Environmental Assessment Report 2022

Air Quality In Montréal

Service de l'environnement

Air Quality Monitoring

An overview of the network

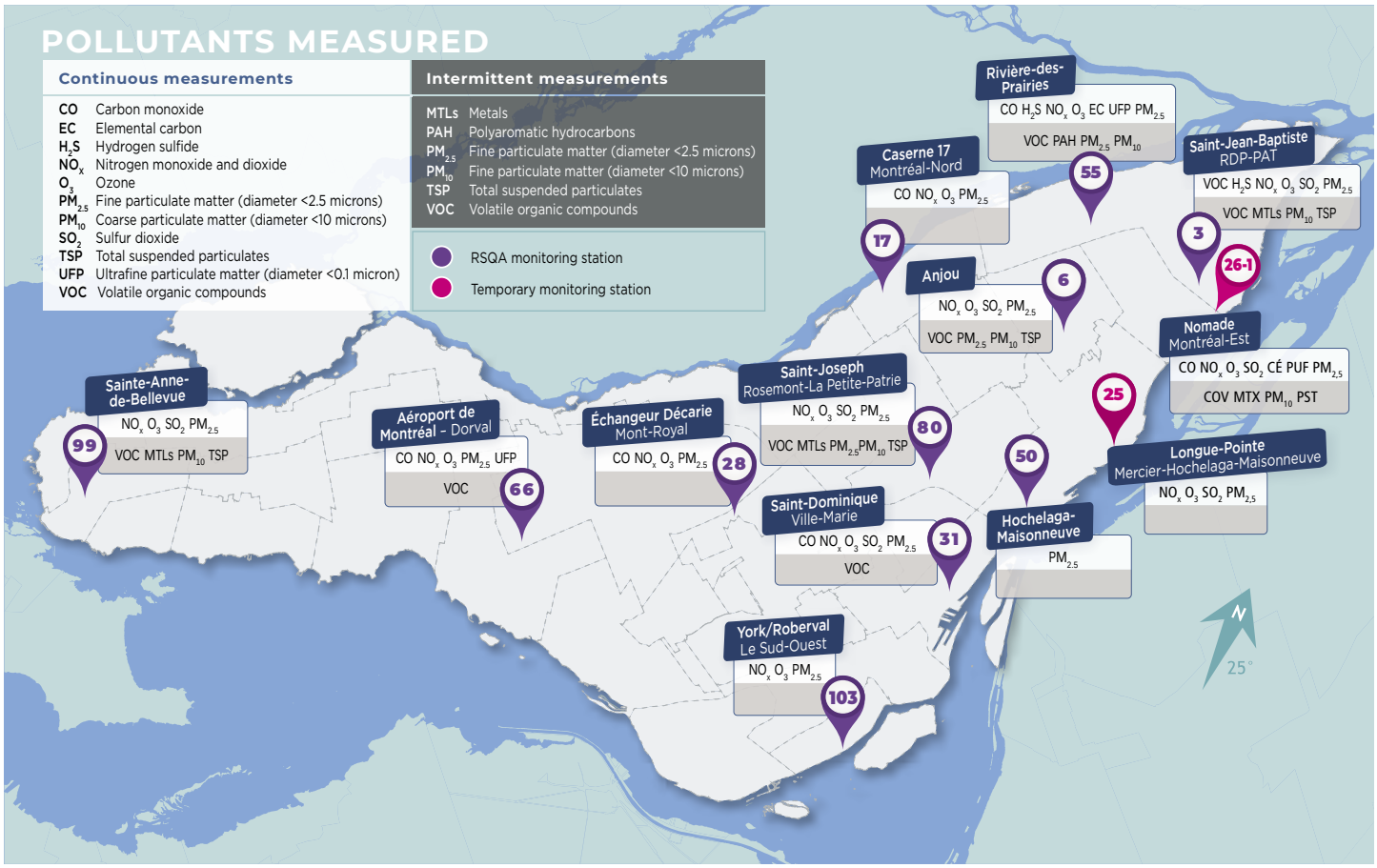
The Réseau de surveillance de la qualité de l'air (RSQA) is composed of 11 fixed monitoring stations and 2 temporary stations, one of which is nomadic, intended to conduct special projects. All stations are equipped with continuous measurement analyzers of concentrations of pollutants such as fine particles, ozone, sulfur dioxide, nitrogen oxides and carbon monoxide. The results obtained are then used to draw an annual portrait and follow the evolution of the situation regarding these pollutants over many years in Montréal. Furthermore, the information on air quality in Montréal is available in real time on the RSQA's Web application and historical data may be consulted on the open data site.

