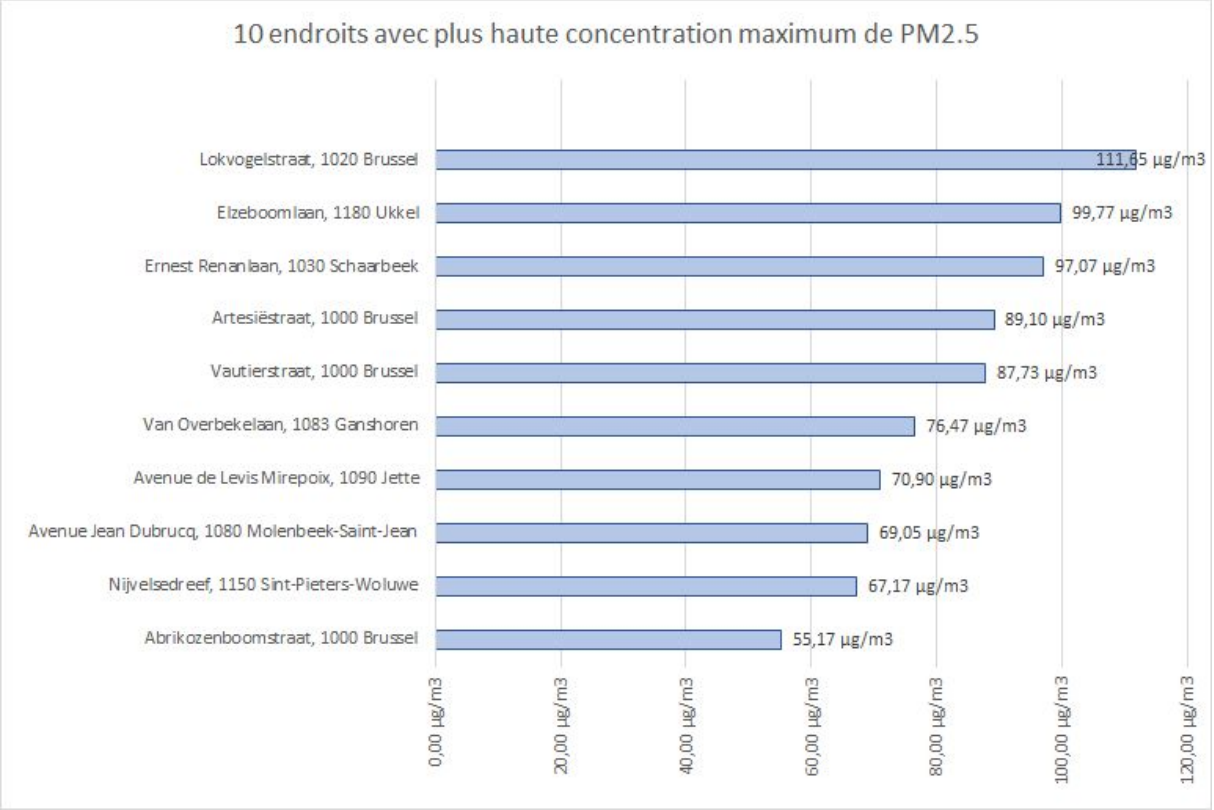

Figure 15 Top 10 areas with maximum PM2.5 concentration - February 2019

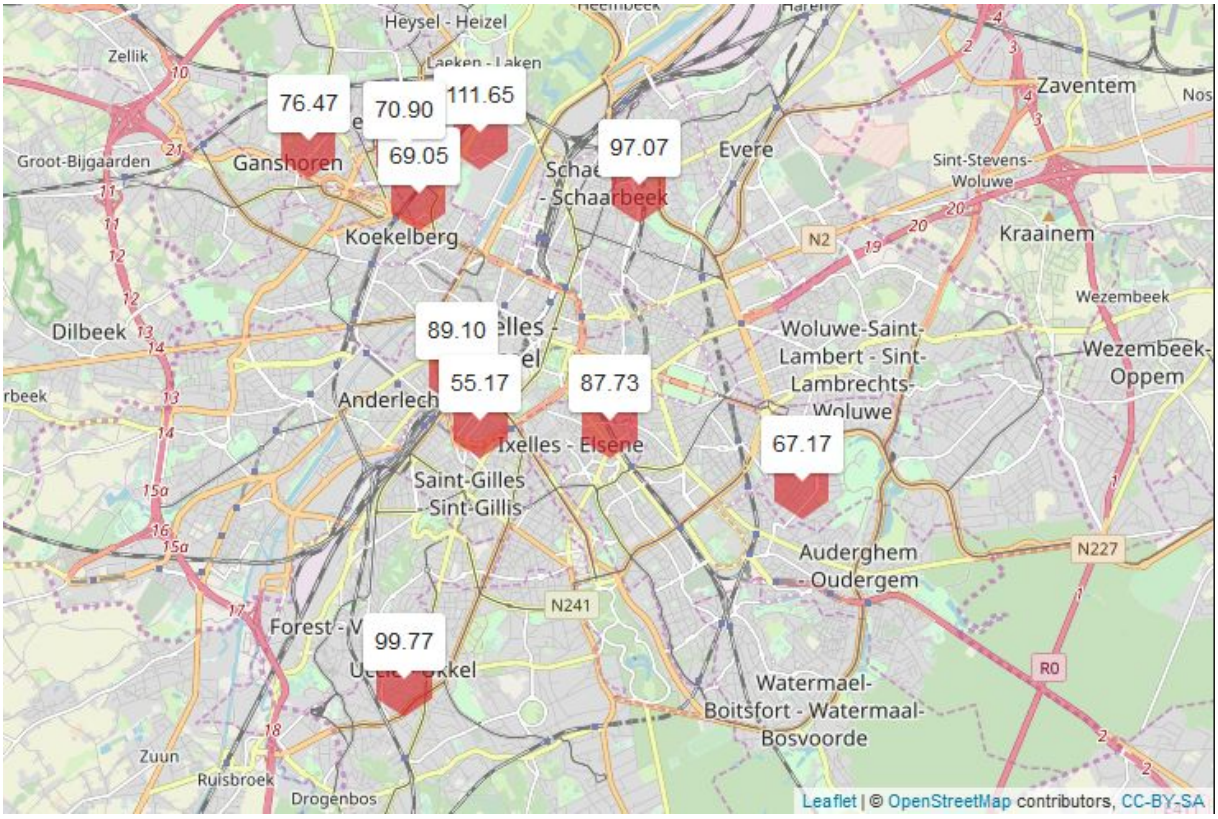

Figure 16 Location of the top 10 areas with maximum PM2.5 concentration - February 2019

4.2 March 2019 Results

4.2.1 Overall values

In the month of March, after analysing the technical acceptability of the data, 81 sensors were used. This is a clear increase in the number of sensors in relation to the month of February.

