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# AIR QUALITY

## CANADIAN ENVIRONMENTAL SUSTAINABILITY INDICATORS

Canada

**Suggested citation for this document:** Environment and Climate Change Canada (2024) Canadian Environmental Sustainability Indicators: Air quality. Consulted on *Month day, year*.
Available at: www.canada.ca/en/environment-climate-change/services/environmental-indicators/air-quality.html.

Cat. No.: En4-144/57-2023E-PDF
ISBN: 978-0-660-37001-9
Project code: EC24019



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# CANADIAN ENVIRONMENTAL SUSTAINABILITY INDICATORS

# AIR QUALITY

## June 2024

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# Air quality

Air pollutants cause adverse health and environmental effects. Problems such as smog and acid rain result from the release of pollutants into the atmosphere. Most of these pollutants come from human activities, such as the burning of fuels for transportation, electricity, heating, and industry. Pollutants from natural sources, such as wildfires, can be equally substantial contributors to poor air quality when they occur. The Air quality indicators present the concentrations of 5 key air pollutants for Canada: fine particulate matter ($PM_{2.5}$), ground-level ozone ($O_3$), nitrogen dioxide ($NO_2$), sulphur dioxide ($SO_2$) and volatile organic compounds (VOCs).

## National air quality trends

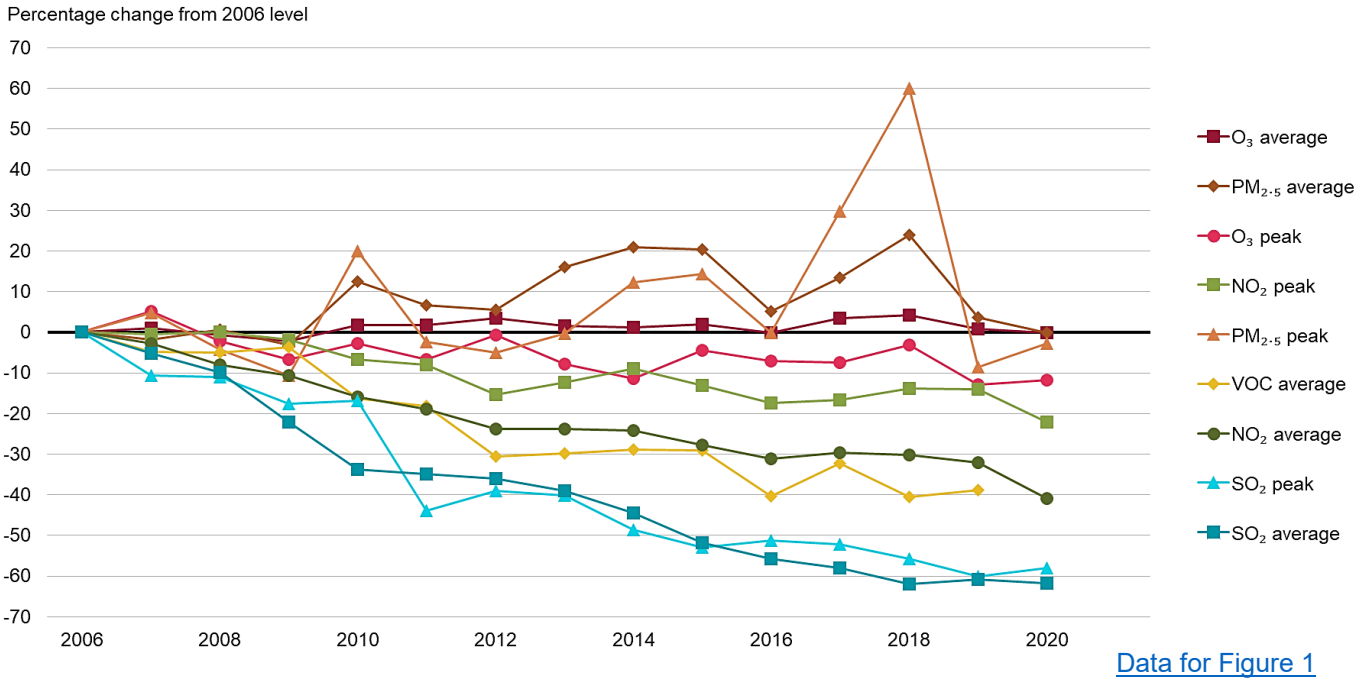
This section presents a summary of outdoor air quality trends for 5 key air pollutants averaged across monitoring stations in Canada. Air quality trends are measured by average and peak[1] ambient levels (concentrations) of $PM_{2.5}$, $O_3$, $NO_2$, $SO_2$ and VOCs. Average concentrations are representative of chronic, prolonged, or repeated exposure to air pollutants over longer time periods, while peak concentrations are representative of immediate or acute short-term exposure to air pollutants.

### Key results

From 2006 to 2020,

- average and peak $PM_{2.5}$ concentrations exhibited large fluctuations compared to 2006 levels, with the highest concentration recorded in 2018 due to wildfire activity
- average $O_3$ concentrations remained close to 2006 levels, while peak $O_3$ concentrations have slightly decreased
- $NO_2$ and $SO_2$ (average and peak) and average VOC[2] concentrations have generally decreased since 2006. The decrease was more pronounced for $SO_2$ than for $NO_2$ or VOC

**Figure 1. Relative air pollutant concentration changes, Canada, 2006 to 2020**




Data for Figure 1

**Note:** No VOC concentration was available for 2020. For more information, consult the Air quality indicator definitions in the Data sources and methods section.

[1] For detailed information on the definition of average and peak concentrations for each pollutant, consult Table 3 in the Data sources and methods section.

[2] VOC sampling in 2020 was limited and no station met the data completeness criteria for that year. Therefore, no VOC concentration is being reported for 2020 in this indicator.

**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal and the Canadian Air and Precipitation Monitoring Network.

On a national scale, in 2020, both $PM_{2.5}$ and $O_3$ average concentrations were at almost the same level as in 2006, with slight decreases of 0.03% and 0.07% respectively, while their peak concentrations were 3.0% and 12.0% lower than the 2006 level, respectively.

For $NO_2$ and $SO_2$, decreasing concentrations were measured between 2006 and 2020 as follows:

- average $NO_2$ was 41% lower
- peak $NO_2$ was 22% lower
- average $SO_2$ was 62% lower
- peak $SO_2$ was 58% lower

For VOC, the national average concentrations decreased by 39% between 2006 and 2019. Over that period, concentrations remained lower than 2006 levels for all years.

The concentrations of these pollutants are influenced by many factors, including the proximity to local emission sources, weather conditions, chemical reactions in the air and the transboundary transport of air pollutants over long distances by wind. Part of the increase in $PM_{2.5}$ concentrations recorded since 2009 may be due to the progressive introduction of monitoring equipment featuring newer technologies enabling more accurate measurements. Additionally, the wildfires over the latest decade have resulted in fluctuating average and peak $PM_{2.5}$ concentrations, especially in western Canada.

# Air quality trends by pollutant

This section presents a summary of outdoor air quality trends by air pollutant, for average and peak concentrations, at national and regional levels[3]. When Canadian Ambient Air Quality Standards[4] (CAAQS, "the standards") exist for a pollutant (average and peak concentrations for $PM_{2.5}$, $NO_2$ and $SO_2$, and peak $O_3$ concentrations) its concentrations are compared to these standards. However, the comparison to the CAAQS is provided for illustrative purposes only, as most standards are based on a 3-year average and the indicator is calculated as a 1-year average.

## Fine particulate matter

Fine particulate matter ($PM_{2.5}$) is emitted directly to the air and can also be formed in the air through the interactions of other pollutants, such as nitrogen oxides, sulphur oxides, ammonia and volatile organic compounds. $PM_{2.5}$ is one of the major components of smog and one of the most widespread outdoor pollutants. Exposure to $PM_{2.5}$ can lead to the onset or development of adverse respiratory and cardiovascular effects, such as asthma attacks, chronic bronchitis, heart attacks as well as lung cancer.[5] Fine particulate matter can also damage vegetation and structures, contribute to acidification and eutrophication[6] of ecosystems, contribute to haze, and reduce visibility.

### National average fine particulate matter concentrations

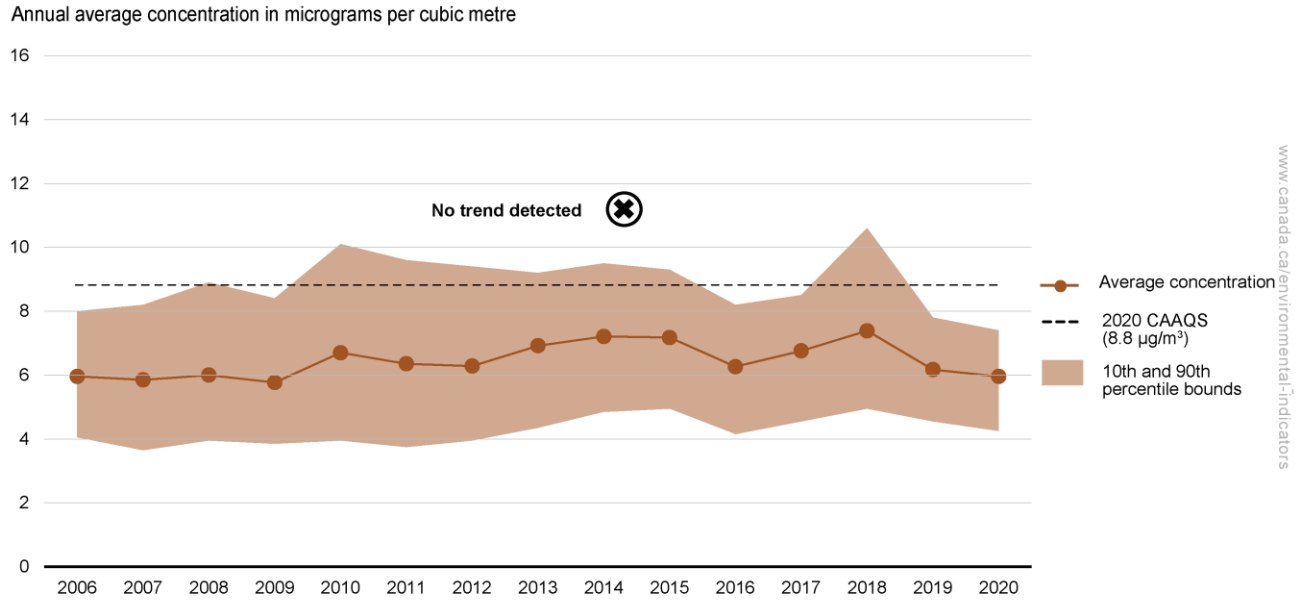
#### Key results

From 2006 to 2020,

- no significant trend was detected in the national average $PM_{2.5}$ concentrations
- national average concentrations remained below the 2020 standard of 8.8 $\mu g/m^3$ for all years, but exceedances were recorded at some monitoring stations in particular in 2018

[3] For more information on regions, consult Figure 35 in the Data sources and methods section
[4] For detailed information on the CAAQS, consult the Data sources and methods section.
[5] Health Canada (2021) Health Impacts of Air Pollution in Canada: Estimates of morbidity and premature mortality outcomes – 2021 Report
[6] Asphyxiation of aquatic ecosystems caused by the excessive development of algae following high concentrations of nutrients in the water.

**Figure 2. National average fine particulate matter concentrations, Canada, 2006 to 2020**




Data for Figure 2

**Note:** The national average $PM_{2.5}$ concentration indicator is based on the annual average of the daily 24-hour average concentrations recorded at 146 monitoring stations across Canada. The comparison to the Canadian Ambient Air Quality Standard is provided for illustrative purposes only. For more information, consult the Air quality indicator definitions in the Data sources and methods section.
**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal.

In 2020, the national average $PM_{2.5}$ concentration was 6.0 µg/m$^3$, the lowest since 2009, and represented a 19.0% decrease compared to 2018, the highest concentration recorded.

Changes in average $PM_{2.5}$ concentrations are related not only to changes in the quantity of emissions of $PM_{2.5}$ and its precursors, but also to annual variations in weather conditions that influence the formation, dispersion, and regional transport of $PM_{2.5}$ as well as transboundary movement of $PM_{2.5}$, such as from the United States.

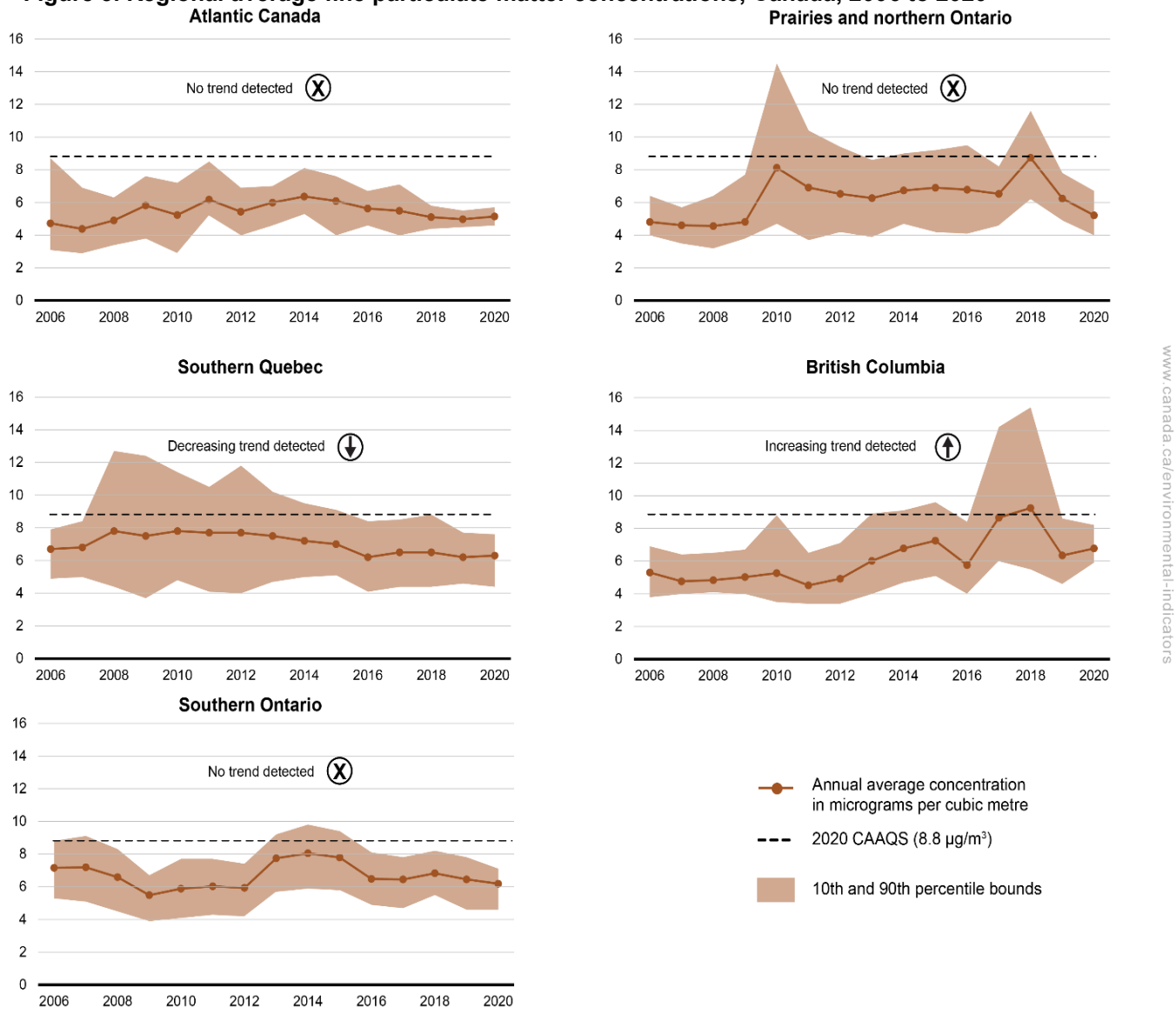
The variations observed in average $PM_{2.5}$ concentrations were also related to the progressive introduction of monitoring equipment that uses newer measurement technologies. From the mid-2000s to 2013, new $PM_{2.5}$ monitoring equipment was progressively introduced across Canada to replace older monitoring equipment. These new instruments measure an additional (semi-volatile) portion of the $PM_{2.5}$ mass not captured by the older instruments. This should be considered when comparing measurements from newer monitors with those from years in which older instruments were used.