NAPS Program

Montréal was the first Canadian city to consider air quality in Canada. Thanks to its air quality monitoring network, it has actively contributed to the National Air Pollution Surveillance (NAPS) program of Environment and Climate Change Canada since 1969, in collaboration with the networks of other provincial, territorial and regional administrations.

Always at the cutting edge of technology, RSQA is a leader in air quality surveillance. For instance, since 2020, three ultrafine particle analyzers have been progressively commissioned, at a time when such instruments are still a rarity in Canadian air quality monitoring networks.

Map of permanent and temporary stations



Portrait of air quality

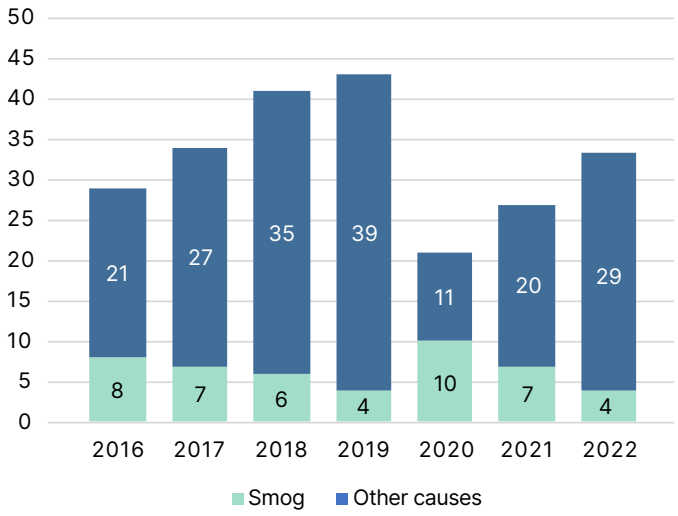
Poor air quality days

What is a poor air quality day? In accordance with established criteria, a day is deemed poor in terms of air quality as soon as fine particle ($PM_{2.5}$) concentrations exceed 35 µg/m^3 during at least 3 hours for a given station. For a poor air quality day to be characterized as a smog day, these excessive concentrations must be measured over more than 75% of the Montréal agglomeration territory. During a smog day, concentrations of fine particulate matter generally remain high for 24 hours and sometimes longer.

In 2022, 33 poor air quality days were recorded, of which 4 smog days. The poor air quality of these days is due to the presence of fine particles. Since 2020, the trend for smog days has followed a downward trend whereas poor air quality days are on the rise.

The increase in the use of solo car ridership for commuting, following post-pandemic recovery in terms of economic and social activities, has greatly contributed to this increase in poor air quality days. The ridership figures of the Société de transport de Montréal (STM) are still below the pre-pandemic rates, as witnessed by the 236 million commutes in 2022 compared to 385 million commutes in 2019 (results at December 31, 2022)[1]. The STM is expecting a return of 75 to 80% of its commuters in the course of 2023. The city of Montréal encourages the entire population of the agglomeration to use public transit and active commuting.