The mean PM2.5 concentration observed was 9.42 µg/m3 and the maximum value was 106.3 µg/m3. These values are slightly lower than those observed in February 2019 (see 3.1.1)

Number of sensors	81
Mean PM2.5 concentration (µg/m3)	9.42
Maximum PM2.5 concentration (µg/m3)	106.3

Table 4 Summary of March 2019

4.2.2 Evolution of the PM2.5 concentration over the month

The following graph shows the evolution of the daily mean PM2.5 concentration. The maximum daily mean is reached on Saturday 23/03/2019, with a value of 39.76 µg/m3. This is a particularly extreme value in view of the means from the other days. On the final day of the month, the mean PM2.5 concentration is also relatively high, with 26.79 µg/m3.

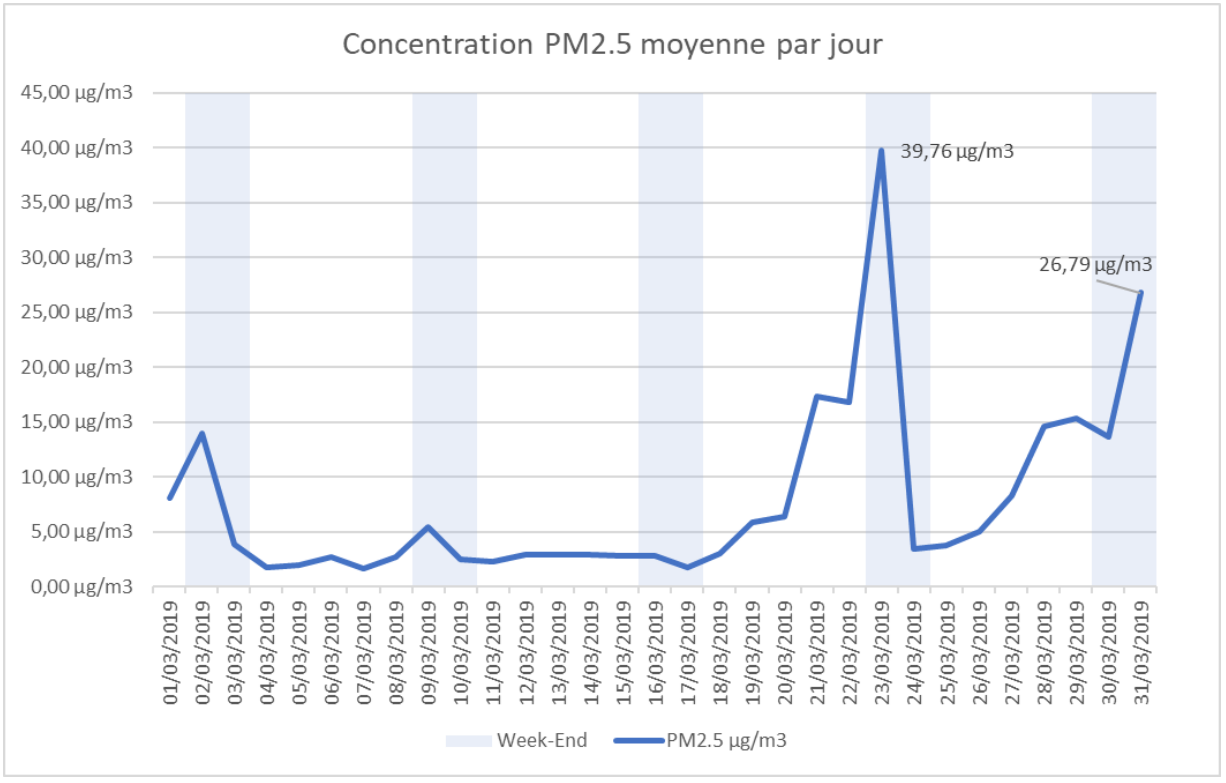

Figure 17 Evolution of the daily mean PM2.5 concentration

Figure 18 includes the maximum PM2.5 concentration per day, the maximum of the month is also reached on 23/03/2019, with 106.30 µg/m3.

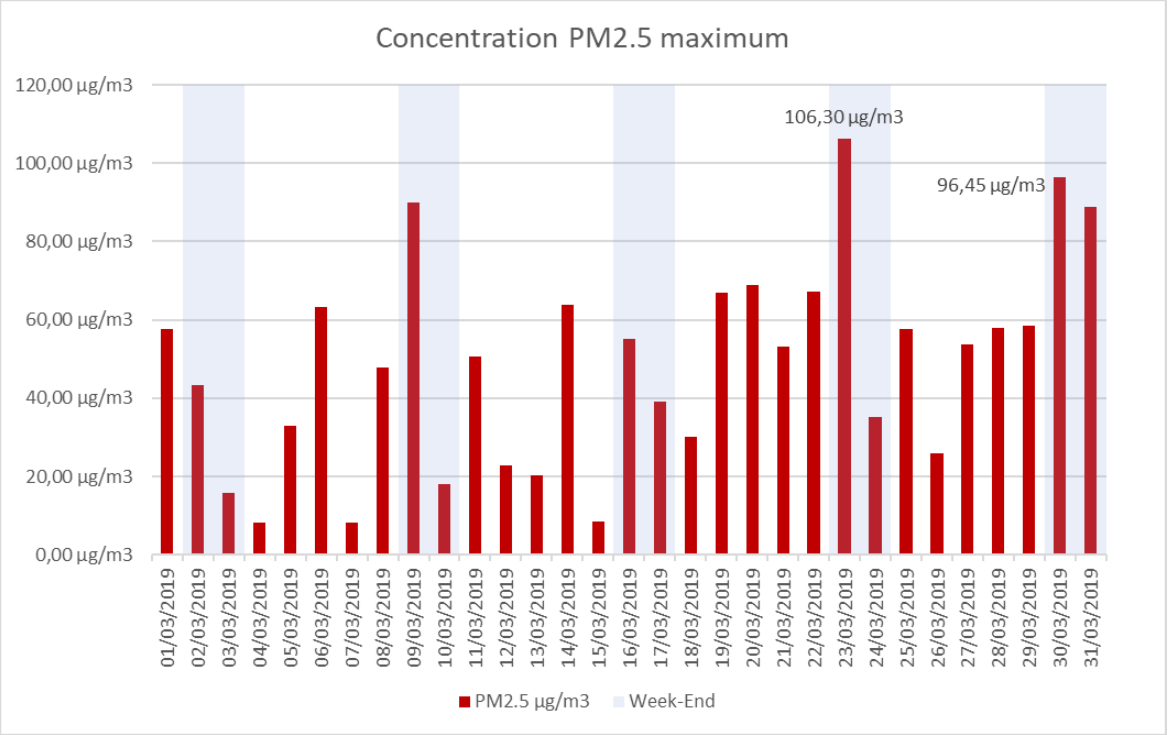

Figure 18 Maximum PM2.5 concentration observed per day - March 2019

These figures show that, over the month of March, the two highest daily PM2.5 concentration readings, either the mean or maximum, are reached on 23/03/2019 and 30/03/2019, i.e. both times on a Saturday.

4.2.3 Locations with the greatest mean PM2.5 concentration

Figure 20 includes the address, restricted to the street, of the 10 sensors which recorded the highest mean reading. The location of these sensors is represented on figure 21.