## Regional average fine particulate matter concentrations

### Key results

- From 2006 to 2020,
  - an increasing trend was detected for average $PM_{2.5}$ concentrations in British Columbia
  - a decreasing trend was detected in the southern Quebec region
  - no trends were detected for the Atlantic Canada, the Prairies and northern Ontario, or southern Ontario regions
- Since 2006, average $PM_{2.5}$ concentrations have remained below the 2020 standard of 8.8 µg/m$^3$ across all regions, with the exception of British Columbia in 2018; however, concentrations at some monitoring stations exceeded the standard in all regions, except Atlantic Canada

**Figure 3. Regional average fine particulate matter concentrations, Canada, 2006 to 2020**






Data for Figure 3

**Note:** The regional average $PM_{2.5}$ concentration indicator is based on the annual average of the daily 24-hour average concentrations recorded at 12 monitoring stations in the Atlantic Canada region, 36 in the southern Quebec region, 38 in the southern Ontario region, 33 in the Prairies and northern Ontario region and 25 in British Columbia. There were not enough stations to report results for the northern territories region. The comparison to the Canadian Ambient Air Quality Standard is provided for illustrative purposes only. For more information, consult the Air quality indicator definitions in the Data sources and methods section.
**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal.

In 2020, British Columbia had the highest regional average $PM_{2.5}$ concentration, at 6.8 µg/m³. The southern Quebec and southern Ontario regions reported a concentration of 6.3 µg/m³ and 6.2 µg/m³, respectively. The Prairies and northern Ontario region and the Atlantic Canada region had the lowest regional average concentrations with 5.2 µg/m³ and 5.1 µg/m³, respectively.

Between 2019 and 2020, increases in concentrations were recorded as follows: 6.8% in British Columbia, 3.4% in the Atlantic Canada region and 1.3% in the southern Quebec region. In contrast, the Prairies and northern Ontario region and the southern Ontario region recorded reductions of 16.5% and 4.1%, respectively.

From 2006 to 2020:

- a decreasing trend of 0.1 µg/m³ per year was detected for the southern Quebec region

- an increasing trend of 0.2 µg/m$^3$ per year was detected for British Columbia
- no trends were detected for the Atlantic Canada, southern Ontario, or the Prairies and northern Ontario regions

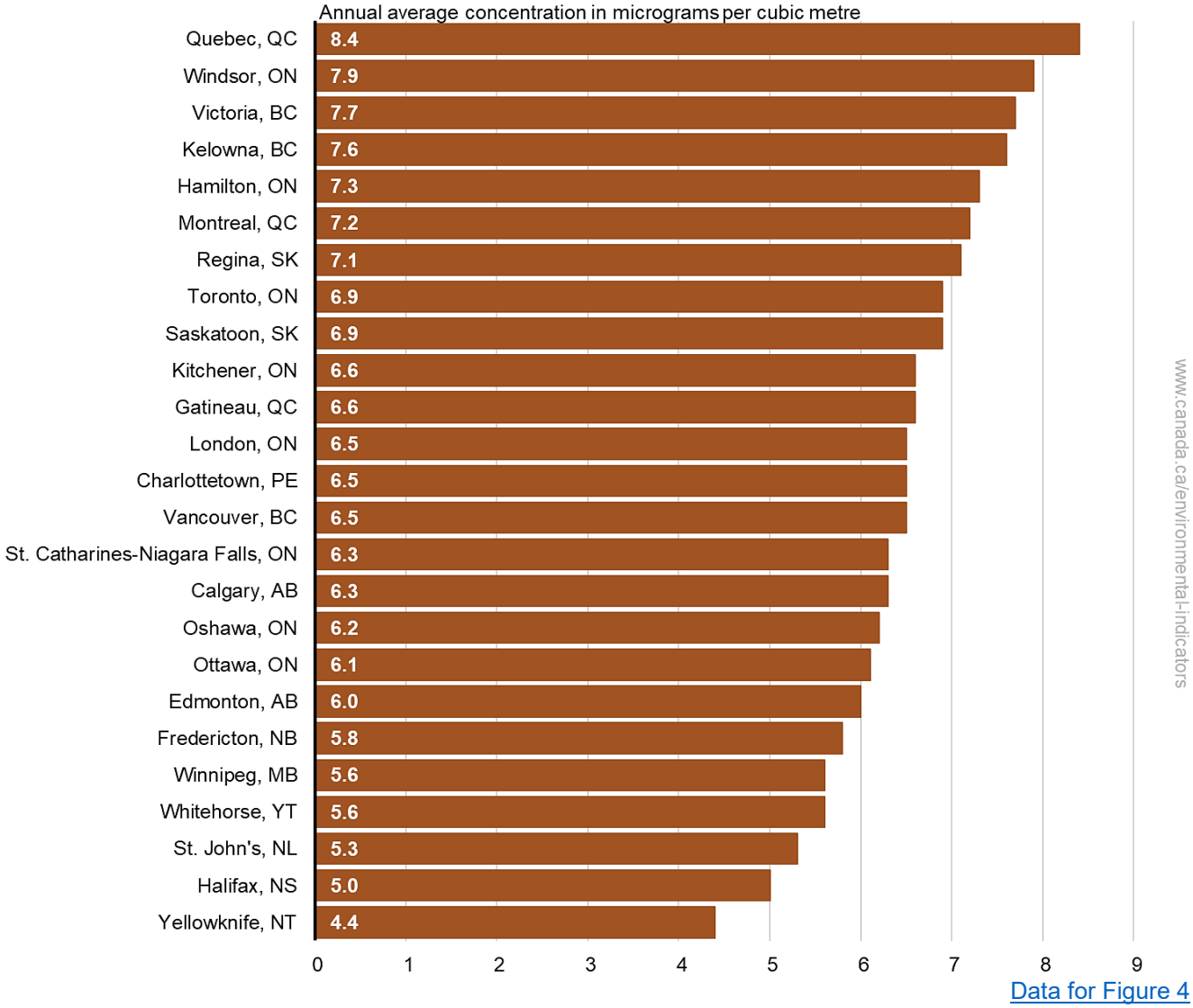
## Average fine particulate matter concentrations in urban areas

### Key results

In 2020, among the selected urban areas

- Quebec, QC had the highest average $PM_{2.5}$ concentration
- Yellowknife, NT had the lowest concentration

**Figure 4. Average fine particulate matter concentrations, selected Canadian urban areas, 2020**




Data for Figure 4

**Note:** The indicator only reports 25 urban areas for the most populated communities in Canada and the provincial and territorial capitals when data meeting the completeness criteria was available. All concentrations available since 2006 for each urban areas are presented in a separate data table.
**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal.

Average $PM_{2.5}$ concentrations in Canadian urban areas differ from one location to another and from year to year. These differences are partly due to differences in emissions of $PM_{2.5}$ and precursor pollutants, variations in weather conditions that influence $PM_{2.5}$ formation, dispersion and regional transport and variations in

transboundary flows of pollution, primarily from the United States. Exceptional events, such as wildfires, can also impact average $PM_{2.5}$ concentrations measured in urban areas.

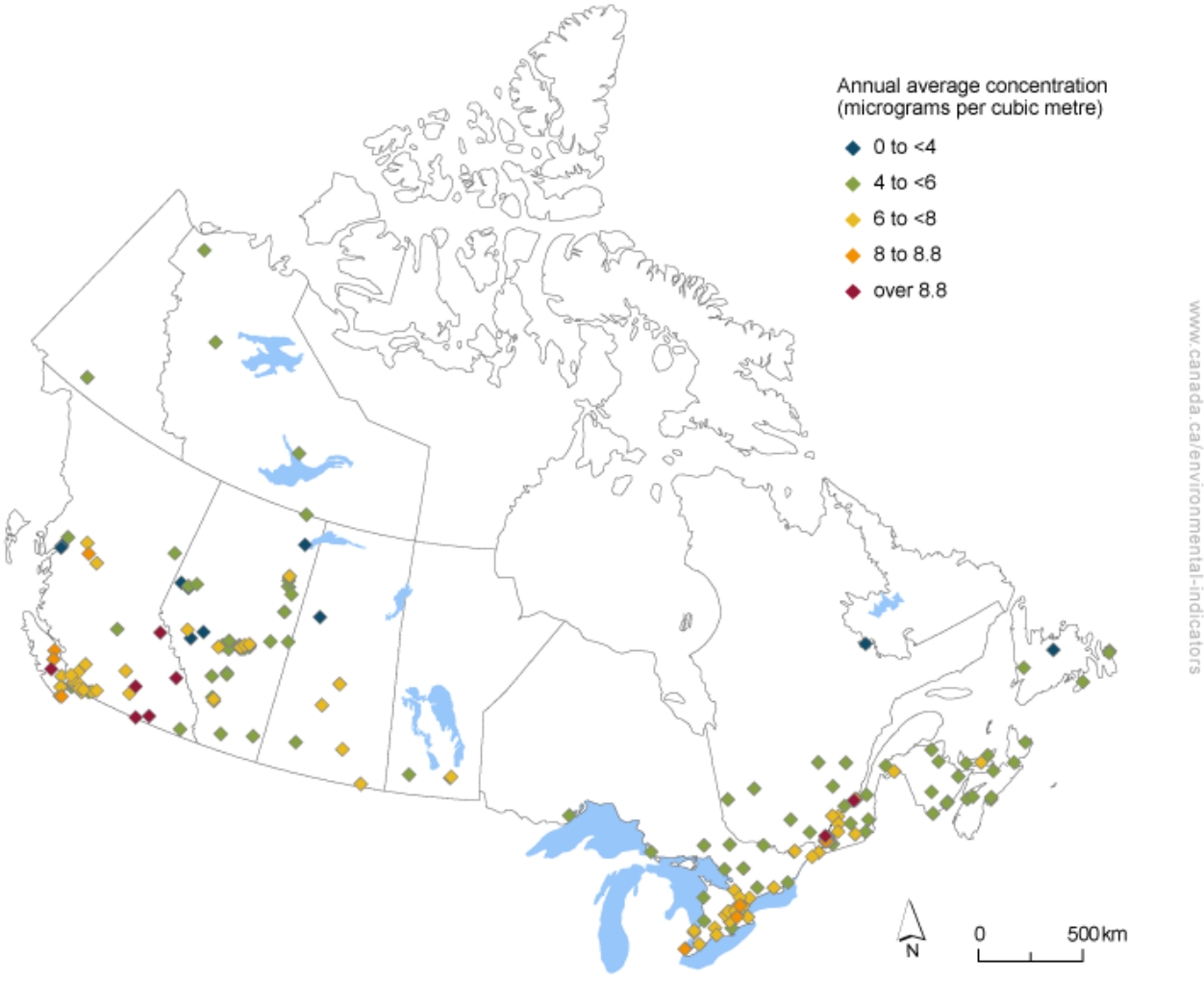
## Average fine particulate matter concentrations at monitoring stations

The National Air Pollution Surveillance program measures air pollutant concentrations at monitoring stations across Canada. The Canadian Environmental Sustainability Indicators provide access to this information through an interactive map. The map allows users to explore average $PM_{2.5}$ concentrations at specific monitoring stations.

In 2020, average $PM_{2.5}$ concentrations were recorded at 213 monitoring stations across Canada. Average $PM_{2.5}$ concentrations varied across monitoring stations.

- 9 stations recorded concentrations above 8.8 µg/m$^3$: 3 stations in Quebec and 6 in British Columbia had concentrations between 8.9 µg/m$^3$ and 12.4 µg/m$^3$
- 11 stations recorded below 4.0 µg/m$^3$: 1 was located in Saskatchewan, 2 in Newfoundland and Labrador, 3 in British Columbia and 5 in Alberta

**Figure 5. Average fine particulate matter concentrations by monitoring station, Canada, 2020**




Navigate data using the interactive map

**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal.

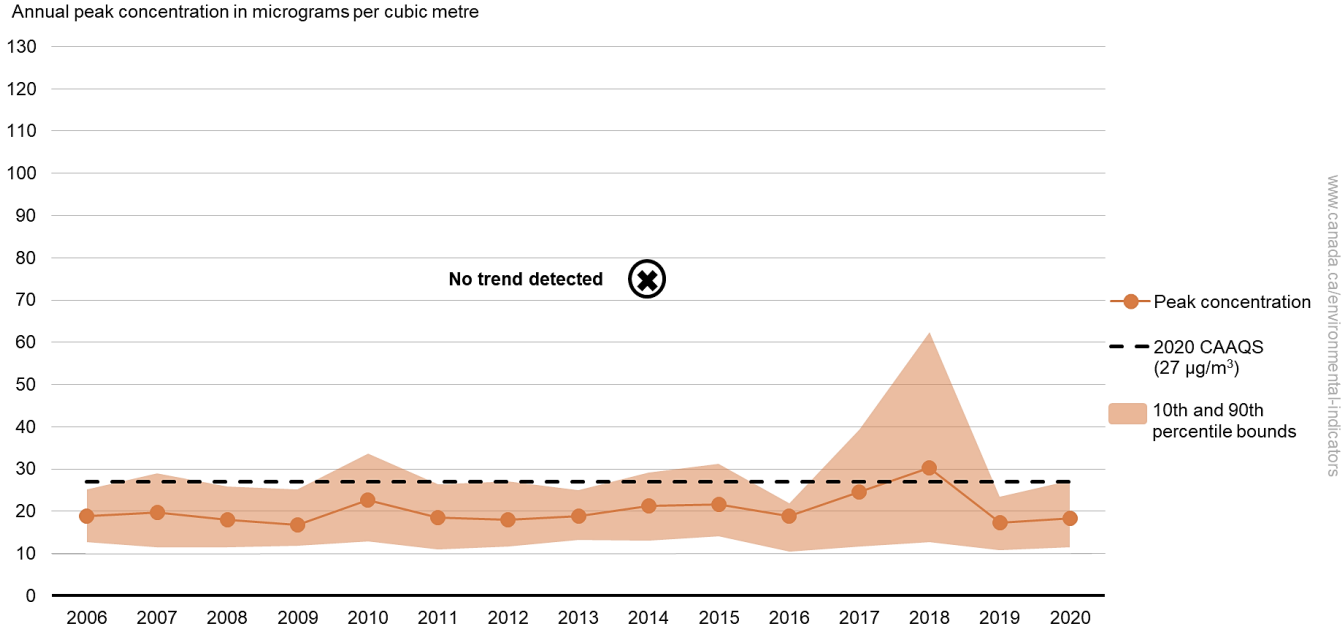
## National average peak fine particulate matter concentrations

### Key results

From 2006 to 2020,

- no trend was detected in the national average peak $PM_{2.5}$ concentrations
- national average peak concentrations remained below the 2020 standard of 27 µg/m$^3$ for all years except 2018; however, concentrations at some monitoring stations exceeded the standard in some years

**Figure 6. National average peak fine particulate matter concentrations, Canada, 2006 to 2020**




Data for Figure 6

**Note:** The national average peak $PM_{2.5}$ concentration indicator is based on the annual 98th percentile of the daily 24-hour average concentrations recorded at 147 monitoring stations across Canada. The comparison to the Canadian Ambient Air Quality Standard is provided for illustrative purposes only. For more information, consult the Air quality indicator definitions in the Data sources and methods section.
**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal.

In 2020, the national average peak $PM_{2.5}$ concentration was 18.4 µg/m$^3$, which was 6.4% (1.1 µg/m$^3$) higher than in 2019. Between 2006 and 2020, national concentrations slightly decreased by 2.8% (0.5 µg/m$^3$). The higher concentrations observed in 2017 and 2018 can be attributed primarily to wildfire activity in western Canada.

Changes in peak $PM_{2.5}$ concentrations are related not only to changes in the quantity of emissions but also to annual variations in weather conditions which influence the formation, dispersion, and regional transport of $PM_{2.5}$ as well as transboundary movement of $PM_{2.5}$ from the United States.