Poor air quality days per year in Montréal since 2016

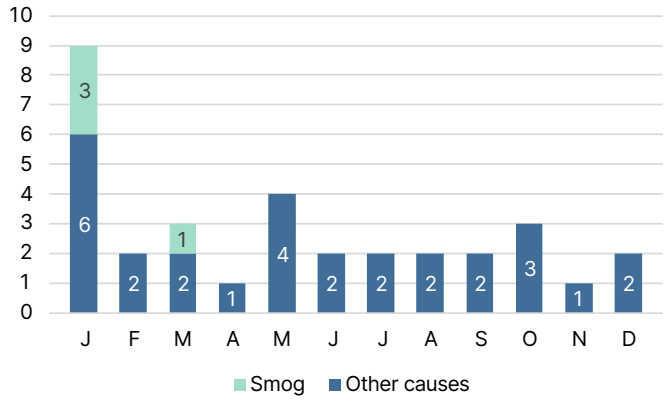


[1] https://www.stm.info/sites/default/files/media/Affairespubliques/Indicateurs/2022/octobre/indicateurs_strategiques_ca_7_decembre_2022.pdf, (accessed 28 February 2023).

Despite this upward trend in poor air quality days caused by fine particles, the annual averages at all RSQA stations for this pollutant have been on the wane for many years now. The annual concentrations of $PM_{2.5}$ in Montréal varied between 6.2 and 9.3 µg/m³ depending on the station in 2022 for an average of 7.1 µg/m³. In the past few years, considerable efforts have focused on making the RSQA's historical data accessible to one and all with a single click. It is now possible to consult the results of all continuously measured pollutants of the permanent stations for the years 1990 to 2022 on the open data site.

In 2022, all smog days were recorded in the winter (January and March). There were no occurrences of smog in the summertime compared to a total of 4 such days observed in 2021, all caused by the fine particles emitted by forest fires in the northwestern sectors of Ontario and Manitoba. Forest fires and their often related smog are strongly influenced by weather conditions. The months of June and July were particularly rainy, thus posing less of a risk of forest fires. Also, according to the Société de protection des forêts contre le feu (SOPFEU), 2022 was a benign year for Québec forests which were largely exempted from forest fires, as witnessed by the fact that only 243 hectares (ha) of forest burnt last year compared to 8333 ha in 2021[2].