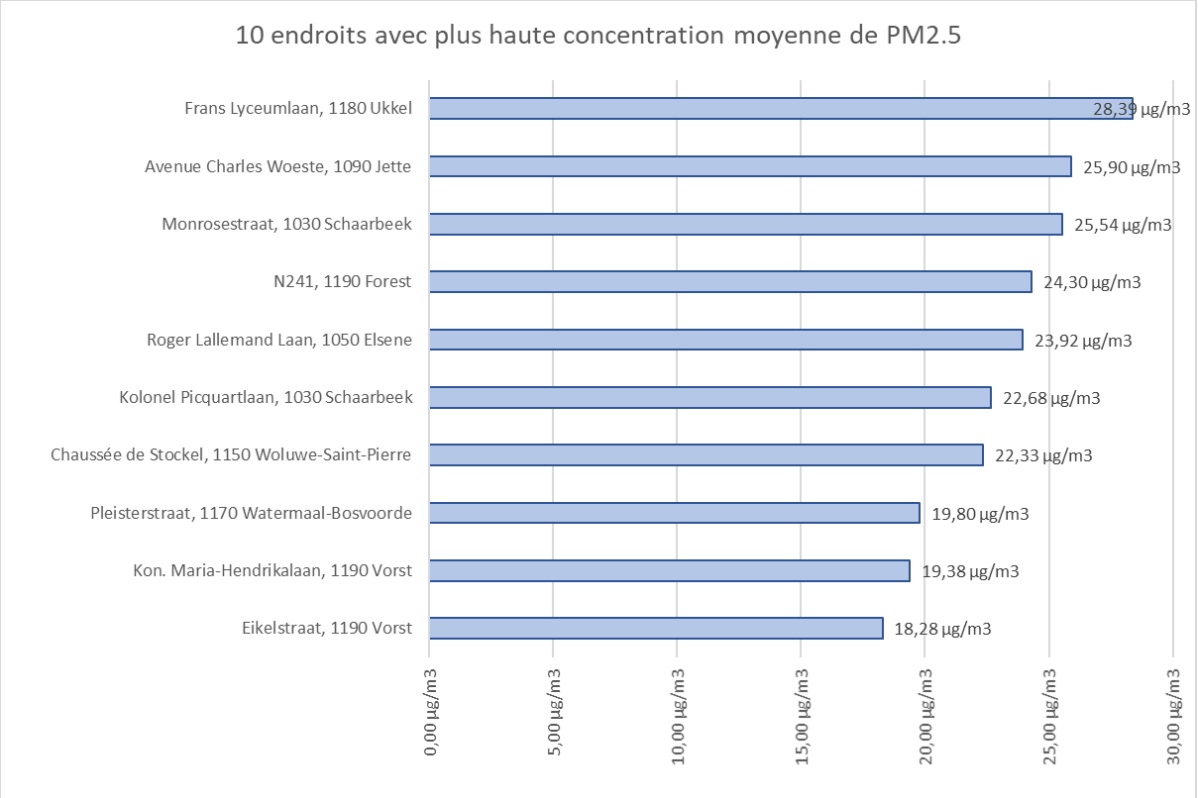

Figure 20 Top 10 areas with the highest mean PM2.5 concentration - March 2019

Compared with the results from the month of February 2019 (Figure 13), the values obtained here are higher and remain above 10 µg/m3.

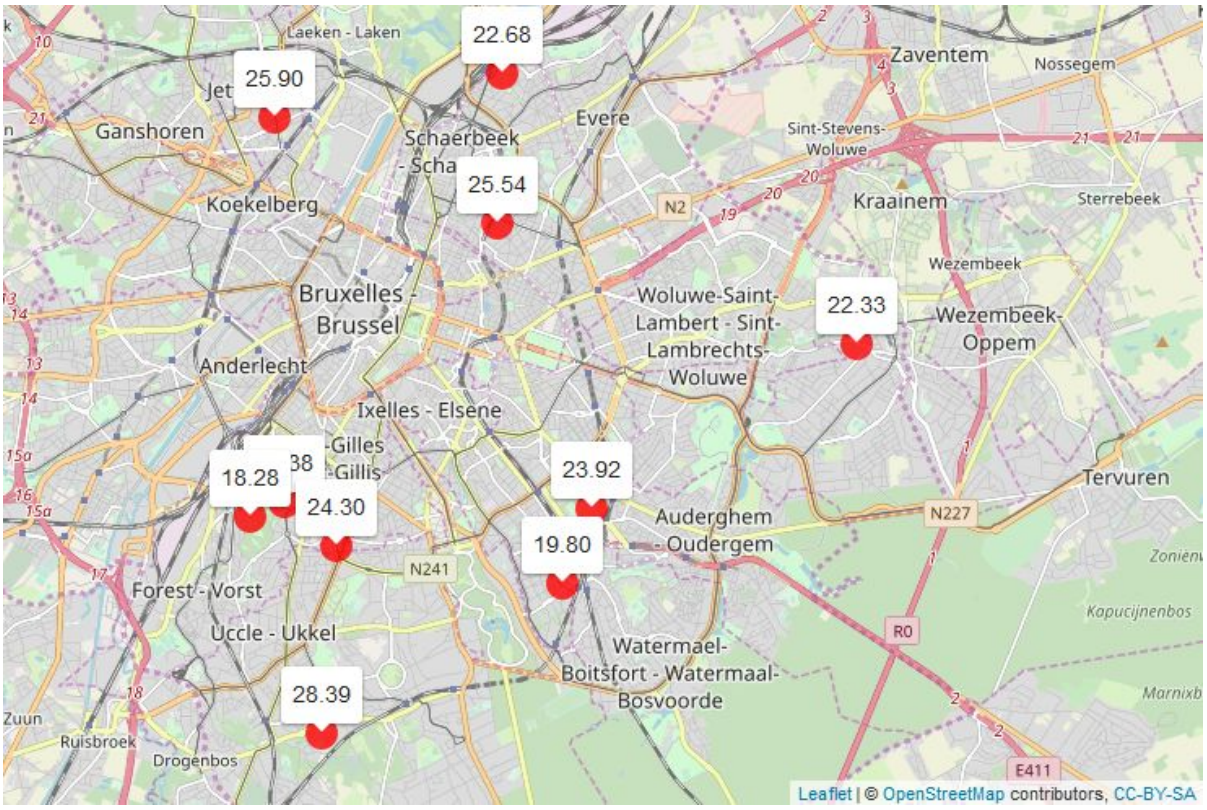

Figure 21 Location of the top 10 areas with the highest mean PM2.5 concentration - March 2019

4.2.4 Locations with the highest maximum PM2.5 concentration

Figure 22 includes the address, restricted to the street, of the 10 sensors which recorded the highest maximum reading. The location of these sensors is represented on figure 23.