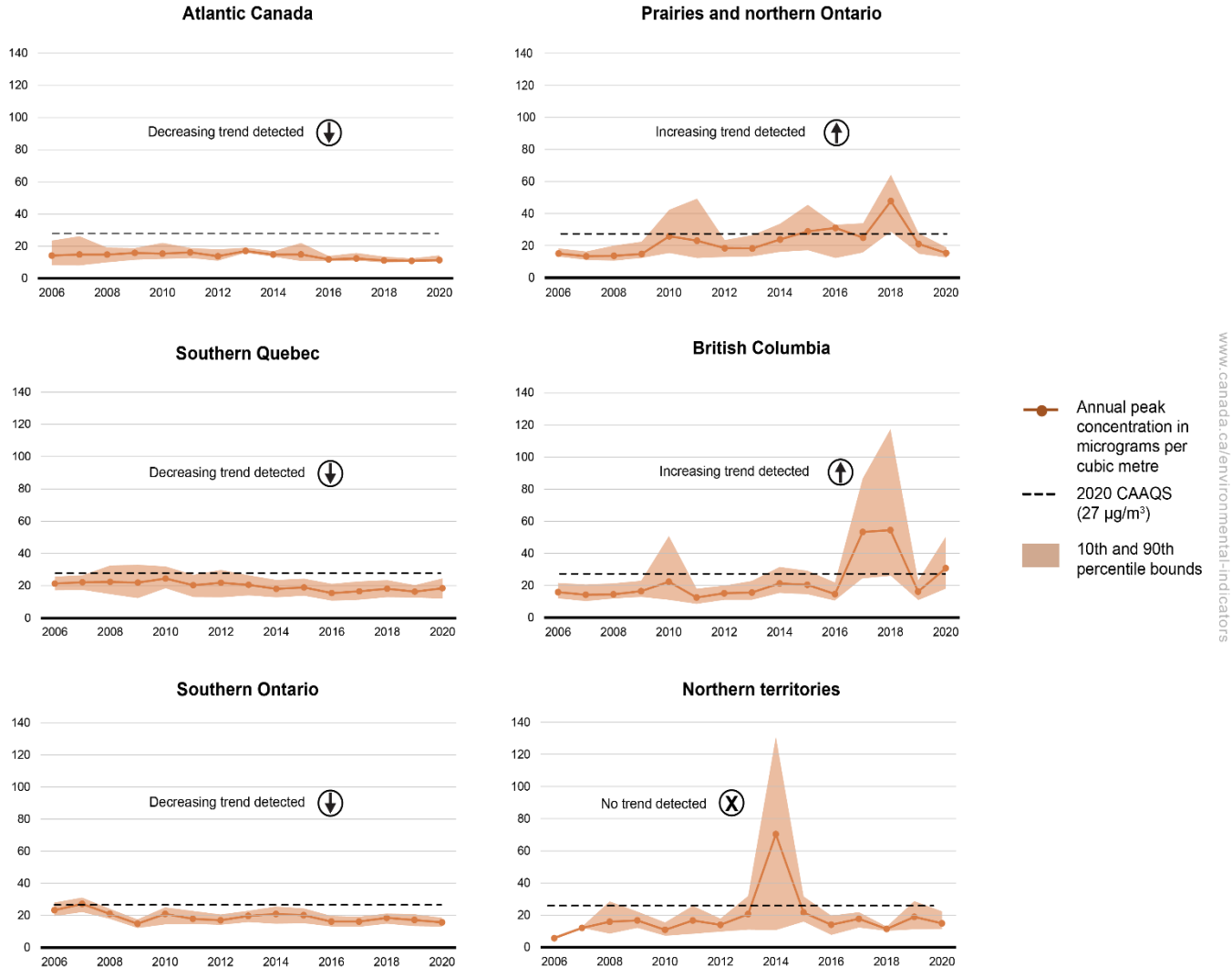
The variations observed in peak $PM_{2.5}$ concentrations were also influenced by the progressive introduction of monitoring equipment that uses newer measurement technologies. From 2000 to 2013, new $PM_{2.5}$ monitoring equipment was progressively introduced across Canada to replace older monitoring equipment. These new instruments measure an additional (semi-volatile) portion of the $PM_{2.5}$ mass not captured by the older instruments. This should be considered when comparing measurements from newer monitors with those from years in which older instruments were used.

## Regional average peak fine particulate matter concentrations

### Key results

- From 2006 to 2020,
  - increasing trends were detected for regional average peak $PM_{2.5}$ concentrations in the Prairies and northern Ontario region and in British Columbia
  - decreasing trends were detected in the Atlantic Canada, southern Quebec, and southern Ontario regions
  - no trend was detected for the northern territories region
- Since 2006, regional average peak $PM_{2.5}$ concentrations have exceeded the 2020 standard of 27 µg/m$^3$ 3 times in both British Columbia and the Prairies and northern Ontario region, and once in both the southern Ontario and northern territories regions. The regional average peak concentrations remained below the standard for all years in the other regions

**Figure 7. Regional average peak fine particulate matter concentrations, Canada, 2006 to 2020**




Data for Figure 7

**Note:** The regional average peak $PM_{2.5}$ concentration indicator is based on the annual 98th percentile of the daily 24-hour average concentrations recorded at 12 monitoring stations in the Atlantic Canada region, 36 in the southern Quebec region, 38 in the southern Ontario region, 33 in the Prairies and northern Ontario region, 25 in British Columbia and 3 in the northern territories region. The comparison to the Canadian Ambient Air Quality Standard is provided for illustrative purposes only. For more information, consult the Air quality indicator definitions in the Data sources and methods section.

**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal.

In 2020, British Columbia had the highest regional average peak $PM_{2.5}$ concentration, at 30.8 µg/m$^3$. The Atlantic Canada region had the lowest average peak concentration, at 11.3 µg/m$^3$.

Between 2019 and 2020, British Columbia, the southern Quebec and Atlantic Canada regions had recorded an increasing concentration with respectively 89.8% (14.6 µg/m$^3$), 12.9% (2.1 µg/m$^3$), 4.4% (0.5 µg/m$^3$). In contrast, concentrations had decreased by 26.9% (5.7 µg/m$^3$) in the Prairies and northern Ontario region, 21.3% (4.0 µg/m$^3$) in the northern territories region and 8.7% (1.5 µg/m$^3$) in southern Ontario region in the same time period.
From 2006 to 2020,

- an increasing trend of 0.9 µg/m$^3$ per year was detected for the Prairies and northern Ontario region
- an increasing trend of 0.8 µg/m$^3$ per year was detected for British Columbia
- a decreasing trend of 0.4 µg/m$^3$ per year was detected for the southern Quebec and the southern Ontario regions
- a decreasing trend of 0.3 µg/m$^3$ per year was detected for the Atlantic Canada region
- no trend was detected for the northern territories region

Regional average peak $PM_{2.5}$ concentrations tend to exceed the standard in years with significant wildfire activity.

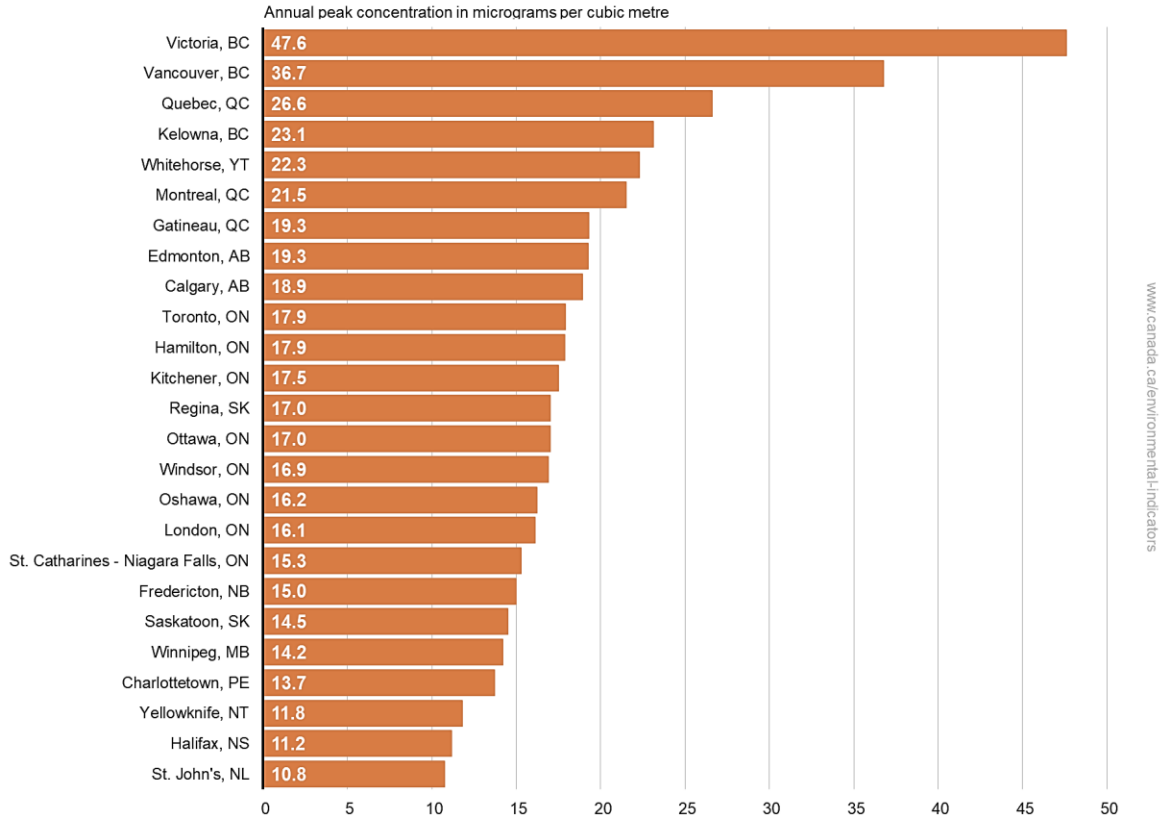
## Average peak fine particulate matter concentrations in urban areas

### Key results

In 2020, among the selected urban areas

- Victoria, BC had the highest average peak $PM_{2.5}$ concentration
- St. John's, NL had the lowest average peak concentration

**Figure 8. Average peak fine particulate matter concentrations, selected Canadian urban areas, 2020**




Data for Figure 8

**Note:** The indicator only reports 25 urban areas for the most populated communities in Canada and the provincial and territorial capitals when data meeting the completeness criteria was available. All concentrations available since 2006 for each urban areas are presented in a separate data table.
**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal.

Peak $PM_{2.5}$ concentrations in Canadian urban areas differ from one location to another and from year to year. These differences are partly due to differences in emissions of pollutants, variations in weather conditions that influence $PM_{2.5}$ formation, dispersion, and regional transport, as well as variations in transboundary flows of pollution, primarily from the United States. Exceptional events, such as wildfires, can also have a significant influence on the peak $PM_{2.5}$ concentrations in urban areas.

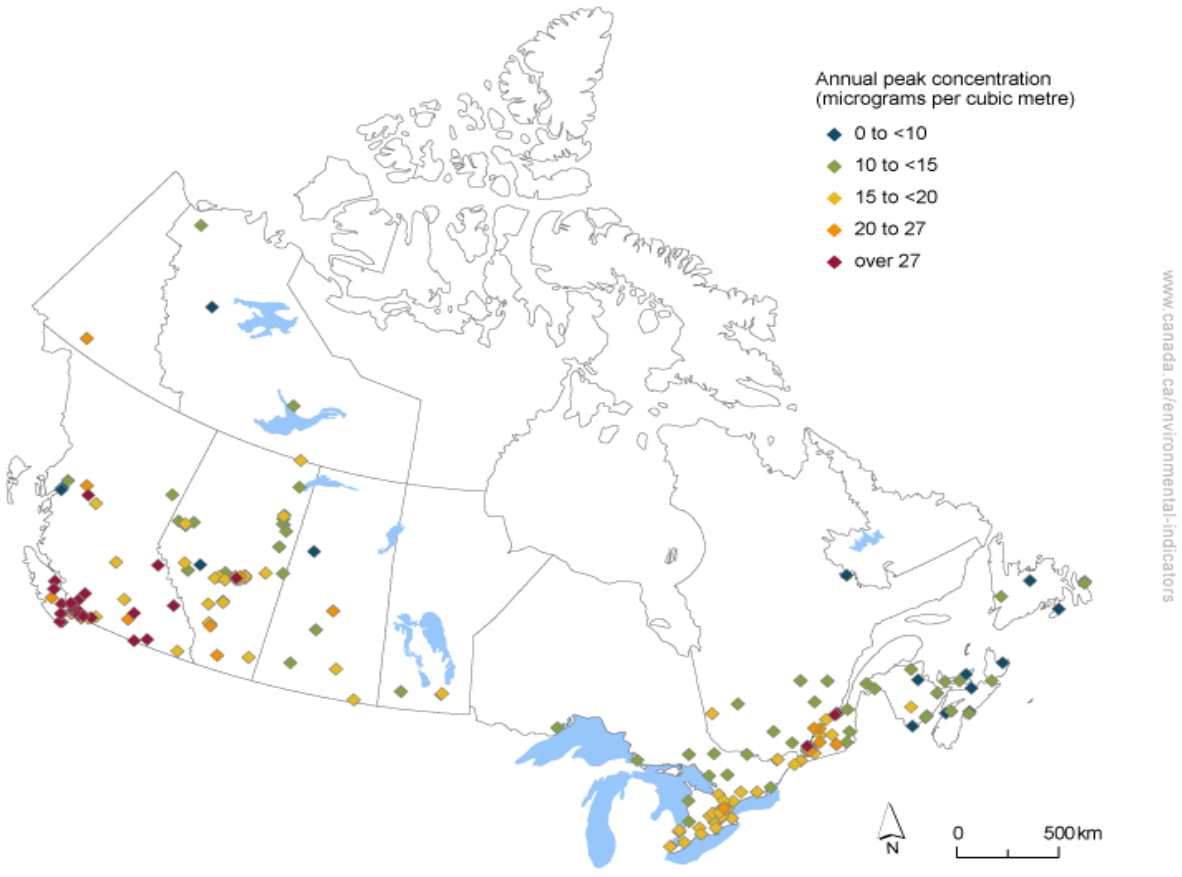
## Peak fine particulate matter concentrations at monitoring stations

The National Air Pollution Surveillance program measures air pollutant concentrations at monitoring stations across Canada. The Canadian Environmental Sustainability Indicators provide access to this information through an interactive map. The map allows users to explore peak $PM_{2.5}$ concentrations at specific monitoring stations.

In 2020, peak $PM_{2.5}$ concentrations were recorded at 214 monitoring stations across Canada. The highest peak $PM_{2.5}$ concentrations were generally recorded at monitoring stations in western Canada.