Poor air quality days per month in Montréal in 2022



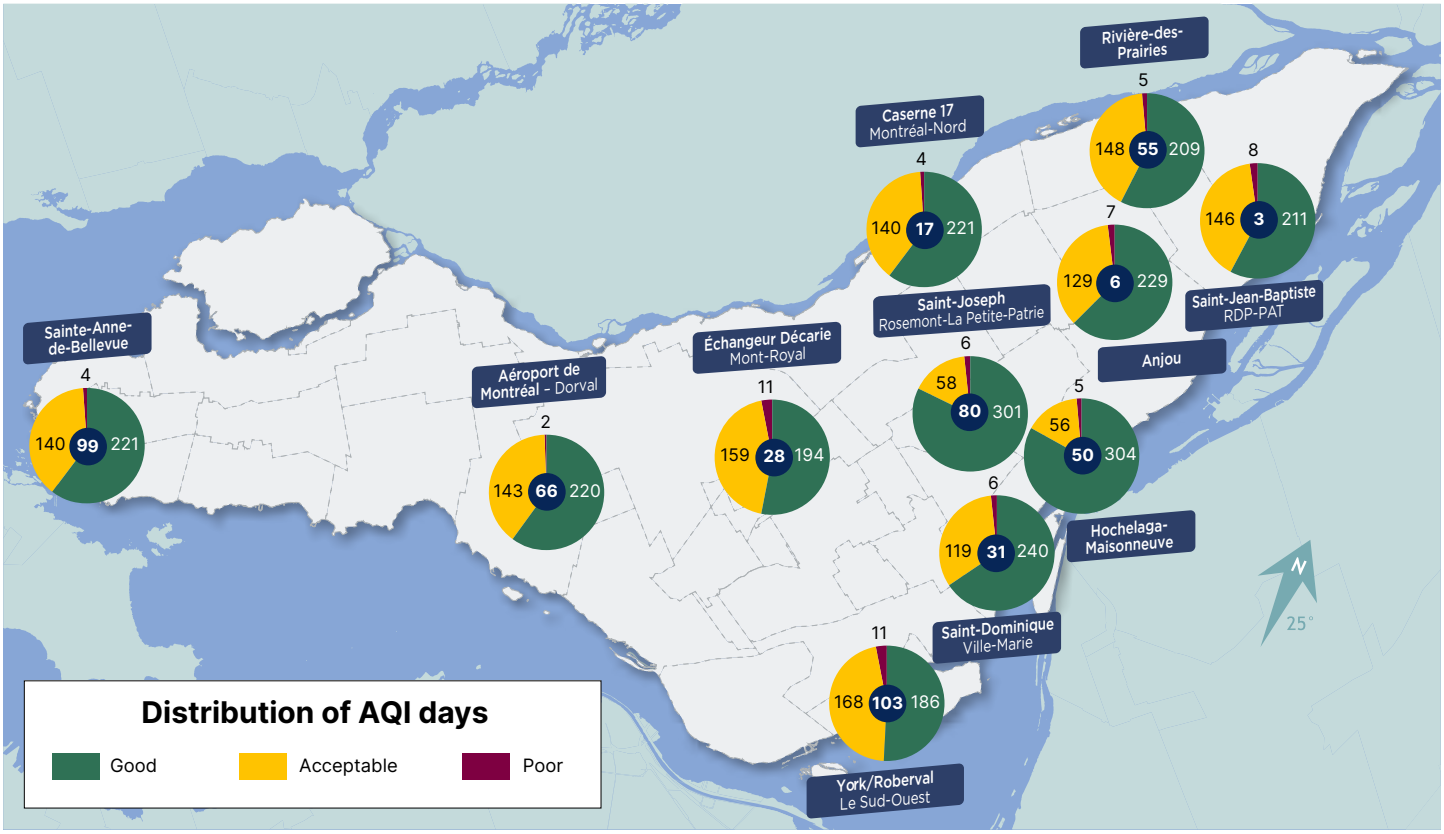
[2] https://sopfeu.qc.ca/communiques/bilan-de-la-saison-2022-tres-faible-superficie-de-foret-brulee-cette-annee/, (accessed 28 February 2023).

Air Quality Indices (AQI) by station

Many human activities are responsible for poor air quality days in Montréal. Disregarding smog days, the sources and events responsible for poor air quality days in Montréal in 2022 are:

- the Montréal East-End industries (station 3);
- the Montréal-Nord transit yard workshops (station 17);
- the traffic on autoroutes (stations 28 and 103);
- the Port of Montréal activities and the traffic on Notre-Dame Est (station 50);
- wood heating in the winter (station 55);
- the Loto-Québec fireworks (stations 6, 50 and 80);
- fires in buildings in Montréal-Est and in the Sud-Ouest borough (stations 3-31-80-103);
- other human activities local in scope (all stations).

Air Quality Index (AQI) by Monitoring Station in 2022



Return and impact of fireworks

The summer of 2022 marked the comeback of the International des Feux Loto-Québec at La Ronde. Indeed, no competitions have been held since 2019, the editions of 2020 and 2021 having been cancelled because of the COVID-19.

Fireworks were responsible for the poor air quality recorded in the evenings of June 25th, July 20th and 27th, and August 3rd and 4th. A total of five poor air quality days are thus attributable to these pyrotechnic events. The fine particle concentrations generally increase during the show and then decrease around midnight, over a duration of some 2 to 4 hours, which might explain the two-day count for some fireworks.