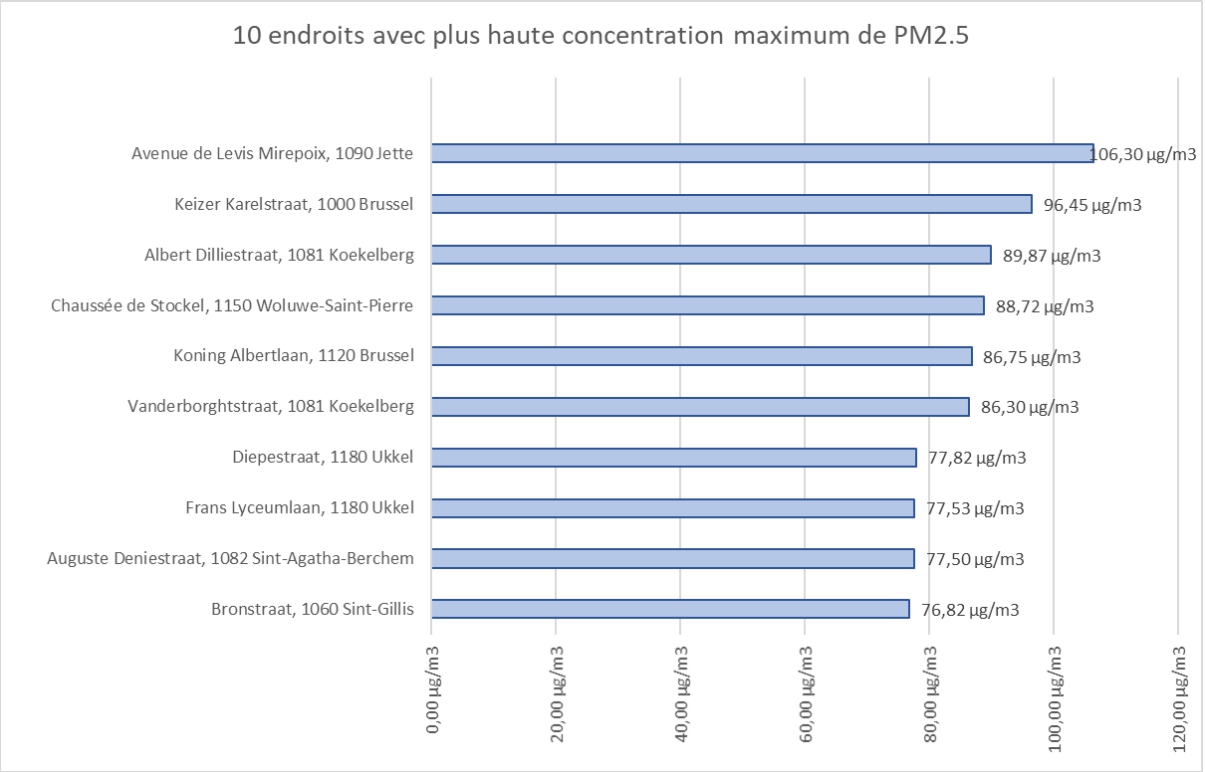

Figure 22 Top 10 areas with maximum mean PM2.5 concentration - March 2019

Figure 22 shows that, in relation to February 2019 (Figure 15), there are more peaks above 50 µg/m3, despite a lower absolute maximum than in the month of February.

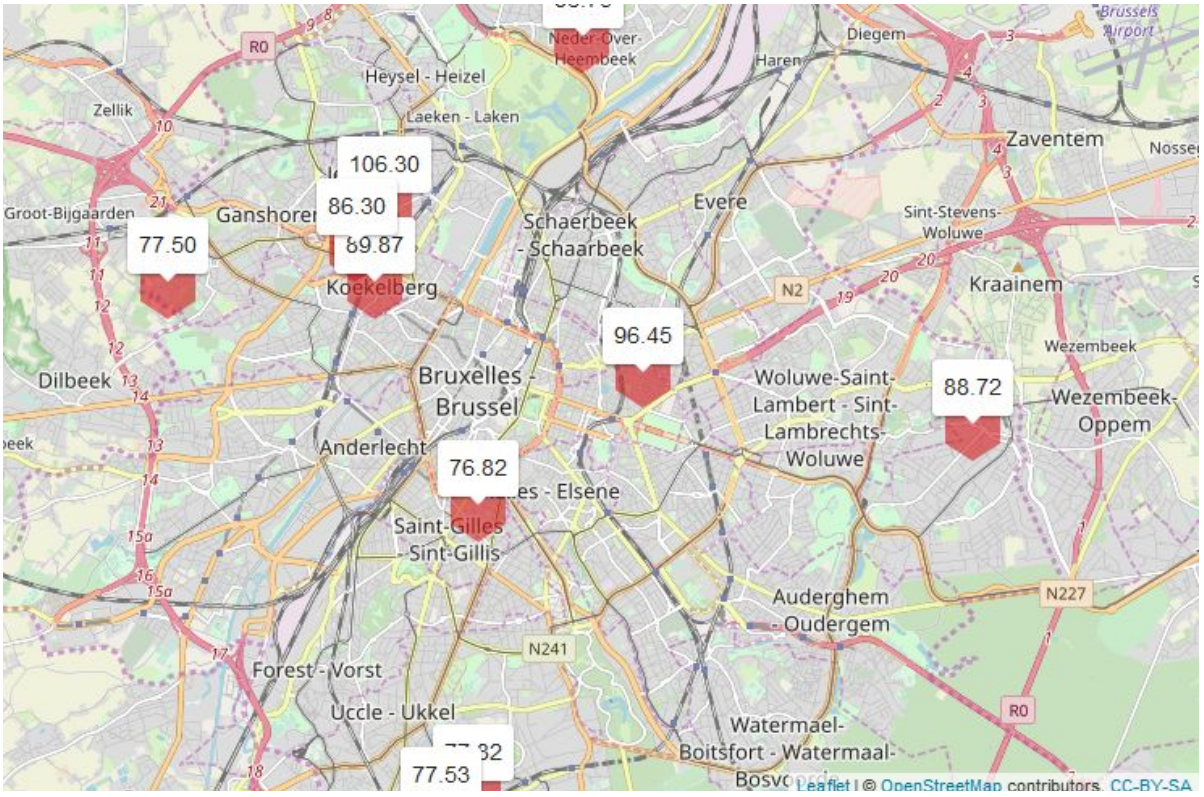

Figure 23 Location of the top 10 areas with maximum mean PM2.5 concentration - March 2019

4.3 April 2019 Results

4.3.1 Overall values

In the month of April, after analysing the technical acceptability of the data, 84 sensors were used. That is to say 3 additional sensors compared with the month March.

The mean PM2.5 concentration observed was 11.64 µg/m3 and the maximum value was 162.5 µg/m3.

Number of sensors	84
Mean PM2.5 concentration (µg/m3)	11.64
Maximum PM2.5 concentration (µg/m3)	162.5
Number of sensors whose PM2.5 reading exceeded 25 µg/m3, on at least one occasion, for more than 24 hours	21

Table 5 Summary of April 2019

4.3.2 Evolution of the PM2.5 concentration over the month

The following graph shows the evolution of the daily mean PM2.5 concentration. The maximum daily mean is reached on Monday 08/04/2019, with a value of 75.67 µg/m3. This is a particularly extreme value in view of the means from the other days. On Monday 08/04/2019, there was a pollution alert throughout Belgium[15].