- 32 stations recorded concentrations above 27 µg/m$^3$, ranging from 27.1 µg/m$^3$ to 64.4 µg/m$^3$. Of these stations, 1 station was located in Alberta, 3 were in Quebec and 28 in British Columbia
- 16 stations recorded concentrations below 10 µg/m$^3$. Of these stations, 4 were located in Nova Scotia, 3 in each British Columbia and Newfoundland and Labrador, 2 in New Brunswick, and 1 station was located in each Prince Edward Island, Saskatchewan, Alberta and Northwest Territories

**Figure 9. Peak fine particulate matter concentrations by monitoring station, Canada, 2020**




Navigate data using the interactive map

**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal

# Ground-level ozone

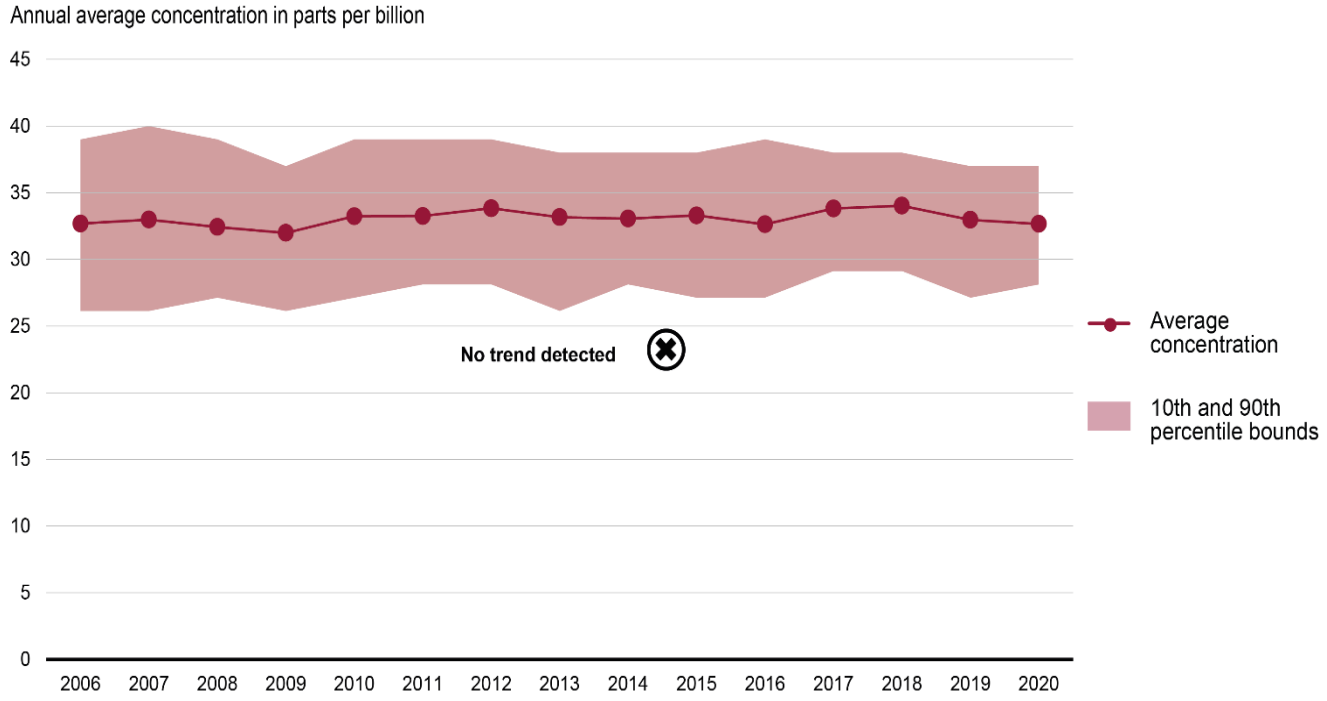
Ozone ($O_3$) is a gas that, when present in the upper atmosphere (10 to 50 kilometres above the earth's surface), protects plant, animal, and human health from the sun's harmful ultraviolet radiation. In the lower atmosphere and at ground level, $O_3$ is a secondary pollutant formed when precursor gases such as nitrogen oxides and volatile organic compounds react in sunlight. Exposure to $O_3$ is harmful to human health and can cause throat irritation, coughing, shortness of breath and aggravation of existing conditions such as asthma. Over time, exposure to $O_3$ may lead to development of asthma, reduced lung function and other lung conditions.[7] Ground-level $O_3$ can impact vegetation, decrease the productivity of some crops, and may contribute to forest decline. It can also damage synthetic materials and textiles, cause cracks in rubber, accelerate fading of dyes and speed deterioration of some paints and coatings. Ground-level $O_3$ is a major component of smog, along with fine particulate matter.

## National average ground-level ozone concentrations

### Key results

- From 2006 to 2020,
  - no trend was detected in the national average $O_3$ concentrations
  - national average concentrations remained stable;
- In 2020, the national average $O_3$ concentration was 32.7 ppb, around 1.0% lower than 2019 level

**Figure 10. National average ozone concentrations, Canada, 2006 to 2020**




Data for Figure 10

**Note:** The national average $O_3$ concentration indicator is based on the annual average of the daily maximum 8-hour average concentrations recorded at 163 monitoring stations across Canada. There is no comparison with CAAQS given no standard exists for $O_3$. For more information, consult the Air quality indicator definitions in the Data sources and methods section.

**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal and the Canadian Air and Precipitation Monitoring Network.

[7] Health Canada (2021). Health Impacts of Air Pollution in Canada: Estimates of morbidity and premature mortality outcomes – 2021 Report

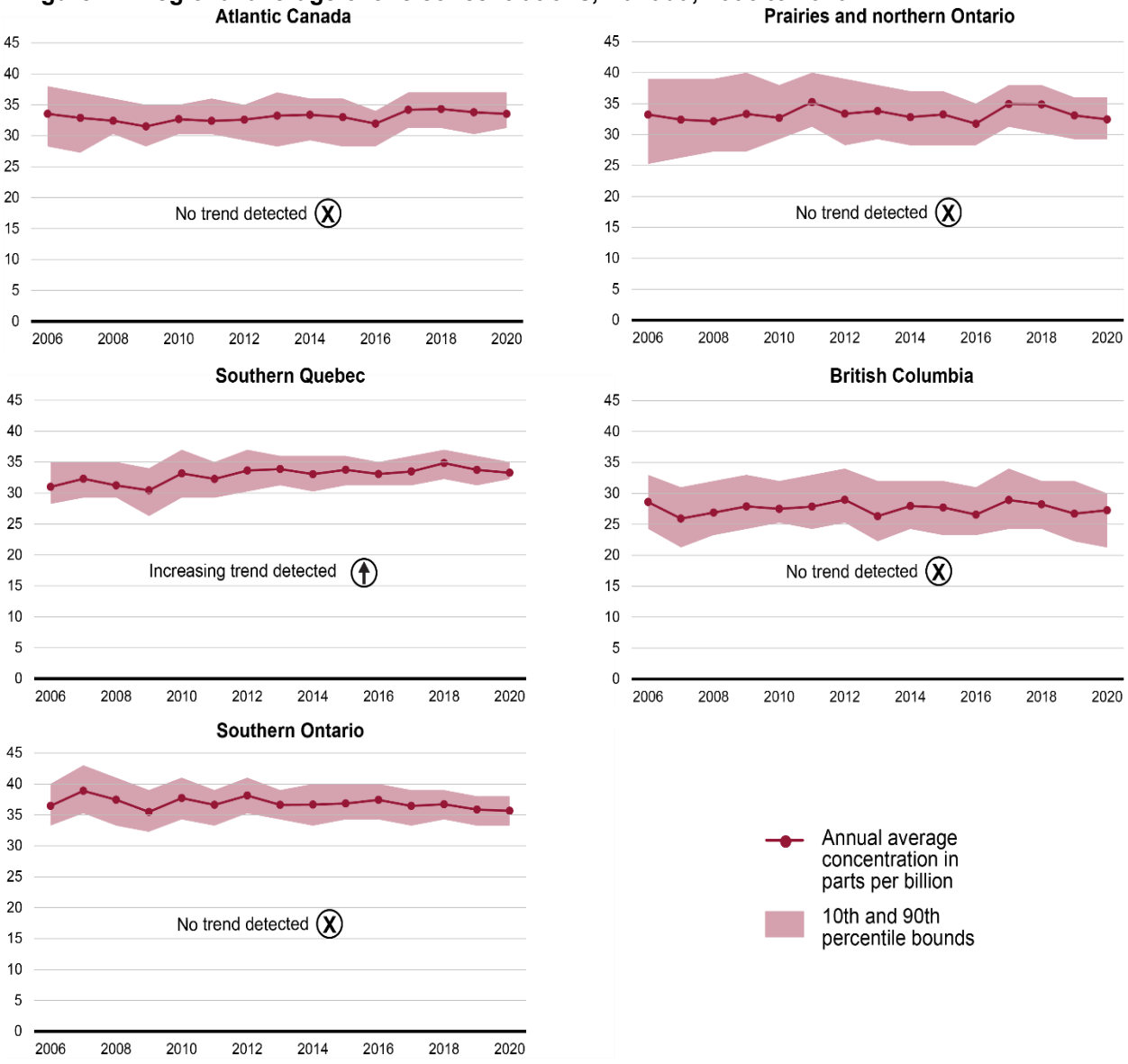
## Regional average ground-level ozone concentrations

### Key results

From 2006 to 2020,

- an increasing trend was detected for average $O_3$ concentrations in the southern Quebec region.
- no trends were detected for any other region.

**Figure 11. Regional average ozone concentrations, Canada, 2006 to 2020**






Data for Figure 11

**Note:** The regional average $O_3$ concentration indicator is based on the annual average of the daily maximum 8-hour average concentrations recorded at 18 monitoring stations in the Atlantic Canada region, 40 in the southern Quebec region, 41 in the southern Ontario region, 32 in the Prairies and northern Ontario region, and 30 in British Columbia. There were not enough stations to report results for the northern territories region. There is no comparison with CAAQS given no standard exists for $O_3$. For more information, consult the Air quality indicator definitions in the Data sources and Methods section.
**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal and the Canadian Air and Precipitation Monitoring Network.

In 2020, the southern Ontario region had the highest regional average $O_3$ concentration, at 35.7 ppb. The Prairies and northern Ontario, the southern Quebec and the Atlantic Canada regions each had an average concentration around 33.0 ppb, followed by British Columbia with regional average concentrations of 27.3 ppb.

The regional average concentration was lower in 2020 than in 2019 in all regions except in British Columbia. The reduction recorded were between 1.9% (0.6 ppb) for the Prairies and northern Ontario region, the largest decrease in concentration, and 0.6% (0.2 ppb) for the southern Ontario region.

From 2006 to 2020, an increasing trend of 0.2 ppb per year was detected for the southern Quebec region. Over that period, all other regions had no trend detected.

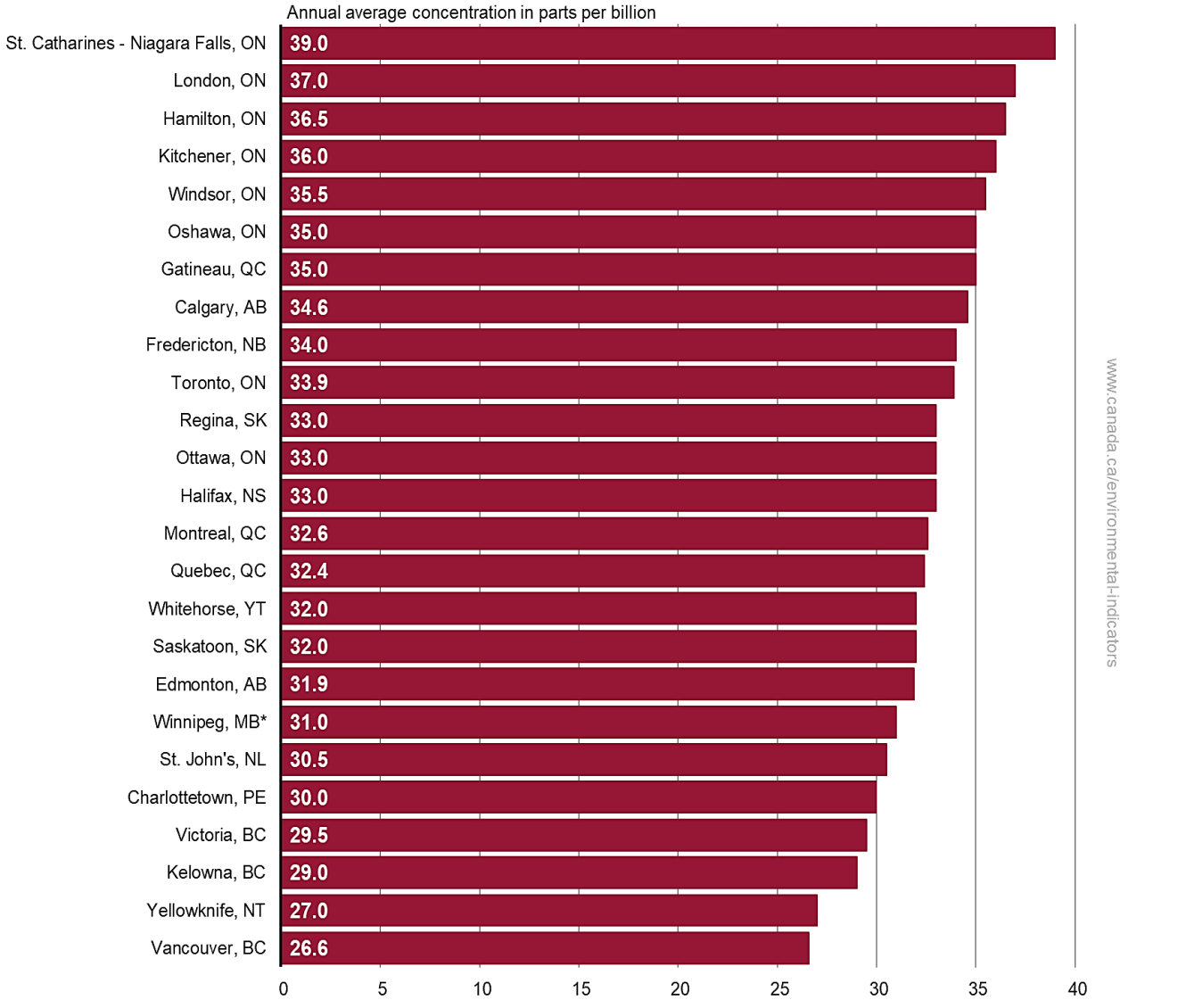
## Average ground-level ozone concentrations in urban areas

### Key results

In 2020, among the selected urban areas:

- St. Catharines - Niagara Falls, ON had the highest average $O_3$ concentration
- Vancouver, BC had the lowest concentration

**Figure 12. Average ozone concentrations of selected Canadian urban areas, 2020**




Data for Figure 12

**Note:** * The concentration is from 2017 and reported for information purposes, as no valid data was available for more recent years. The indicator only reports 25 urban areas for the most populated communities in Canada and the provincial and territorial capitals when data meeting the completeness criteria was available. All concentrations available since 2006 for each urban areas are presented in a separate data table.
**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal and the Canadian Air and Precipitation Monitoring Network.

Annual average $O_3$ concentrations in Canadian urban areas differ from one location to another and from year to year. These differences are partly due to variations in local emissions of $O_3$ precursors (mostly $NO_X$ and VOCs), variations in weather conditions that influence $O_3$ formation and variations in transboundary flows of pollution, primarily from the United States.

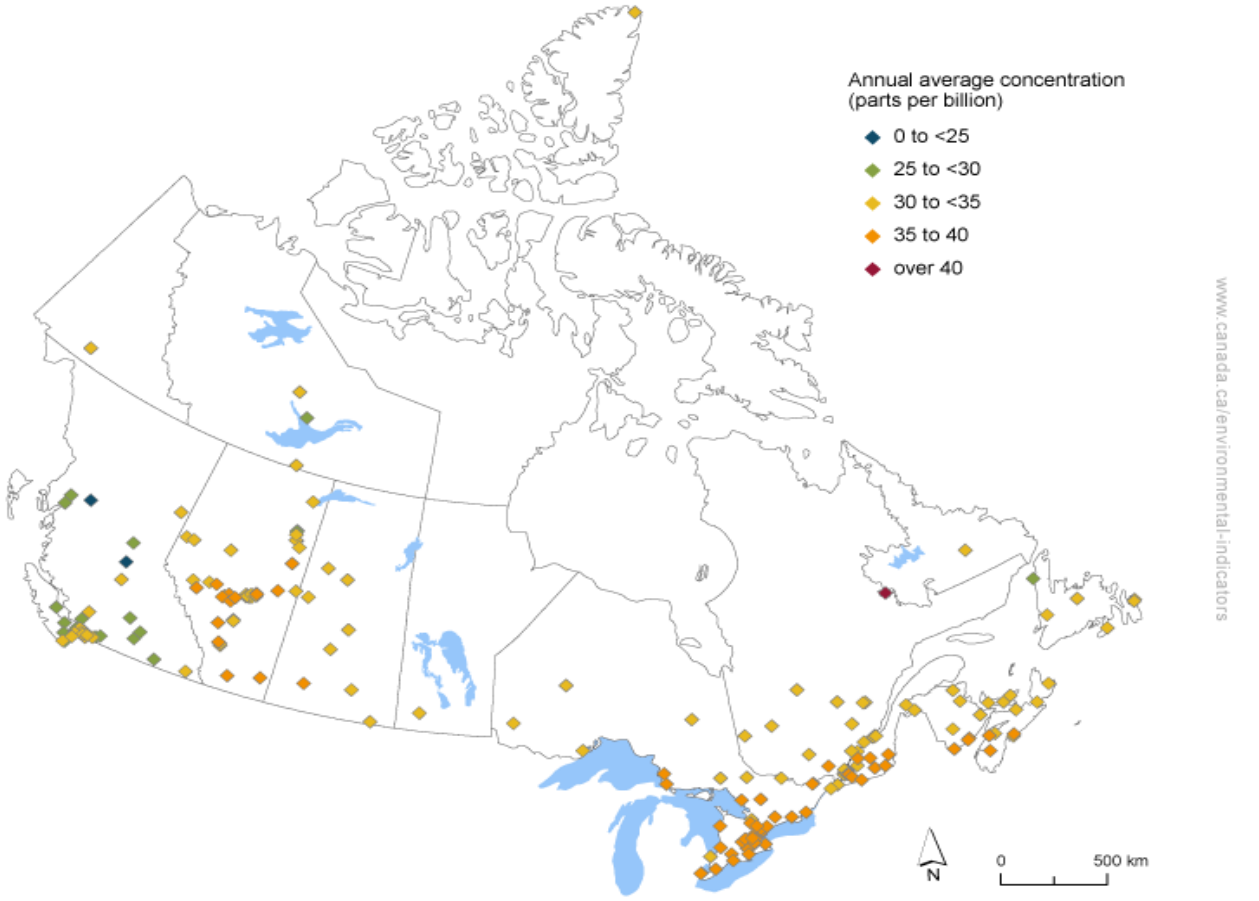
## Average ground-level ozone concentrations at monitoring stations.