Many chemical products are used in pyrotechnic mixes in order to obtain bright colors and stunning visual effects. These colors are derived from a wide variety of metal compounds, and mainly from metal salts. For example, strontium sulfates are responsible for the red coloration, whereas the color green comes from barium chloride, and potassium nitrate is used to propel the fireworks in the sky. Some of these compounds are released upon exploding and may adversely effect the environment and human health. However, the ephemeral nature of the event reduces the exposure time to these emissions.

According to wind velocity and direction, the stations affected by the smoke plumes of fireworks vary from one event to another (consult the following table). For example, on August 3, 2022, the southerly winds propagated the fireworks' smoke plume towards stations 50 and 6 where high concentrations of $PM_{2.5}$ were measured. As such, between 9 and 10 p.m., the hourly concentration of fine particles measured at station 50, located in the borough of Hochelaga-Maisonneuve only 1.7 km away from the event's venue, reached 379 µg/m³. In the hour that followed, the dispersion of these same pollutants by light winds blowing from the southwest resulted in an hourly concentration of 157 µg/m³ of these particles at station 6, in the Anjou sector, about 8.6 km from the fireworks' location.

Distance between the RSQA's monitoring stations and the location of Loto-Québec's fireworks

RSQA monitoring station	Distance as the crow flies from the fireworks' location (c.f. Google Earth)	Source of the prevailing winds (to capture the smoke plume)	Date(s) of the poor air quality days observed in 2022
Station 50	1.7 km	South/ Southwest	June 25, July 27 and August 3
Station 6	8.6 km	South / Southwest-	August 3 and 4
Station 80	3.2 km	Southeast	July 20

Just one day of poor air quality due to the smoke plume of fireworks was recorded in 2019 compared to five days in 2018 and none in 2017. Thus, there exists a significant annual variability in terms of the impact of fireworks on poor air quality days in Montréal.

Nomadic station

A nomadic station (26-1) is a station that allows us to further deepen our knowledge of the quality of ambient air. As its name suggests, this station will change location at the end of each project, usually of a duration of some 12 to 24 months. Its location since the end of 2022 is at the Jardins collectifs of Montréal-Est at the intersection of Victoria Street and Marien Avenue. This station is one of the network's most complete in terms of pollutants measured. Given that it was installed within the framework of a special project, the concentrations of a sector's pollutants are assessed over an extended period. This explains why its results are not available in real time; rather, a report will be produces every six months and made available on the open data site.

It should be noted that the commissioning of this station satisfied one of the recommendations of the committee formed by the city of Montréal, the Direction régionale de santé publique de Montréal (DRSP), the Institut national de santé publique du Québec (INSPQ) and the Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs (MELCCFP).

Novelty for ultrafine particles

In October 2020, an ultrafine particle analyzer (UFP), installed and since used at station 55 (12400, Wilfrid-Ouellette Street, Rivière-des-Prairies–Pointe-aux-Trembles), makes it possible to assess concentrations in residential neighborhoods influenced by wood heating. The annual average count for ultrafine particles at this station in 2022 was 7552 particles/cm^3 compared to 7629 particles/cm^3 in 2021, for a very slight decrease of 1%.

In order to draw a better portrait of the situation on the island of Montréal, two other UFP analyzers were added to the network in the fall of 2022, one at station 66-Aéroport de Montréal and the other at the nomadic station (26-1) temporarily located in Montréal-Est. Currently, there is no legislation for this emerging pollutant. Nevertheless, the RSQA is sparing no effort to collect information and further its knowledge regarding this pollutant in order to contribute to the drafting of future regulations.

Benzene under control in the east end of Montréal!