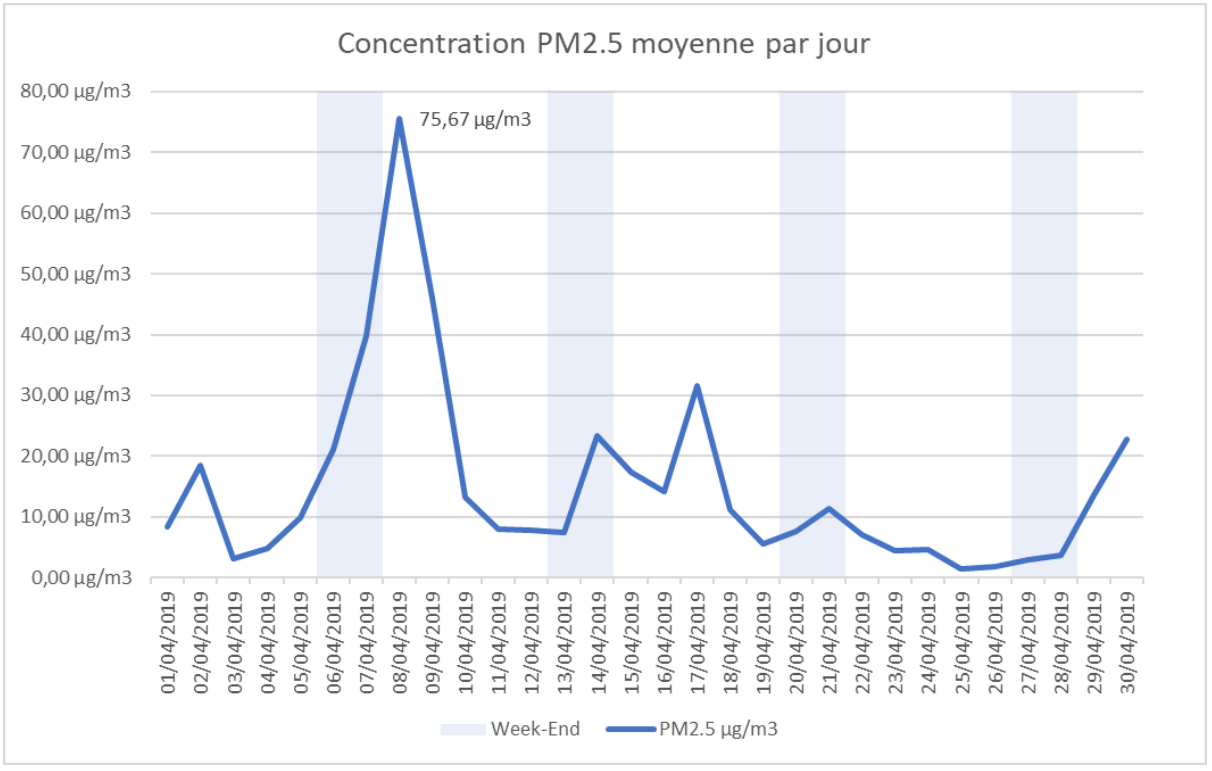

Figure 24 Evolution of the daily mean PM2.5 concentration - April 2019

Figure 25 includes the maximum PM2.5 concentration per day, the maximum of the month is reached on 07/04/2019, with 162.50 µg/m3.

15 https://www.lesoir.be/217146/article/2019-04-08/pic-de-pollution-aux-particules-fines-ce-lundi-dans-tout-le-pays

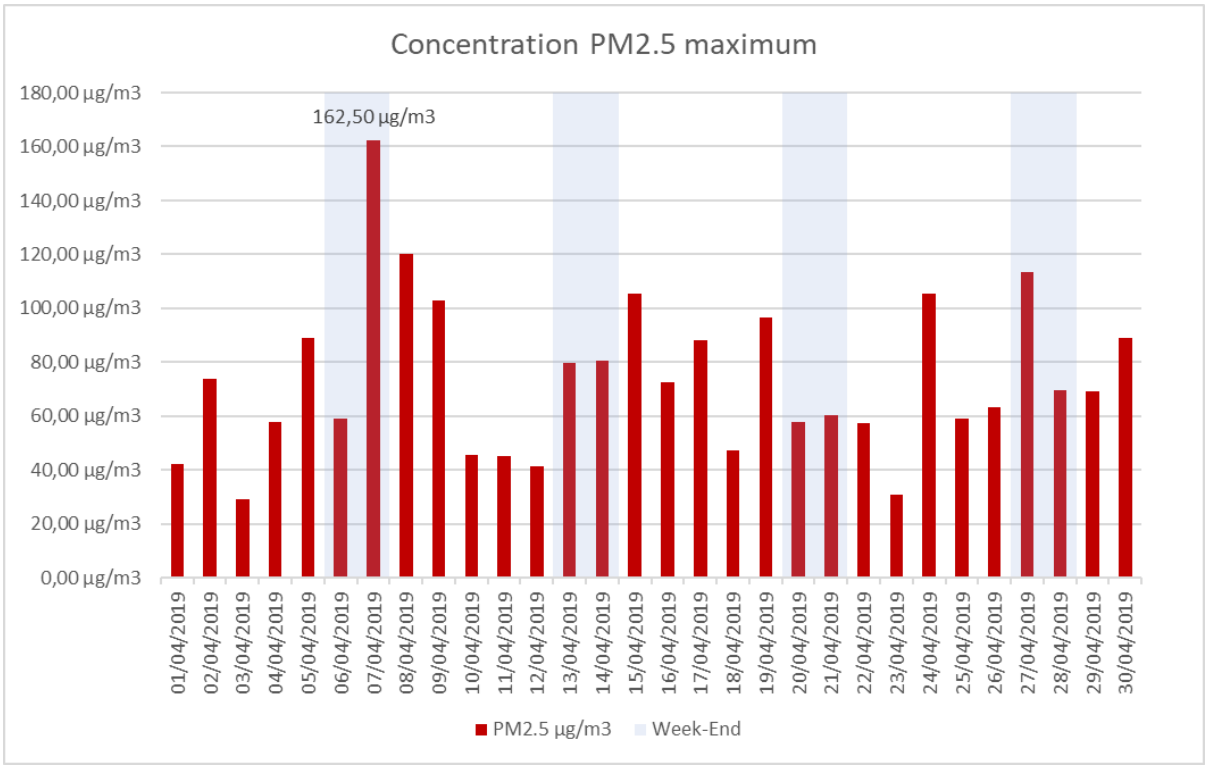

Figure 25 Maximum PM2.5 concentration observed per day - April 2019

4.3.3 Locations with the greatest mean PM2.5 concentration

Figure 27 includes the address, restricted to the street, of the 10 sensors which recorded the highest mean reading. The location of these sensors is represented on figure 28.