The National Air Pollution Surveillance program measures air pollutant concentrations at monitoring stations across Canada. The Canadian Environmental Sustainability Indicators provide access to this information through an interactive map. The map allows users to explore average $O_3$ concentrations at specific monitoring stations.

In 2020, average $O_3$ concentrations were recorded at 216 monitoring stations across Canada. Of these stations:

- 1 station located in Newfoundland and Labrador had a concentration above 40 ppb, with 44.0 ppb
- 6 stations had concentrations below 25 ppb, all of them were located in British Columbia

**Figure 13. Average ozone concentrations by monitoring station, Canada, 2020**




Navigate data using the interactive map

**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal and the Canadian Air and Precipitation Monitoring Network.

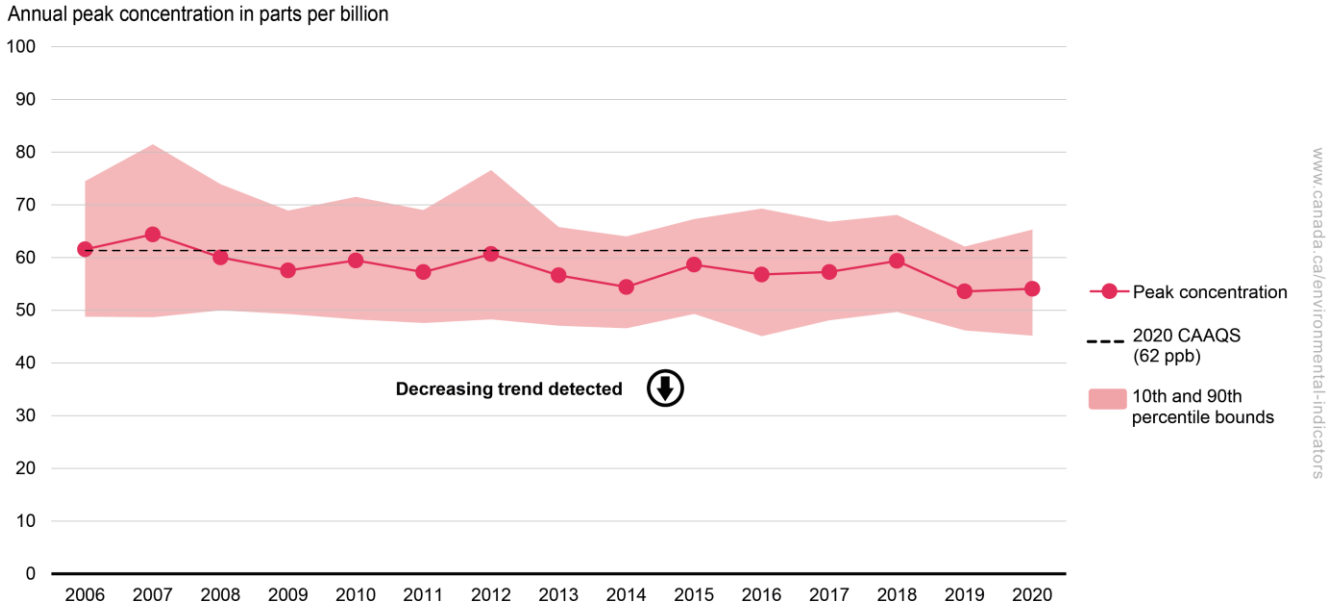
## National average peak ground-level ozone concentrations

### Key results

From 2006 to 2020,

- a decreasing trend was detected in the national average peak $O_3$ concentrations
- national average peak concentrations remained below the 2020 standard of 62 ppb since 2008, with, however, many exceedances recorded at some monitoring stations particularly in southern Ontario region

**Figure 14. National average peak ozone concentrations, Canada, 2006 to 2020**




Data for Figure 14

**Note:** The national average peak $O_3$ concentration indicator is based on the annual 4th-highest of the daily maximum 8-hour average concentrations recorded at 163 monitoring stations across Canada. The comparison to the Canadian Ambient Air Quality Standard is provided for illustrative purposes only. For more information, consult the Air quality indicator definitions in the Data sources and methods section.
**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal and the Canadian Air and Precipitation Monitoring Network.

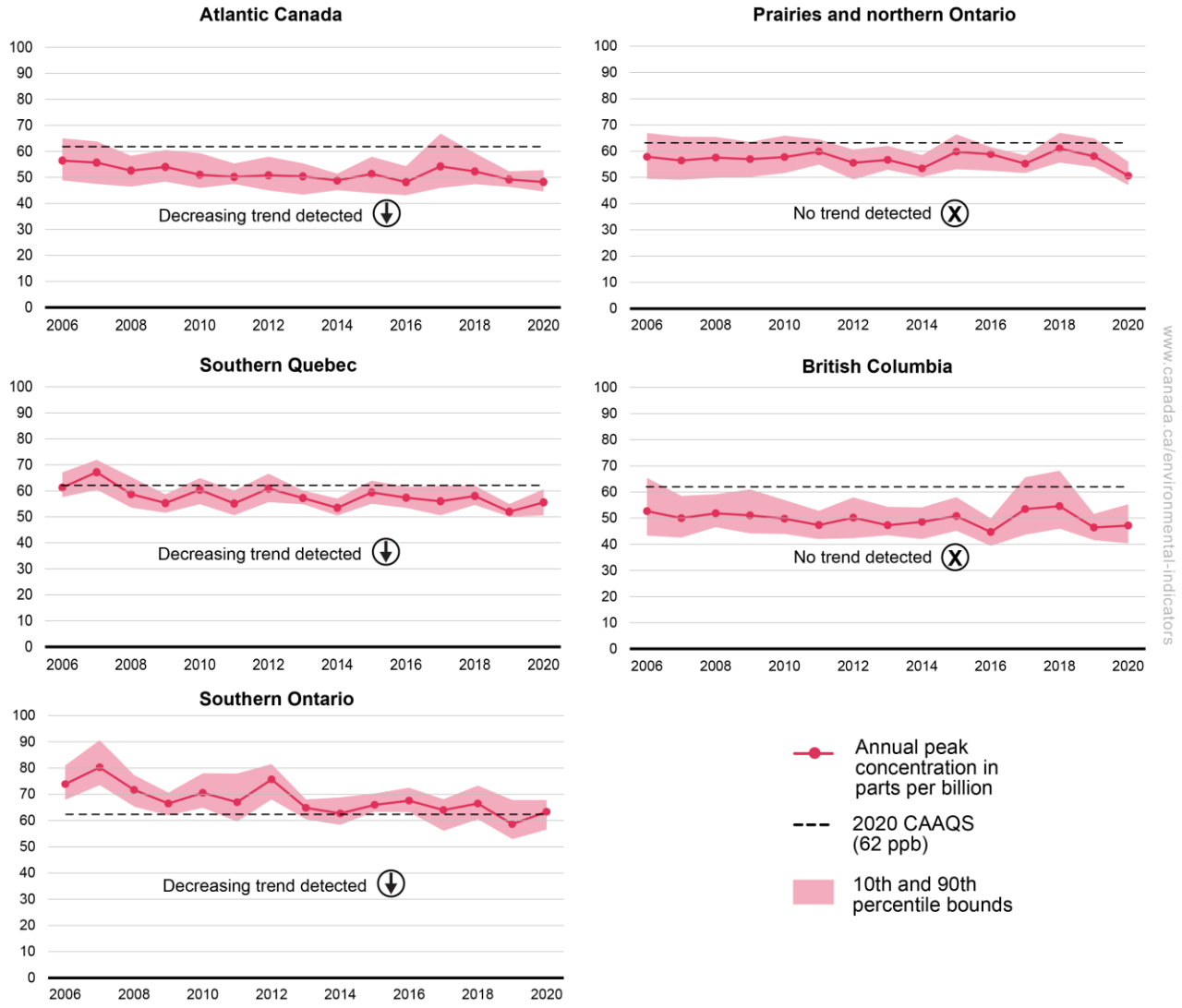
In 2020, the national average peak $O_3$ concentration was 54.1 ppb, 0.9% higher than 2019 level. From 2006 to 2020, a decreasing trend of 0.5 ppb per year was detected. National concentrations decreased by 12.2% (7.5 ppb) between 2006 and 2020. Reductions in Canadian and American emissions of ground-level $O_3$ precursor gases (nitrogen oxides and volatile organic compounds) are important factors in this general downward trend.

## Regional average peak ground-level ozone concentrations

### Key results

- From 2006 to 2020,
  - decreasing trends were detected for regional average peak $O_3$ concentrations in the Atlantic Canada, southern Quebec, and southern Ontario regions
  - no trends were detected for the Prairies and northern Ontario region or British Columbia
- Since 2006,
  - both southern Quebec and southern Ontario regions have regional average peak concentrations that exceeded the 2020 standard of 62 ppb. In the southern Ontario region, except for 2019, regional average peak concentrations were consistently above the standard
  - other regional average peak $O_3$ concentrations remained below the standard, with exceedances measured at some monitoring stations

**Figure 15. Regional average peak ozone concentrations, Canada, 2006 to 2020**




Data for Figure 15

**Note:** The regional average peak $O_3$ indicator is based on the annual 4th-highest of the daily maximum 8-hour average concentrations recorded at 18 monitoring stations in the Atlantic Canada region, 40 in the southern Quebec region, 41 in the southern Ontario region, 32 in the Prairies and northern Ontario region, and 30 in British Columbia. There were not enough stations to report results for the northern territories region. The comparison to the Canadian Ambient Air Quality Standard is provided for illustrative purposes only. For more information, consult the Air quality indicator definitions in the Data sources and methods section.
**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal and the Canadian Air and Precipitation Monitoring Network.

In 2020, the southern Ontario region had the highest regional average peak $O_3$ concentration at 63.3 ppb. British Columbia had the lowest average peak $O_3$ concentration at 47.2 ppb.

Between 2019 and 2020, the Prairies and northern Ontario region had the largest reduction in average concentration, with a decrease of 12.7% (7.4 ppb). This decrease is likely due in part to reduced wildfire activity in western Canada and fewer summer smog episodes in 2020. The Atlantic Canada region recorded a smaller decrease of 2.1% (1.0 ppb). On the other hand, the southern Ontario, southern Quebec region and British Columbia had increases of 8.0% (4.7 ppb), 7.0% (3.6 ppb) and 1.6% (0.7 ppb), respectively.

From 2006 to 2020,

- a decreasing trend of 0.9 ppb per year was detected for the southern Ontario region
- a decreasing trend of 0.5 ppb per year was detected for the Atlantic Canada region

- a decreasing trend of 0.4 ppb per year was detected for the southern Quebec region
- no trends were detected for the British Columbia or Prairies and northern Ontario regions.

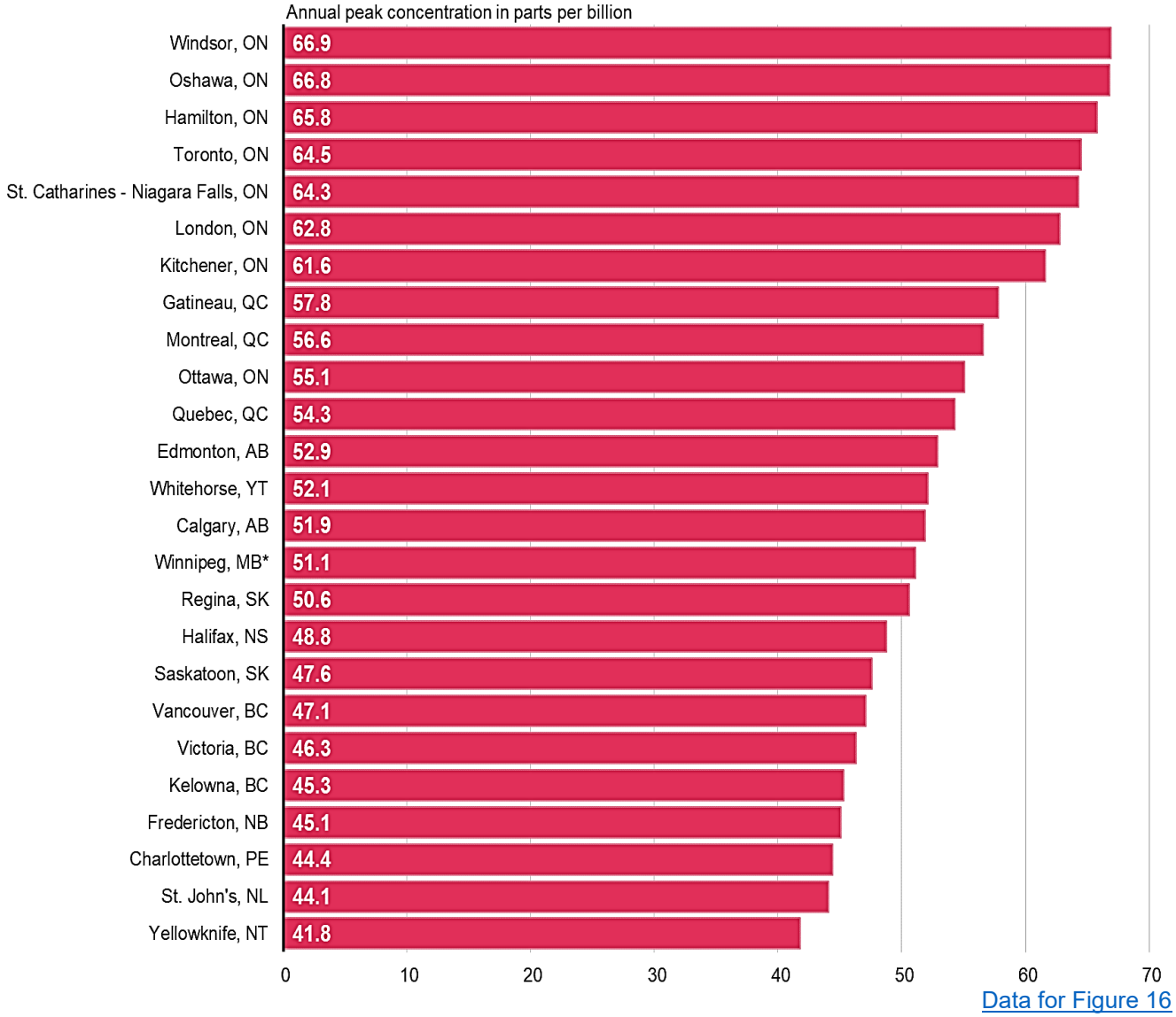
## Average peak ground-level ozone concentrations in urban areas

### Key results

In 2020, among the selected urban areas

- Windsor, ON and Oshawa, ON had the highest average peak $O_3$ concentrations
- Yellowknife, NT had the lowest average peak concentration

**Figure 16. Average peak ozone concentrations, selected Canadian urban areas, 2020**




Data for Figure 16

**Note:** * The concentration is from 2017 and reported for information purposes, as no valid data was available for more recent years. The indicator only reports 25 urban areas for the most populated communities in Canada and the provincial and territorial capitals when data meeting the completeness criteria was available. All concentrations available since 2006 for each urban areas are presented in a separate data table.
**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal and the Canadian Air and Precipitation Monitoring Network.