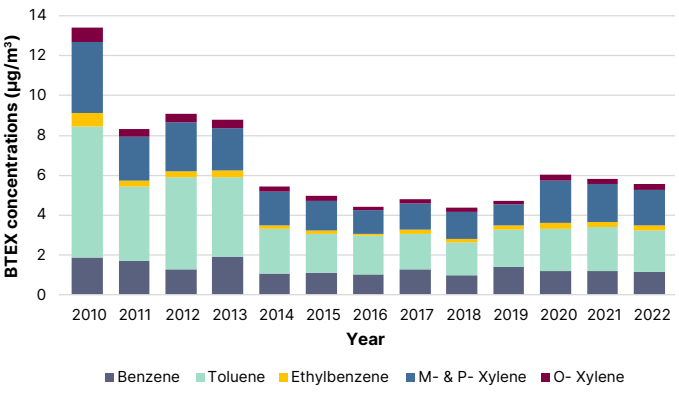
Among the one hundred or so volatile organic compounds measured by the RSQA, benzene remains one of the most preoccupying pollutants, given its known toxicity. Indeed, it is categorized as being carcinogenic for humans (Group 1) by the International Agency for Research on Cancer[3]. In the ambient air, the sources of benzene are mainly related to the use of automobiles and the manufacturing and distribution of petrol products and are also found in the emissions from motors, wood burning and the combustion of fossil fuels[4]. Historically, it is at station 3 (1050A, Saint-Jean-Baptiste Blvd., Rivière-des-Prairies–Pointe-aux-Trembles) in the east end of the island that annual averages have been the greatest in Montréal and even in Canada. The implementation of various mitigation measures, mainly the recovery of petrol vapors at petrol terminals and stations (Bylaw 90-3 in 1996), the reduced benzene content in fuels (Benzene in Gasoline Regulations under the Canadian Environmental Protection Act (1999)) and the mitigation measures for fugitive emissions from oil tanks and equipment (Bylaw 90-6 in 2001) have all had a positive impact on BTEX concentrations in the east end of Montréal.

Since 2010, an instrument for the continuous measurement of BTEX (benzene, toluene, ethylbenzene and xylene) allows the city of Montréal to obtain a better temporal analysis of the concentrations of these pollutants at station 3. This instrument is equipped with a gas chromatograph with a flame ionisation detector (GC-FID), allowing for the quantification of the concentrations of these pollutants present in the sector. The controls performed indicate that the results obtained by this method of analysis are similar to those obtained by the in-laboratory method of analysis. The annual averages of benzene measured by the continuous analyzer are of the same order of magnitude, an average deviation of -3% in the years 2010 to 2022, as those measured with the TO-14 reference method for samples collected over a 24-hr period, once every six days. Their analyses are then performed by the laboratory of the National Air Pollution Surveillance (NAPS) program of Environment and Climate Change Canada (ECCC). On average, the number of days sampled using the reference method was 60 days per year, whereas that number using the continuous analyzer varied between 111 and 354 days per year. Consequently, it's only normal to see an annual variability between the results of the two methods.

[3] https://publications.iarc.fr/Book-And-Report-Series/Iarc-Monographs-On-The-Identification-Of-Carcinogenic-Hazards-To-Humans/Benzene-2018, (accessed 7 February 2023).
[4] https://www.euro.who.int/__data/assets/pdf_file/0017/123056/AQG2ndEd_5_2benzene.pdf, (accessed 7 February 2023).

The evolution of BTEX concentrations in the 2010-2022 period is presented in the graph below.

Evolution of BTEX concentrations (2010 to 2022)



BTEX concentrations recorded their greatest decrease (67%) between 2010 and 2016. Concentrations of benzene dropped 46% from 1.87 µg/m³ to 1.02 µg/m³ over that same period. While the closing of the Shell refinery in 2010 likely had a positive impact on the air quality in the sector, it must be mentioned that the remaining industries are very cooperative through their implementation of new emission-cutting measures, such as the installation of floating roofs on wastewater treatment ponds or the recovery of benzene at boat loading docks. Since 2016, the trend has been relatively stable with benzene concentrations varying between 0.99 and 1.42 µg/m³. It's worthwhile mentioning that the thresholds under Bylaw 2001-10 of the Communauté métropolitaine de Montréal for benzene are for periods of one hour (260 µg/m³) or eight hours (150 µg/m³) and that they have been complied with since 2010. For the other compounds, ethylbenzene is the only one that does not have an upper threshold established in the regulation, whereas the concentrations of toluene and xylene have always complied with their respective thresholds of 2,000 µg/m³ and 2,300 µg/m³ (in both cases the same threshold applies whether for 8 hours or 12 hours).