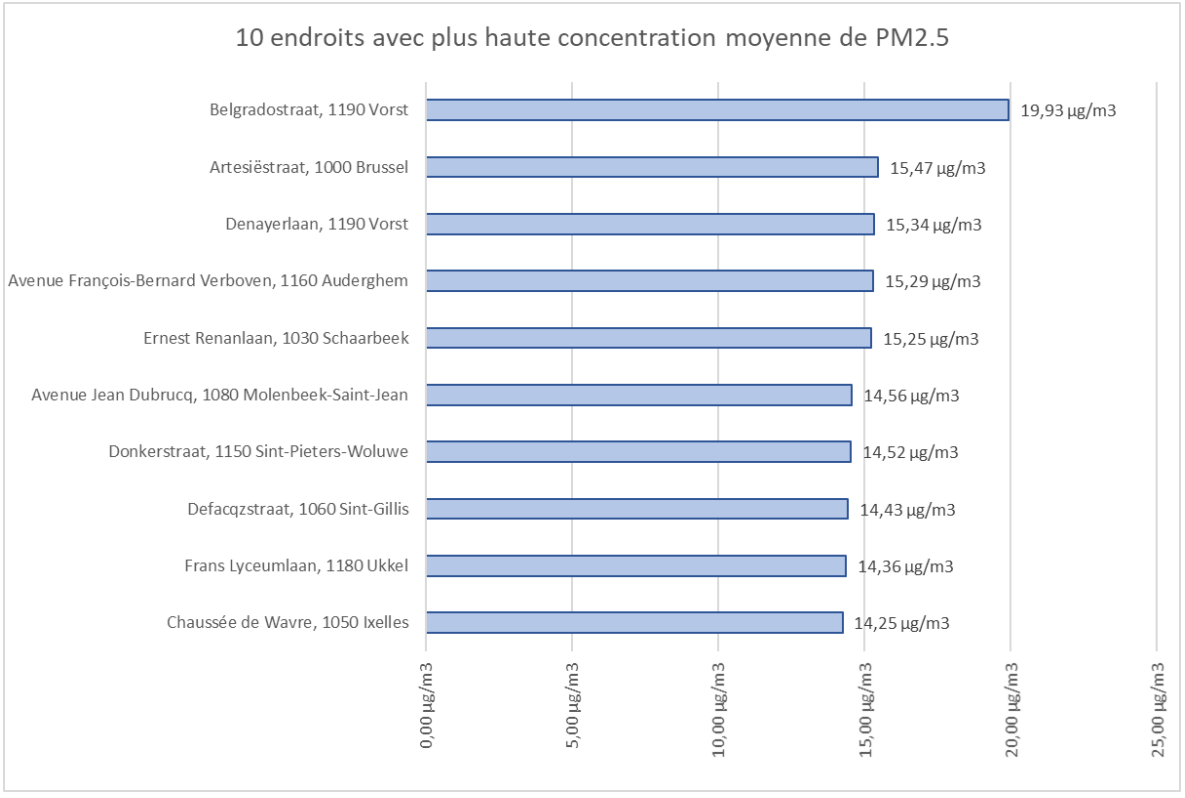

Figure 27 Top 10 areas with the highest mean PM2.5 concentration - April 2019

These mean values are similar to those recorded for February 2019 (see Figure 13).

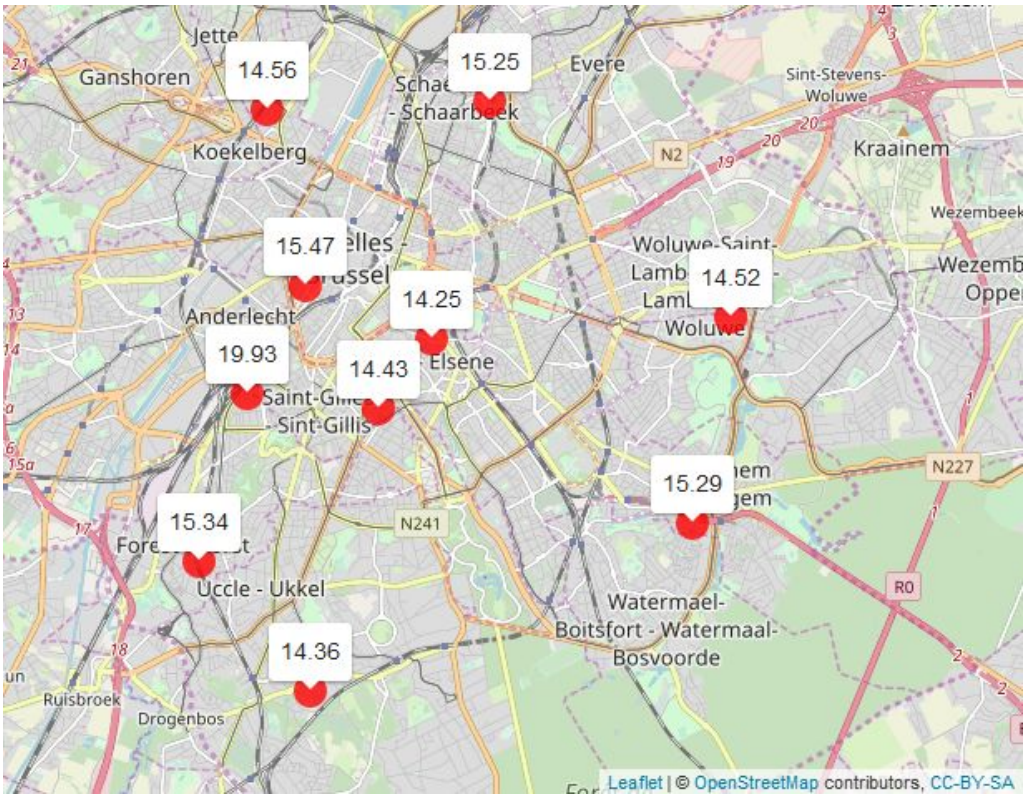

Figure 28 Location of the top 10 areas with the highest mean PM2.5 concentration - April 2019

4.3.4 Locations with the highest maximum PM2.5 concentration

Figure 29 includes the address, restricted to the street, of the 10 sensors which recorded the highest maximum reading. The location of these sensors is represented on figure 30.