Average peak $O_3$ concentrations in Canadian urban areas differ from one location to another and from year to year. These differences are partly due to variations in local emissions of $O_3$ precursors (mostly $NO_X$ and VOCs),

variations in weather conditions that influence $O_3$ formation and variations in transboundary flows of pollution, primarily from the United States.

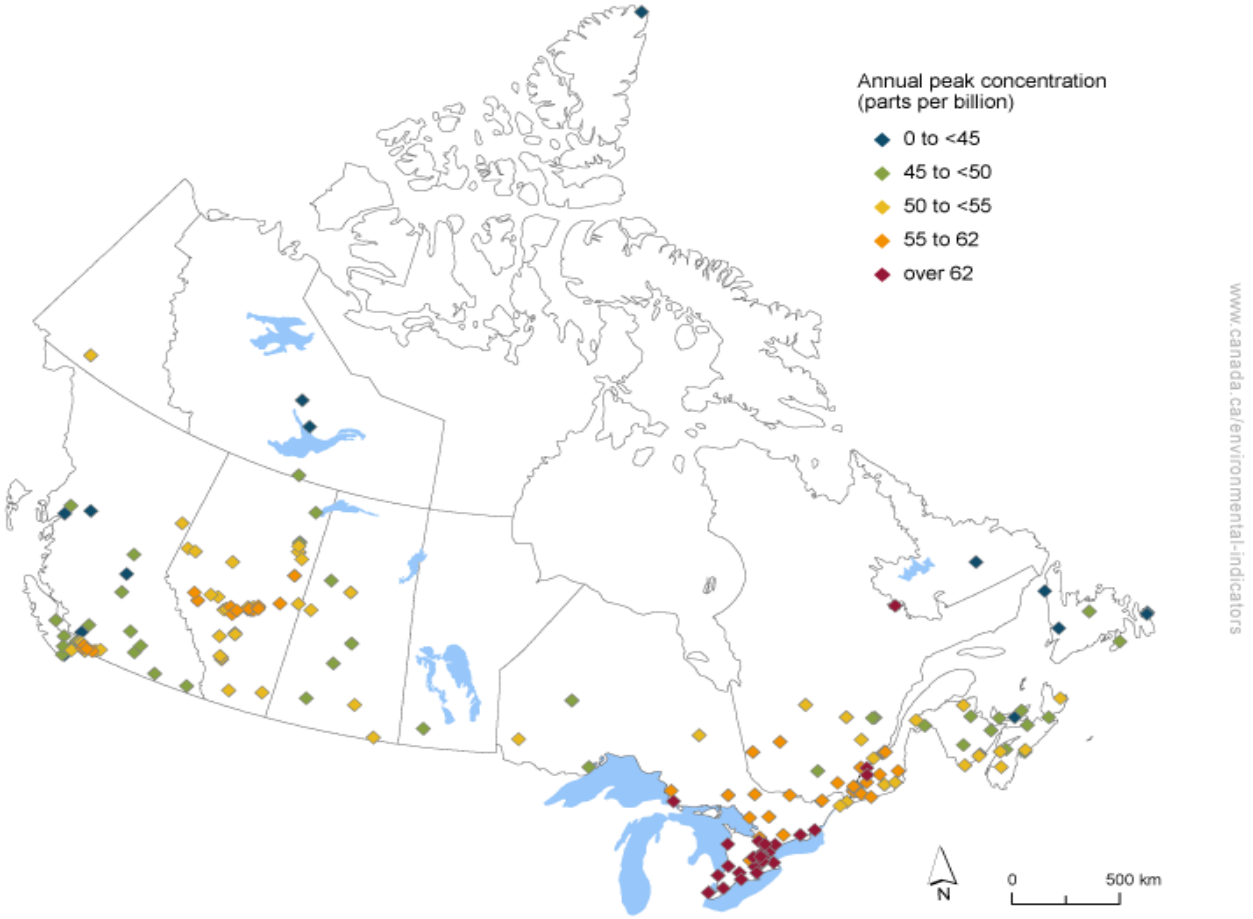
## Peak ground-level ozone concentrations at monitoring stations

The National Air Pollution Surveillance program measures air pollutant concentrations at monitoring stations across Canada. The Canadian Environmental Sustainability Indicators provide access to this information through an interactive map. The map allows users to explore peak $O_3$ concentrations at specific monitoring stations.

In 2020, peak $O_3$ concentrations were recorded at 216 monitoring stations across Canada.

- 33 stations had concentrations over 62 ppb. Most of them (30) were located in Ontario, the 3 remaining stations were in Quebec (2) and Newfoundland and Labrador (1)
- 21 stations recorded concentrations below 45 ppb. Of these stations, 11 were located in British Columbia, 5 in Newfoundland and Labrador, 2 in the Northern Territories and 1 station in each Alberta, Nunavut and Prince Edward Island

**Figure 17. Peak ozone concentrations by monitoring station, Canada, 2020**




Navigate data using the interactive map

**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal and the Canadian Air and Precipitation Monitoring Network.

# Nitrogen dioxide

Nitrogen dioxide ($NO_2$) belongs to a group of substances called nitrogen oxides ($NO_X$). Nitrogen oxides are emitted into the atmosphere from high-temperature combustion processes such as vehicle engines, power plants and industrial processes. The main sources of nitrogen oxides in Canada are the oil and gas, transportation, industry and off-road vehicles and mobile equipment. The majority of emitted $NO_X$ is nitrogen monoxide (NO); however, once in the atmosphere NO reacts with volatile organic compounds and ozone to form $NO_2$. Exposure to $NO_2$ can result in adverse health effects; it can irritate the lungs, decrease lung function, and increase susceptibility to allergens for people with asthma. Long-term exposure to $NO_2$ may lead to the development of allergies and asthma.[8] $NO_2$ also has adverse environmental impacts. It contributes to the formation of $O_3$ and $PM_{2.5}$ and has major impacts on acid deposition (acid rain) and eutrophication of aquatic ecosystems.

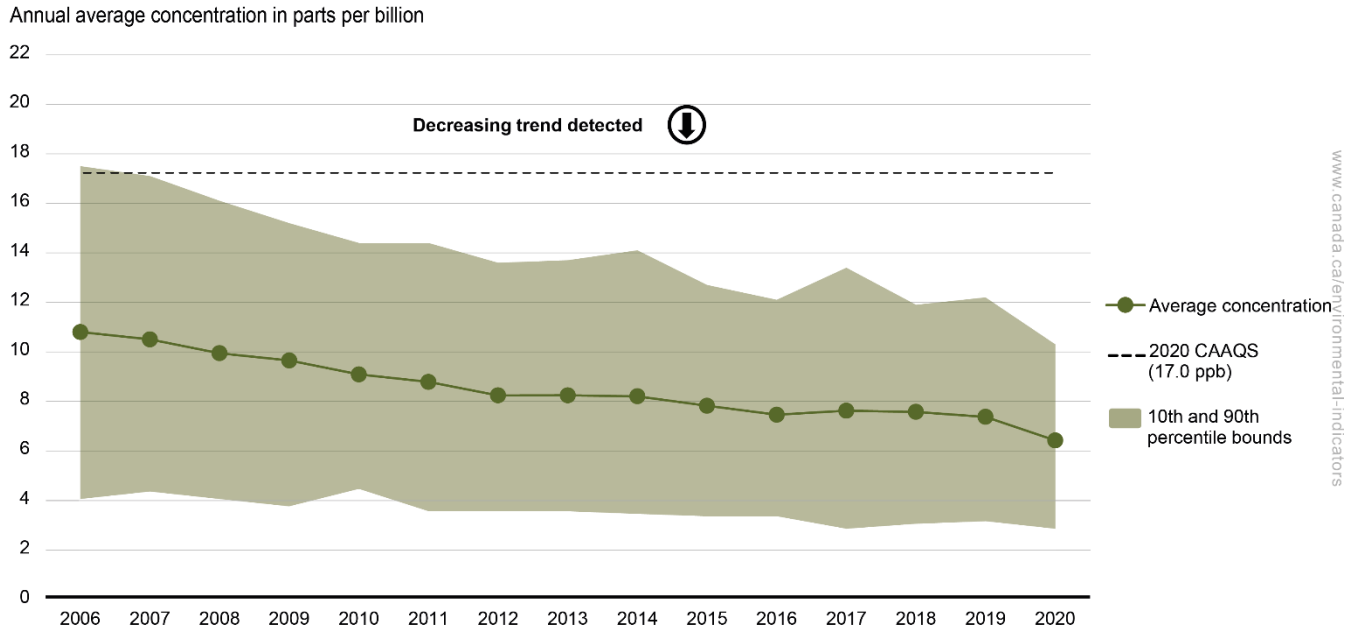
## National average nitrogen dioxide concentrations

### Key results

From 2006 to 2020,

- a decreasing trend was detected in the average $NO_2$ concentration.
- the national average concentrations remained well below the 2020 standard of 17.0 parts per billion (ppb) in this period; however, concentrations at few monitoring stations exceeded the standards

**Figure 18. National average nitrogen dioxide concentrations, Canada, 2006 to 2020**




Data for Figure 18

**Note:** The national average $NO_2$ concentration indicator is based on the annual average of the hourly concentrations recorded at 118 monitoring stations across Canada. The comparison to the Canadian Ambient Air Quality Standard is provided for illustrative purposes only. For more information, consult the Air quality indicator definitions in the Data sources and methods section.
**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal.

In 2020, the national average $NO_2$ concentration was 6.3 ppb, which was 13.0% (0.9 ppb) lower than in 2019. From 2006 to 2020, a decreasing trend of 0.3 ppb per year was detected. The national average concentration decreased by 41.0% (4.3 ppb) between 2006 and 2020. This trend is mainly attributable to 2 factors:

[8] Health Canada (2021). Health Impacts of Air Pollution in Canada: Estimates of morbidity and premature mortality outcomes – 2021 Report

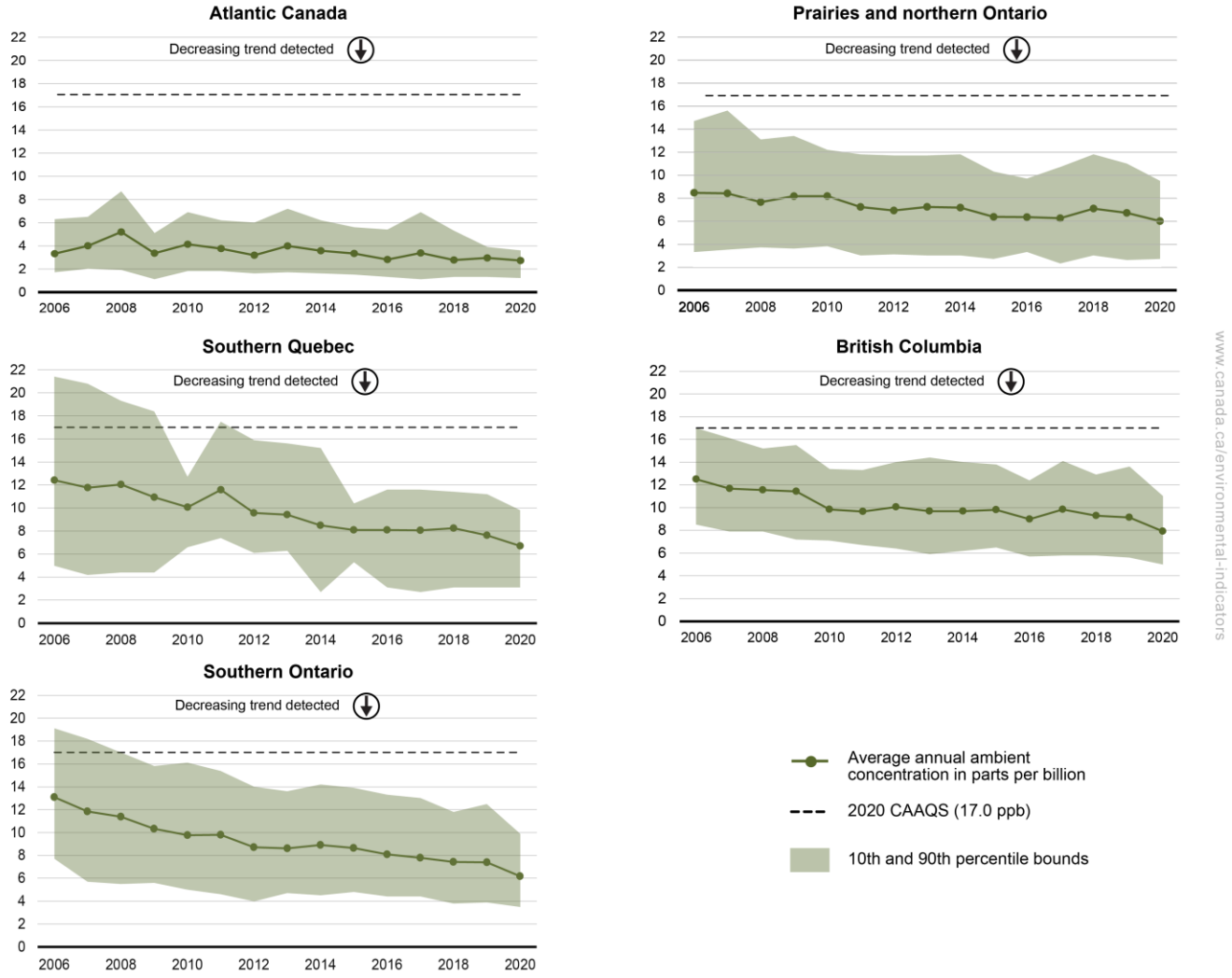
- lower emissions from vehicles and engines following the adoption of new technologies and clean fuel for vehicles and the introduction of progressively more stringent emission regulations by the federal government
- lower emissions from fossil-fuel-fired (for example, coal-fired) power-generating utilities from improved emission control technologies and the closures of some coal-fired power plants

## Regional average nitrogen dioxide concentrations

### Key results

- From 2006 to 2020, decreasing trends were detected for all 5 regions
- Since 2006, regional average $NO_2$ concentrations remained below the 2020 standard of 17.0 ppb in all regions; however, very few monitoring stations recorded concentrations exceeding standards

**Figure 19. Regional average nitrogen dioxide concentrations, Canada, 2006 to 2020**




Data for Figure 19

**Note:** The regional average $NO_2$ concentration indicator is based on the annual average of the hourly concentrations recorded at 8 monitoring stations in the Atlantic Canada region, 16 in the southern Quebec region, 30 in the southern Ontario region, 34 in the Prairies and northern Ontario region and 28 in British Columbia. There were not enough stations to report results for the northern territories region. The comparison to the Canadian Ambient Air Quality Standard is provided for illustrative purposes only. For more information, consult the Air quality indicator definitions in the Data sources and methods section.
**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal.

In 2020, British Columbia had the highest regional average $NO_2$ concentration, at 7.9 ppb. The southern Quebec region followed with a concentration of 6.7 ppb. The southern Ontario and Prairies and northern Ontario regions reported concentrations of 6.2 ppb and 6.0 ppb, respectively. The Atlantic Canada region had the lowest regional average concentration, at 2.7 ppb.

All 5 regions had lower concentrations in 2020 than in 2019. The southern Ontario region had the largest reduction proportion in average concentration, with a decrease of 16.6% (1.2 ppb). British Columbia, southern Quebec and Prairies and northern Ontario regions reported decreases of 13.3% (1.2 ppb), 12.1% (0.9 ppb) and 10.6% (0.7 ppb), respectively. The Atlantic Canada had the lowest reduction of 7.7% (0.2 ppb).