The industry's efforts, over many years now, to limit the emissions of organic volatile compounds in the atmosphere have paid off, as witnessed by the declines in benzene concentrations measured in the east end of Montréal which have stabilized around the 1 µg/m³ mark. The instrument for the continuous measurement of BTEX is nearing the end of its useful life after 13 years on-site and its replacement is scheduled for 2024.

Measuring of metals in Montréal

Metals in the ambient air have drawn a lot of interest from the media and remain very topical, both as an environmental issue and a public health issue. At the RSQA, the measurement of metals is done on particles of a size less than 10 µm sampled on filters during a time span of 24 hours. The samples collected are then dried, weighed and sent to a laboratory for analysis. Thereafter, the results are processed and validated, which explains the delays in obtaining final results. However, the city of Montréal is committed to posting these results as fast as possible on its open data Web site in the visualization tool available that allows for a temporal graphic representation by metal.

The metals that generated the most interest are arsenic and nickel. The sources of these two metals in the ambient air are similar, both deriving from industrial activities, the combustion of fossil fuels and waste incineration. However, arsenic and nickel are naturally occurring inorganic chemicals in the environment.

Starting in 2020, the results of metal sampling have been available for three monitoring stations: 3, 80 and 99. Historical data are also available, but only for station 3. The 2022 annual averages for arsenic and nickel are presented in the table below.

2022 Annual averages of metals on PM_{10} 24 hr (ng/m^3)

Station	Arsenic	Nickel
3	0.18	1.18
80	0.03	0.45
99	0.07	0.22

Arsenic concentrations at the three stations were very low in 2022 and below 0.20 ng/m^3. The annual averages for nickel were a little higher, but were all under 1.2 ng/m^3. Station 3 shows metal concentrations a little higher than those of the other stations owing to its location near industrial activities. Station 99, located at the western tip of the island and greatly influenced by the prevailing westerly winds, obtained the lowest results. As far as station 80 is concerned, it is located half way between the two other stations, and its urban environment is both residential and commercial.

Metals are measured in PM_{10} over 24-hr periods at the RSQA stations. Thus, it is possible to compare the results obtained for nickel in the ambient air to the standards set out in the Règlement sur l'assainissement de l'atmosphère (RAA) of the Loi sur la qualité de l'environnement (provincial), even though that regulation does not apply to our territory. These standards are of 70 ng/m^3 (24 hr) and 20 ng/m^3 (annual average). The measured concentrations of nickel in 2022 on the territory of the city of Montréal are well below the RAA standards. The RSQA's results for arsenic cannot be compared to the RAA's annual standard of 3 ng/m^3 for this metal, since the latter is for arsenic measured in total suspended particulates (TSP) and not in PM_{10}, as sampled by the RSQA.

Canadian Ambient Air Quality Standards (CAAQS)

Since 2017, the CAAQS deal with fine particulate matter ($PM_{2.5}$), ozone (O_3), sulfur dioxide (SO_2) and nitrogen dioxide (NO_2). These standards are the core of the Air Quality Management System (AQMS) promoted by the Canadian Council of Ministers of the Environment (CCME).

As part of the following comparative exercise, the averages were obtained by using the data of all RSQA stations. The CAAQS are used for reference purposes only. Although the Province of Québec supports the objectives of the AQMS, the province has its own air quality standards covered by Bylaw 2001-10 of the Communauté métropolitaine de Montréal (CMM) for the Agglomeration of Montréal and the Règlement sur l'assainissement de l'atmosphère in the rest of the province. These data are presented in micrograms per cubic meter (µg/m³) or parts per billion (ppb).