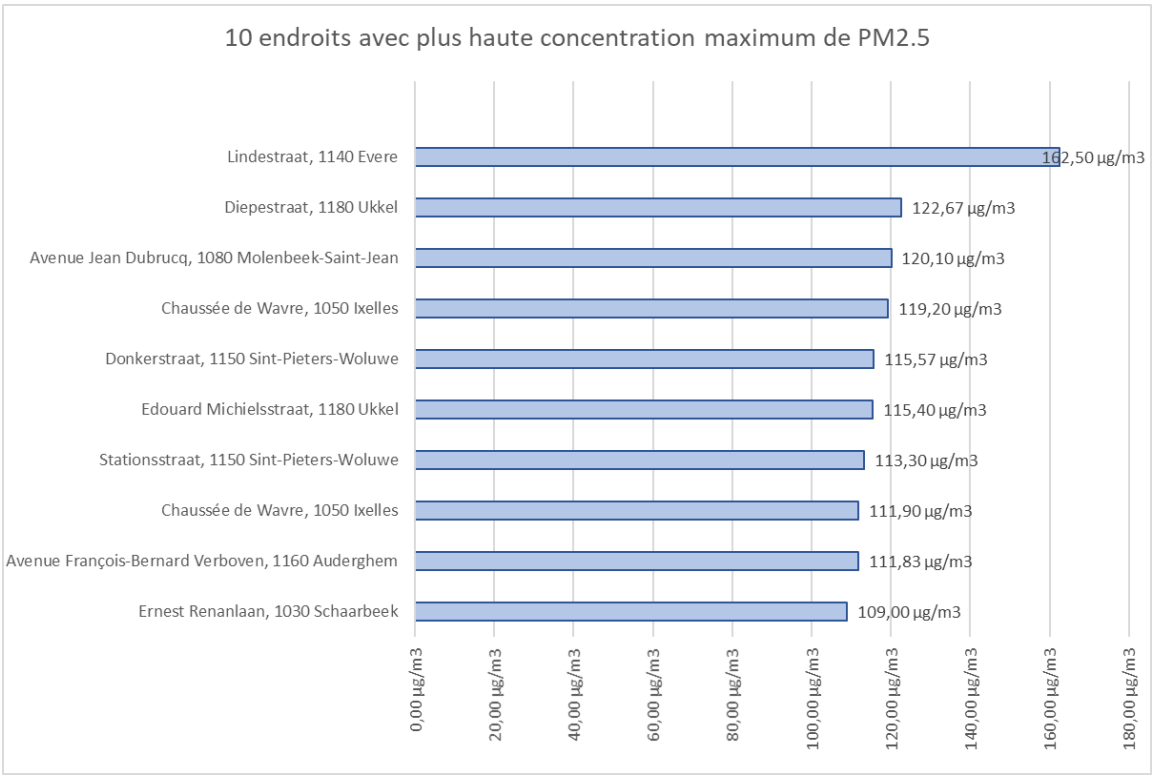

Figure 29 Top 10 areas with maximum mean PM2.5 concentration - April 2019

Figure 29 shows that the maximums reached in April are higher than those from the months of February and March.

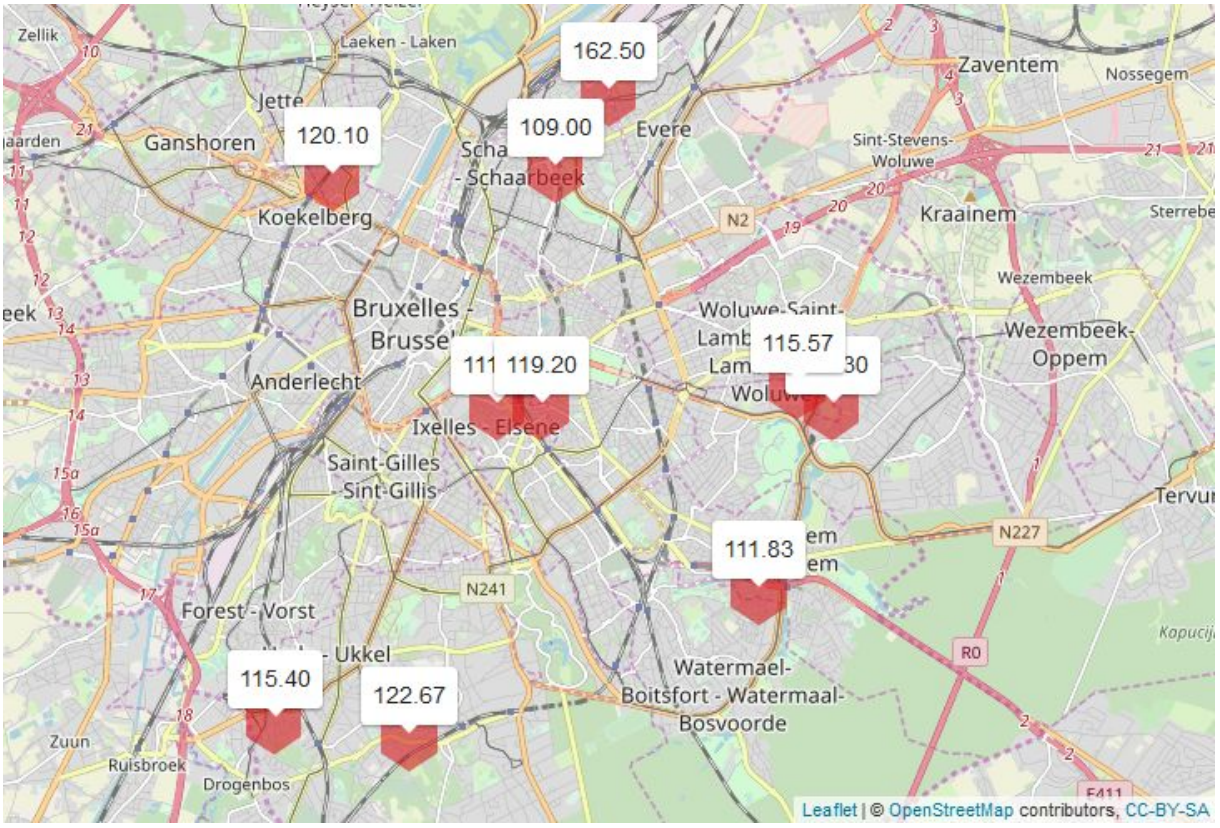

Figure 30 Location of the top 10 areas with maximum mean PM2.5 concentration - March 2019

5. Conclusions

This report has covered various aspects related to air quality on the basis of measurements taken using *Luftdaten* sensors as part of the collaborative science project entitled *Les chercheurs d'air*.

Firstly in relation to the reliability of these sensors, the comparison between their data and those of the CELINE network has shown that the *Luftdaten* sensors can be considered to be reliable (due to the fact that the faulty sensors and anomalous measurements have been filtered out). Indeed, over the entire period, the measurements from the two networks are pretty similar and both show the same PM2.5 concentration peaks over the period (see Figure 6). Furthermore, the daily PM2.5 concentration curves of CELINE and *Les chercheurs d'air* during the pollution peak dates are very similar (see Figure 3, Figure 4 and Figure 5).

Secondly, once the validity of the *Luftdaten* data was confirmed, further in-depth analysis was conducted to show different metrics related to air quality. The report has shown that the mean concentration exceeds the recommended annual concentration of the WHO (10 µg/m3) and that there are several episodes during which the mean over 24 hours was exceeded (25 µg/m3).

Thirdly, the analysis shows a geographical and time-related disparity in the PM2.5 concentration. At some locations, concentration peaks are much higher, with data exceeding 100 µg/m3 and concentrations above 25 µg/m3 lasting for prolonged periods. At other locations, there is a strong variation in PM2.5 concentration throughout the day.

These geographical and time-related disparities ought to be examined as part of a future study. We have to understand why there is a stronger PM2.5 concentration in some areas or why there is a strong variation in the PM2.5 concentration during the day in others. The difference in PM2.5 concentration between weekdays and weekends is interesting and ought to be examined in greater depth. This variation in space and time might enable us to understand the formation of PM2.5 concentration.

It is also important to note that the analyses and report have been produced with limited resources. With greater resources, we would be able to further this analysis and improve our understanding of the formation of PM2.5 pollution in Brussels.