From 2006 to 2020, a decreasing trend of:

- 0.4 ppb per year was detected for the southern Ontario and the southern Quebec regions
- 0.2 ppb per year was detected for British Columbia and the Prairies and northern Ontario region
- 0.1 ppb per year was detected for the Atlantic Canada region

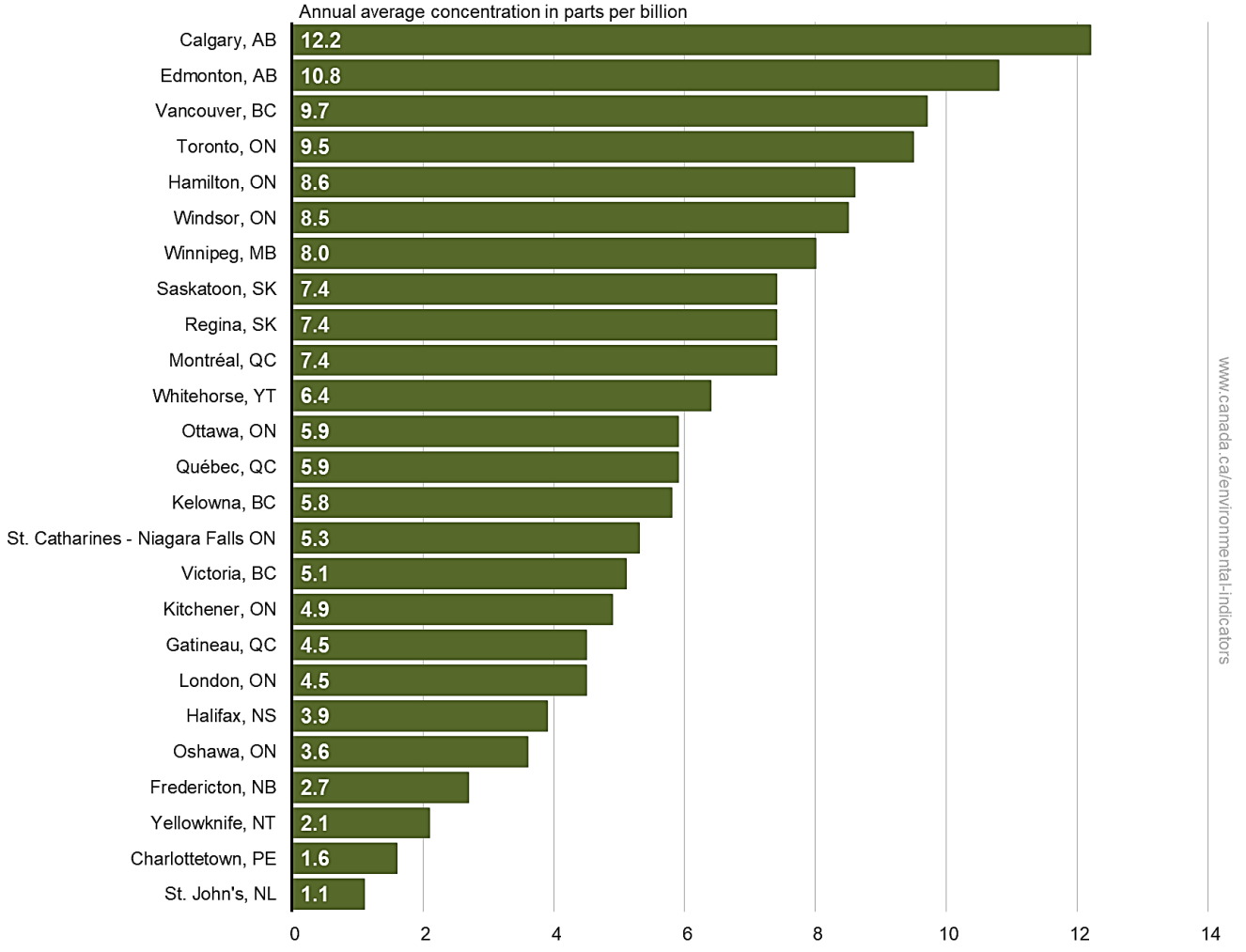
## Average nitrogen dioxide concentrations in urban areas

### Key results

In 2020, among the selected urban areas

- Calgary, AB had the highest average $NO_2$ concentration
- St. John's, NL had the lowest average concentration

**Figure 20. Average nitrogen dioxide concentrations, selected Canadian urban areas, 2020**




Data for Figure 20

**Note:** The indicator only reports 25 urban areas for the most populated communities in Canada and the provincial and territorial capitals when data meeting the completeness criteria was available. All concentrations available since 2006 for each urban areas are presented in a separate data table.
**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal.

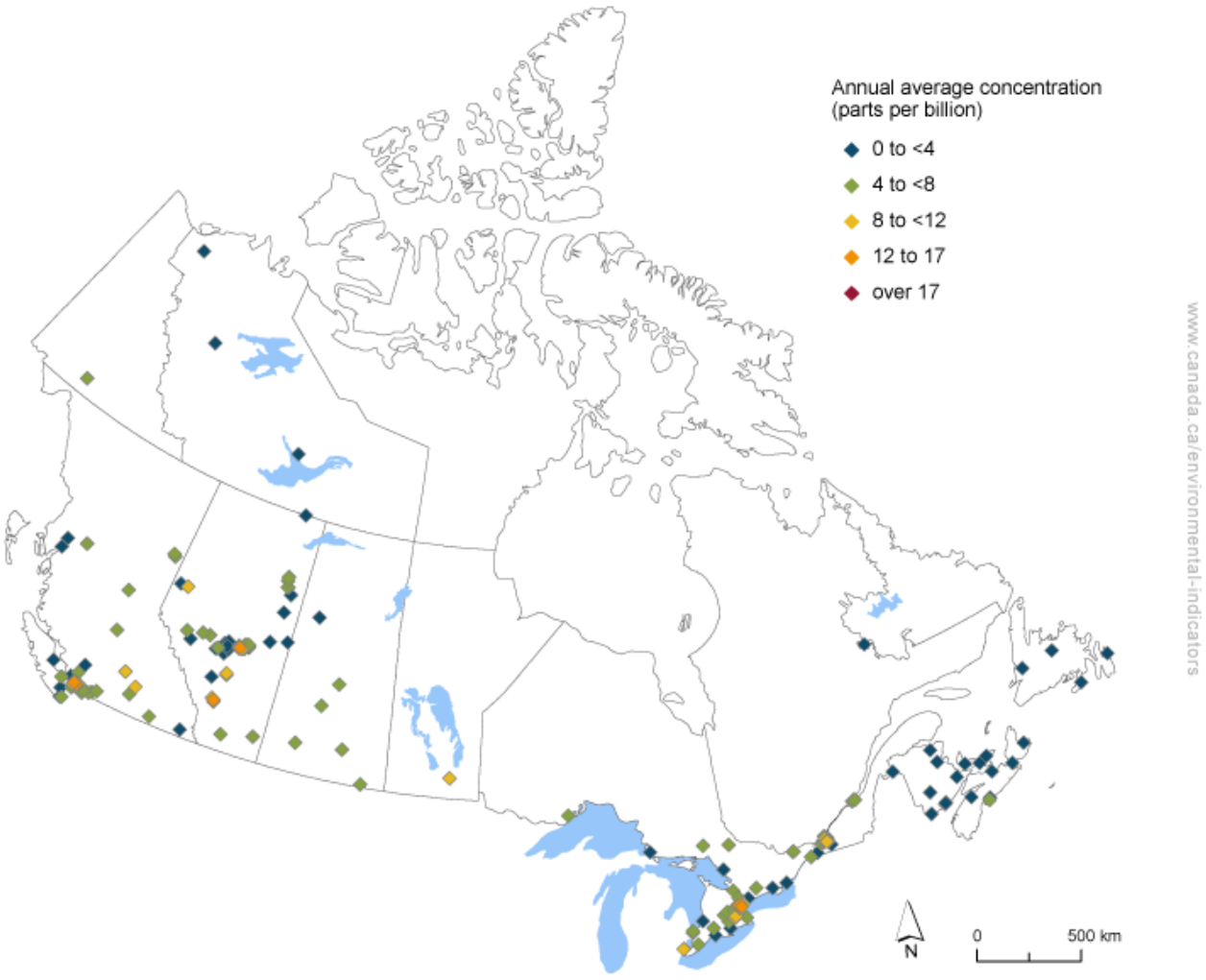
## Average nitrogen dioxide concentrations at monitoring stations

The National Air Pollution Surveillance program measures air pollutant concentrations at monitoring stations across Canada. The Canadian Environmental Sustainability Indicators provide access to this information through an interactive map. The map allows users to explore average $NO_2$ concentrations at specific monitoring stations.

In 2020, average $NO_2$ concentrations were recorded at 186 monitoring stations across Canada. Average $NO_2$ concentrations were lower in eastern and northern areas of Canada.

- no stations had average concentrations above 17.0 ppb
- 61 stations had average concentrations below 4.0 ppb, with most of them in the Atlantic Canada region (22) and in the Prairies and north Ontario region (17)

**Figure 21. Average nitrogen dioxide concentrations by monitoring station, Canada, 2020**




Navigate data using the interactive map

**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal.

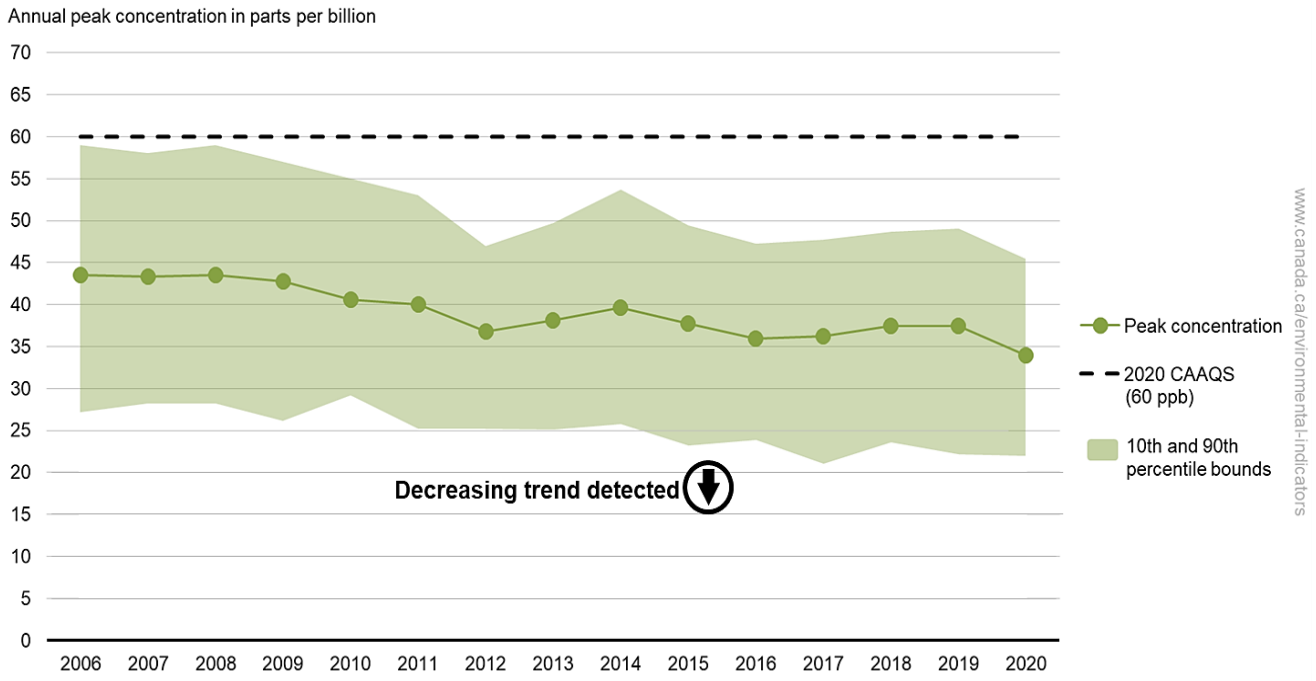
## National average peak nitrogen dioxide concentrations

### Key results

From 2006 to 2020,

- a decreasing trend was detected in the national average peak $NO_2$ concentration
- national average peak concentrations remained below the 2020 standard of 60 ppb for all years; however, concentrations at only a few monitoring stations exceeded the standard

**Figure 22. National average peak nitrogen dioxide concentrations, Canada, 2006 to 2020**




Data for Figure 22

**Note:** The national average peak $NO_2$ concentration indicator is based on the annual 98th percentile of the daily maximum 1-hour average concentrations recorded at 118 monitoring stations across Canada. The comparison to the Canadian Ambient Air Quality Standard is provided for illustrative purposes only. For more information, consult the Air quality indicator definitions in the Data sources and methods section.
**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal.

In 2020, the national average peak $NO_2$ concentration was 33.9 ppb, which was 9.3% lower than in 2019.

From 2006 to 2020, a decreasing trend of 0.6 ppb per year was detected. National average peak concentration decreased by 22.1% (9.6 ppb) between 2006 and 2020. This trend is mainly attributable to 2 factors:

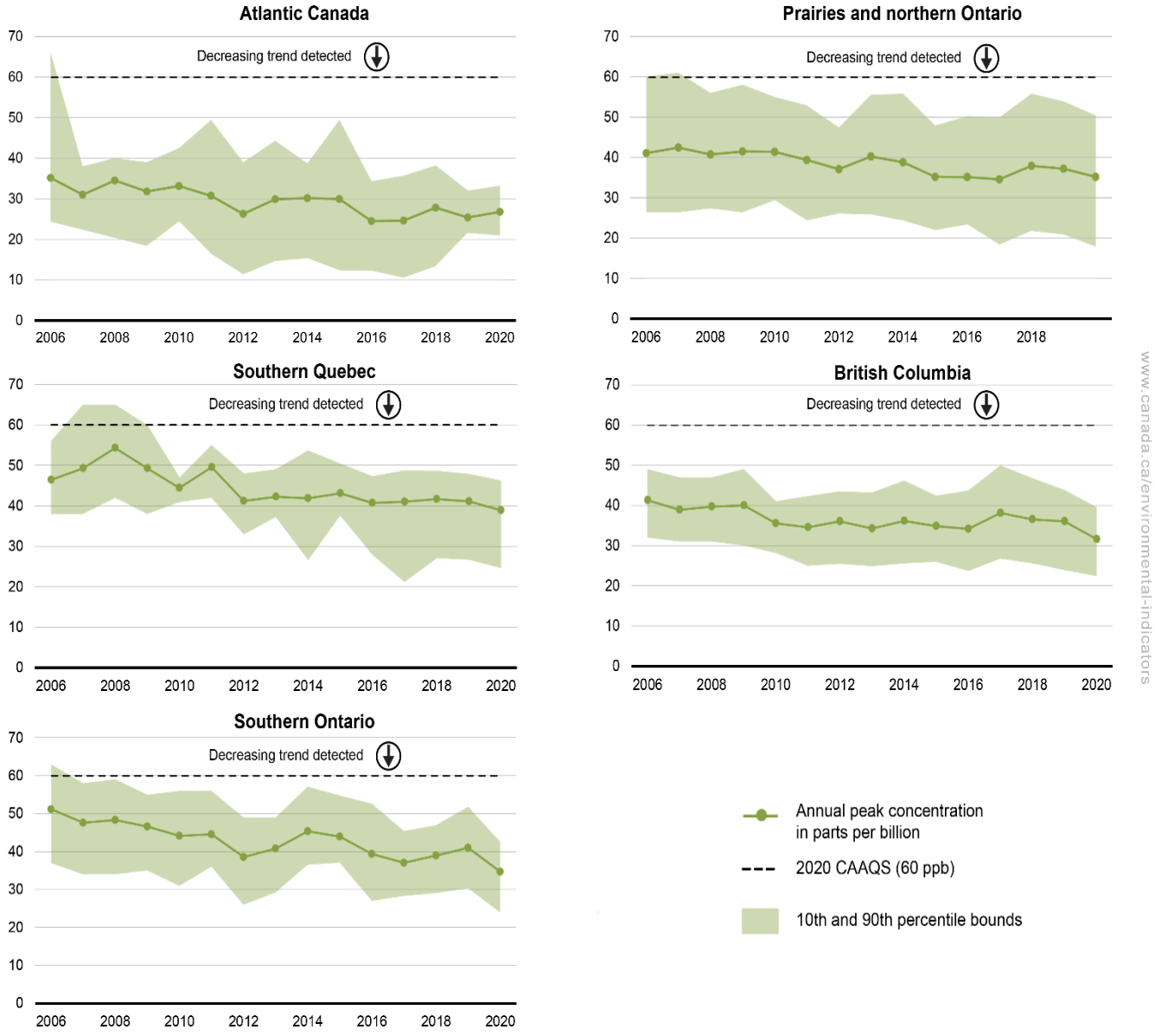
- lower emissions from vehicles and engines following the adoption of new regulations and clean fuel for vehicles and the introduction of progressively more stringent emission regulations by the federal government
- lower emissions from fossil-fuel-fired (for example, coal-fired) power-generating utilities from improved emission control technologies and the closures of some coal-fired power plants

## Regional average peak nitrogen dioxide concentrations

### Key results

- From 2006 to 2020, decreasing trends were detected for all 5 regions
- Since 2006, regional average peak $NO_2$ concentrations remained below the 2020 standard of 60 ppb in all regions; however, exceedances were recorded at a few monitoring stations in all regions except British Columbia

**Figure 23. Regional average peak nitrogen dioxide concentrations, Canada, 2006 to 2020**






Data for Figure 23

**Note:** The regional average peak $NO_2$ concentration indicator is based on the annual 98th percentile of the daily maximum 1-hour average concentrations recorded at 8 monitoring stations in the Atlantic Canada region, 16 in the southern Quebec region, 30 in the southern Ontario region, 34 in the Prairies and northern Ontario region and 28 in British Columbia. There were not enough stations to report results for the northern territories region. The comparison to the Canadian Ambient Air Quality Standard is provided for illustrative purposes only. For more information, consult the Air quality indicator definitions in the Data sources and methods section.
**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal.