Since 2016, the 3-year average concentrations of $PM_{2.5}$ have stabilized at 20 µg/m³. However, a slight improvement in $PM_{2.5}$ concentrations is observed in Montréal's ambient air, the 3-year average of average annual concentrations showing a decrease of 7.4 to 7.2 µg/m³. It should be noted that any improvement is desirable, given that there is no threshold below which fine particulate matter does not result in adverse health effects. For these two standards, the situation is similar to that of recent years and the results are below the standards that had been set for 2020. However, the 2025 standards for fine particulate matter have yet to be established, their announcement by the CCME having been delayed to sometime in 2023 or 2024.

Fine Particulate Matter ($PM_{2.5}$) Concentrations Expressed in µg/m³

3-year average of the annual 98th percentile of the daily 24-hour average concentrations Standard = 28 in 2015 and 27 in 2020				
2016-2018	2017-2019	2018-2020	2019-2021	2020-2022
20	20	20	20	20

3-year average of the annual average concentrations Standard = 10 in 2015 and 8.8 in 2020				
2016-2018	2017-2019	2018-2020	2019-2021	2020-2022
7.4	7.4	7.3	7.2	7.2

The trend for O_3 is rather stable with 3-year averages fluctuating between 54 and 57 ppb from 2016 to 2022. The concentrations of O_3 are compliant with the 60 ppb standard for 2025.

Ozone (O_3) Concentrations Expressed in ppb

3-year average of the annual 4th highest daily maximum 8-hour average concentrations Standard = 62 in 2020 and 60 in 2025				
2016-2018	2017-2019	2018-2020	2019-2021	2020-2022
57	55	54	55	56

The results for SO_2 show a slight improvement since 2016 and are compliant with the 2025 standard. Indeed, in recent years, the fluctuations have been minimal.

Sulfur Dioxide (SO_2) Concentrations Expressed in ppb

3-year average of the annual 99th percentile of the daily maximum 1-hour average concentrations Standard = 70 in 2020 and 65 in 2025				
2016-2018	2017-2019	2018-2020	2019-2021	2020-2022
17	17	16	16	14

Arithmetic average over a single calendar year of all 1-hour average concentrations Standard = 5 in 2020 and 4 in 2025				
2018	2019	2020	2021	2022
0.6	0.5	0.4	0.4	0.5

The 3-year averages for NO_2 hardly varied from 2016 to 2022. The 3-year average concentration of 42 ppb recorded in 2020-2022 is equal to the 2025 standard of 42 ppb. As far as the annual average of 8.4 ppb is concerned, it is compliant with the 2025 standard of 12 ppb despite a slight increase in 2022 compared to 2021 (8.0 ppb). The efforts made by Montréal to deal with the sources of NO_2, such as the use of fossil fuels in automobiles and home heating systems, should bear fruit in the next few years (objectives of the city's Climate Plan: reduction of solo car trips, increased number of electric vehicles, electrification of the heating systems of residential buildings, etc.)[5].

Nitrogen Dioxide (NO_2) Concentrations Expressed in ppb

3-year average of the annual 98th percentile of the daily maximum 1-hour average concentrations Standard = 60 in 2020 and 42 in 2025				
2016-2018	2017-2019	2018-2020	2019-2021	2020-2022
45	46	44	43	42

Arithmetic average over a single calendar year of all 1-hour average concentrations Standard = 17 in 2020 and 12 in 2025				
2018	2019	2020	2021	2022
10.4	9.1	8.4	8.0	8.5

[5] https://portail-m4s.s3.montreal.ca/pdf/Plan_climat%2020-16-16-VF4_VDM.pdf, (accessed 1 March 2023).

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