Finally, the assessment is not very positive as these measurements show that the air quality in Brussels does not respect WHO recommendations. It is therefore necessary to continue our research in this area with a view to understanding the formation of pollution and proposing measures to improve the air quality in Brussels

6. Appendices

6.1 Air quality measuring principle

The sensor distributed by *Les chercheurs d'air* was developed by Luftdaten.info. Inside this sensor, there is a fine particulate matter sensor called SDS011[16] designed by the Chinese firm "Nova Fitness Co., Ltd". The fine particulate measuring principle of the SDS011 sensor is based on fine suspended particle laser scattering.

The technical reference of this sensor[17] specifies that it can be used at temperatures between -10°C and +50°C and at a relative humidity rate of up to 70%.

A study[18] has focused on the precision of the SDS011 sensor and concluded that this sensor is able to provide precise PM2.5 concentration measurements under particular conditions, especially with regard to humidity in the air.

In this report, section 2.4 showed that the data of the *Luftdaten* SDS011 sensors are similar to those of the official measurements of the CELINE network. This initial comparison shows that the difference between the two is not considerable, but this comparison must be monitored in case the difference increases over time (damaged sensors)

6.2 Analysis of the technical acceptability of readings

Before they were analysed, the raw data were assessed with regard to technical acceptability. The following data were excluded:

- Sensors with no humidity measuring instruments.
- Measurements where the humidity exceeds 70% at the same time
- Sensors which do not provide a regular enough supply of data
- Sensors whose variation in the reading of PM2.5 between two readings, at intervals of at least 2 minutes, was excessive.

In view of the fact that the SDS011 sensor manufacturer indicates that the instrument cannot be used in humidity conditions which exceed 70%, any sensors with no humidity measuring instruments have been excluded, and so too have readings taken at a time when the humidity rate was above 70%.

For some sensors, we observed an irregularity in the supply of data. In some cases, these sensors produced a measurement every 2-3 minutes, but with interruptions which sometimes exceeded an hour. These sensors were excluded as a precautionary measure.

For other sensors, we observed a phenomenon where the PM2.5 reading soars to extreme values, in some cases to the maximum (999 µg/m3) in under 5 mins, before subsequently dropping to normal values in the space of a few minutes. This phenomenon is illustrated in Figure 31. It may be due to the sensor being momentarily blocked by dust or mist. These PM2.5 concentration readings were excluded from the subsequent analysis as a precautionary measure.

[16] http://www.inovafitness.com/en/a/chanpinzhongxin/95.html
[17] https://aqicn.org/sensor/sds011/es/
[18] Budde, Matthias & Müller, Thomas & Laquai, Bernd & Streibl, Norbert & Schwarz, Almuth & Schindler, Gregor & Riedel, Till & Beigl, Michael & Dittler, Achim. (2018). *Suitability of the Low-Cost SDS011 Particle Sensor for Urban PM-Monitoring*. https://www.researchgate.net/publication/325416608_Suitability_of_the_Low-Cost_SDS011_Particle_Sensor_for_Urban_PM-Monitoring

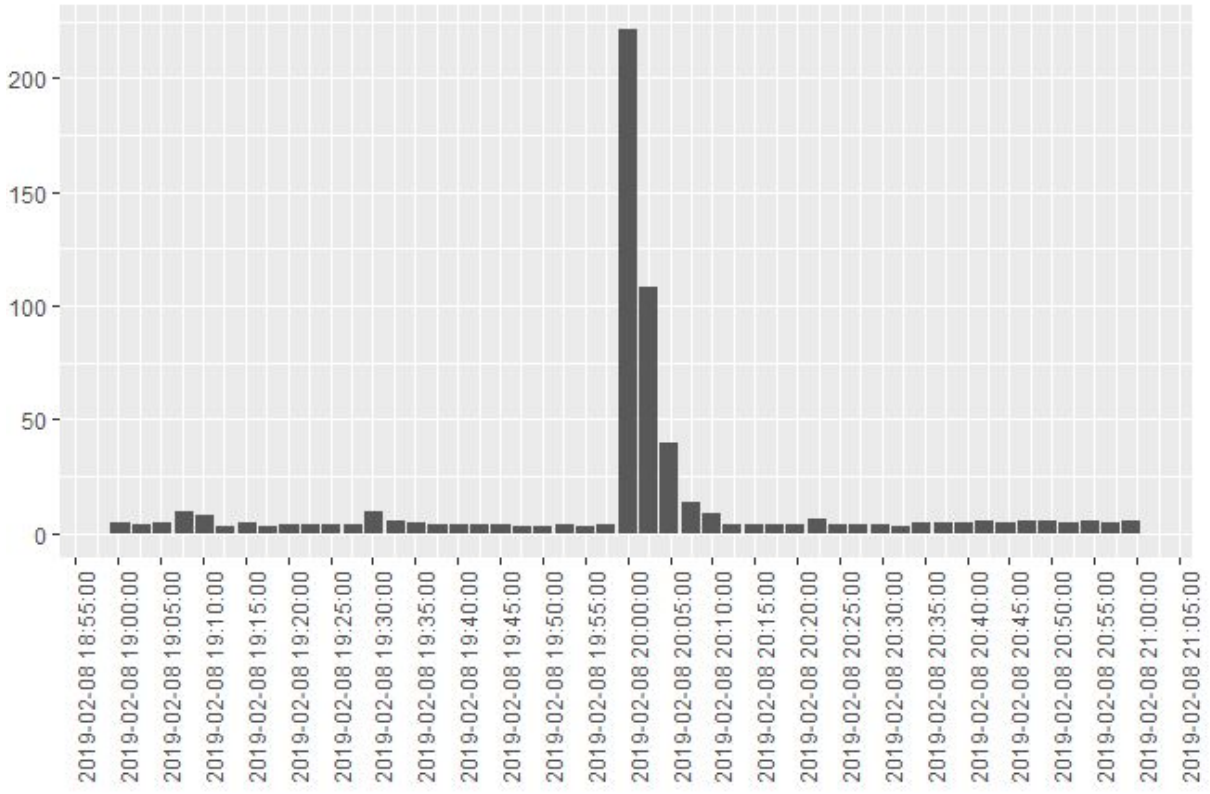

Figure 31 Example of a phenomenon where the sensor is blocked

6.3 Collection, filtering and geolocation of data

Data are collected from the monthly files on luftdate.info. Data are supplied in time series along with the sensor ID and sensor position in geographical coordinates (latitude and longitude).

Luftdaten.info supplies data related to the whole of Europe and also other continents. By initially filtering data based on geographical location, it is possible to classify them and use only those taken from sensors located in a rectangle around Brussels. By subsequently filtering data based on distance, it is possible to restrict the sensors to those located within 15 km from the centre of Brussels.

Finally, the geolocation services of Google and Open Street Map are used to identify the postal address relating to the geographical coordinates of the sensors. These geolocation services provide the nearest postal address of the geographical coordinates. In some cases, there may be several candidate addresses such as, for instance, when the geographical coordinates provided by the fitter of the sensor are near to a division wall, in the middle of a garden or any other place between several addresses. Therefore, the address may not correspond to the precise installation address of the sensor, but to a nearby address.

Once the address has been ascertained, only sensors with an address located in the Brussels region are used. In this report, we have excluded the street number out of confidentiality and respect for privacy.