In 2020, the southern Quebec region had the highest regional average peak $NO_2$ concentration, at 38.9 ppb. The Prairies and northern Ontario region followed with an average peak concentration of 35.2 ppb, the southern Ontario region with 34.7 ppb, and British Columbia with 31.6 ppb. The Atlantic Canada region had the lowest regional average peak concentration, at 26.8 ppb.

Except for the Atlantic Canada region, all regions had lower concentrations in 2020 than in 2019. The southern Ontario region had the largest reduction in average peak concentration, with a decrease of 15.3% (6.3 ppb) followed by British Columbia with 12.4% (4.4 ppb). The southern Quebec region and the Prairies and northern Ontario region reported nearly the same lowest decrease rate of 5.4% (2.2 ppb and 2.0 ppb, respectively), while the Atlantic Canada region reported an increase of 5.5% (1.4 ppb).

From 2006 to 2020, a decreasing trend of:

- 0.9 ppb per year was detected for southern Ontario
- 0.6 ppb per year was detected the Atlantic Canada and the southern Quebec regions
- 0.5 ppb per year was detected for the Prairies and northern Ontario region
- 0.4 ppb per year was detected for British Columbia

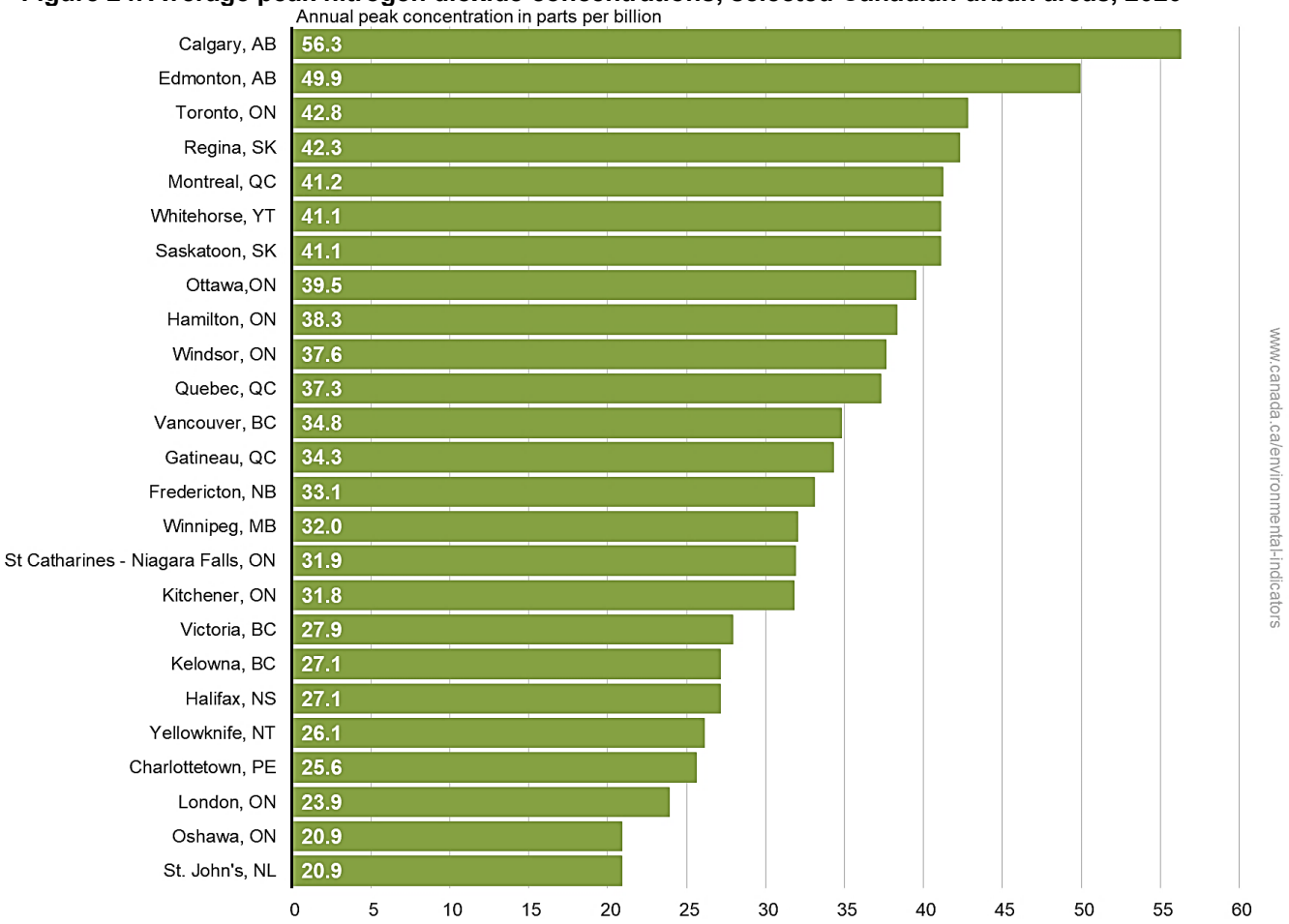
## Average peak nitrogen dioxide concentrations in urban areas

### Key results

In 2020, among the selected urban areas:

- Calgary, AB had the highest average peak $NO_2$ concentration
- Oshawa, ON and St John's, NL had the lowest concentrations

**Figure 24. Average peak nitrogen dioxide concentrations, selected Canadian urban areas, 2020**




Data for Figure 24

**Note:** The indicator only reports 25 urban areas for the most populated communities in Canada and the provincial and territorial capitals when data meeting the completeness criteria was available. All concentrations available since 2006 for each urban areas are presented in a separate data table.
**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal.

Urban areas in proximity to important sources of $NO_2$, such as large road network and highways, may explain the discrepancy between city's concentrations.

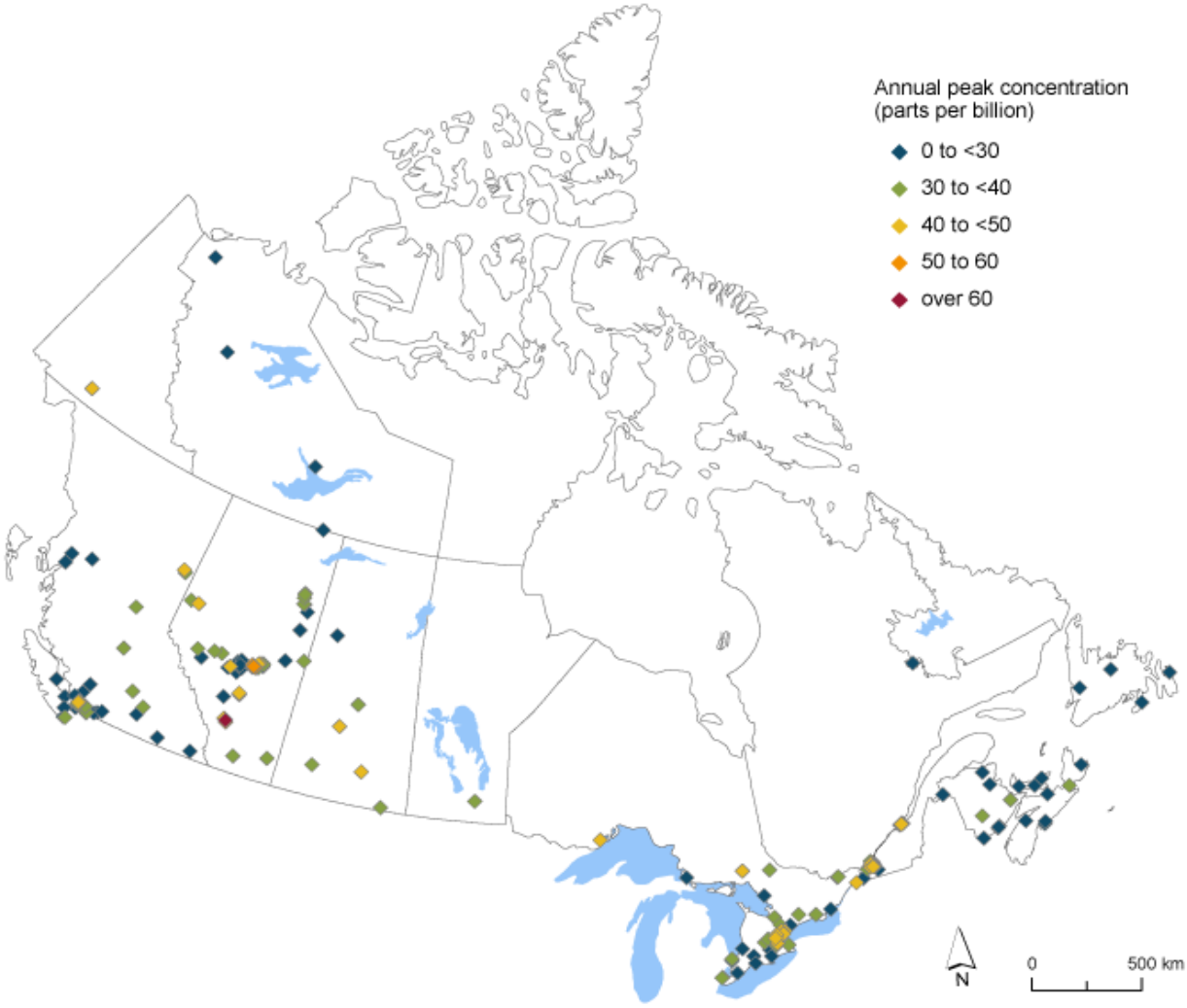
## Peak nitrogen dioxide concentrations at monitoring stations

The National Air Pollution Surveillance program measures air pollutant concentrations at monitoring stations across Canada. The Canadian Environmental Sustainability Indicators provide access to this information through an interactive map. The map allows users to explore peak $NO_2$ concentrations at specific monitoring stations.

In 2020, peak $NO_2$ concentrations were recorded at 186 monitoring stations across Canada. Of these stations:

- 1 station in Alberta recorded concentration above 60 ppb (65 ppb)
- 72 stations had concentrations below 30 ppb, 4 of them were below 10 ppb; these were located in Prince Edward Island (2 stations), Nova Scotia and New Brunswick

**Figure 25. Peak nitrogen dioxide concentrations by monitoring station, Canada, 2020**




Navigate data using the interactive map

**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal.

# Sulphur dioxide

Sulphur dioxide ($SO_2$) is emitted when a fuel or raw material containing sulphur is burned or used in industrial processes such as metal ore smelting. The main sources of sulphur oxide emissions in Canada are the oil and gas industry, combustion of fossil fuels for electricity generation, and processes in the non-ferrous smelting and refining industry. Sulphur dioxide emissions contribute to acid deposition and are a major precursor to fine particulate matter. Exposure to high concentrations of $SO_2$ can adversely affect the respiratory systems of humans and animals. $SO_2$ exposure can irritate the lungs, reduce lung function, and increase susceptibility to allergens in people with asthma. $SO_2$ can also damage vegetation and contributes to the deterioration of building materials such as paint or concrete.

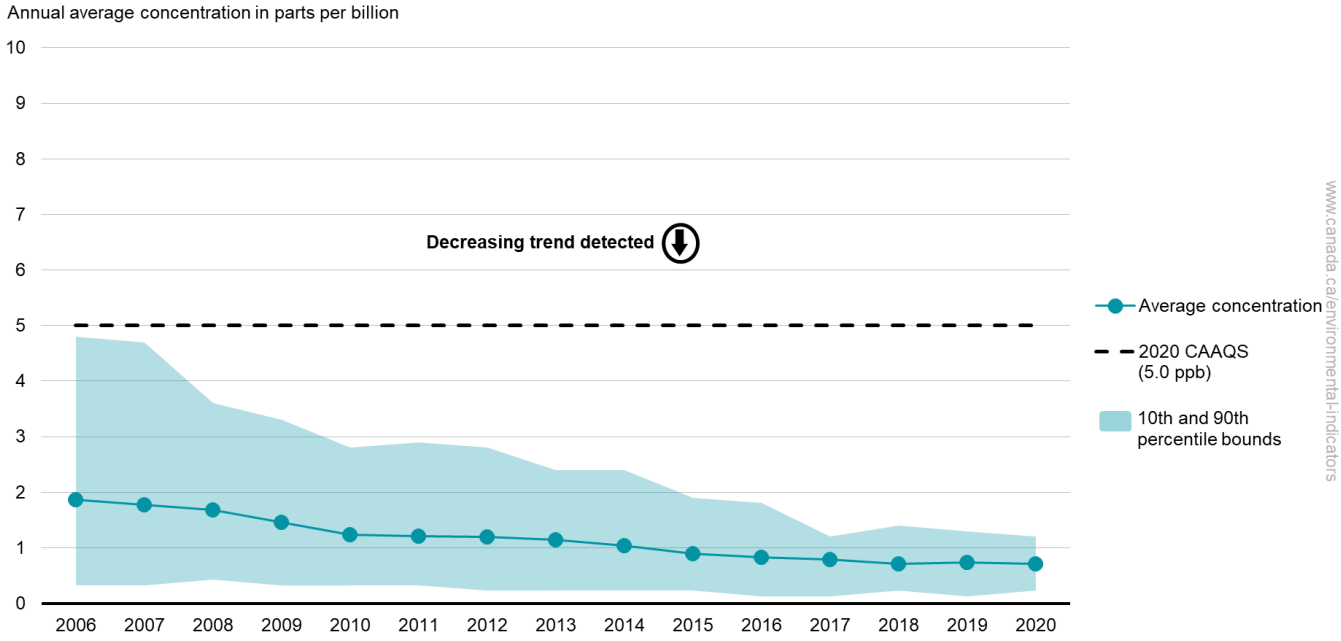
## National average sulphur dioxide concentrations

### Key results

From 2006 to 2020,

- a decreasing trend was detected in the average $SO_2$ concentration
- national average concentrations remained below the 2020 standard of 5.0 ppb for all years; however, concentrations at a few monitoring stations exceeded the standard

**Figure 26. National average sulphur dioxide concentrations, Canada, 2006 to 2020**




Data for Figure 26

**Note:** The national average $SO_2$ concentration indicator is based on the annual average of the hourly concentrations recorded at 84 monitoring stations across Canada. The comparison to the Canadian Ambient Air Quality Standard is provided for illustrative purposes only. For more information, consult the Air quality indicator definitions in the Data sources and methods section.
**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal.

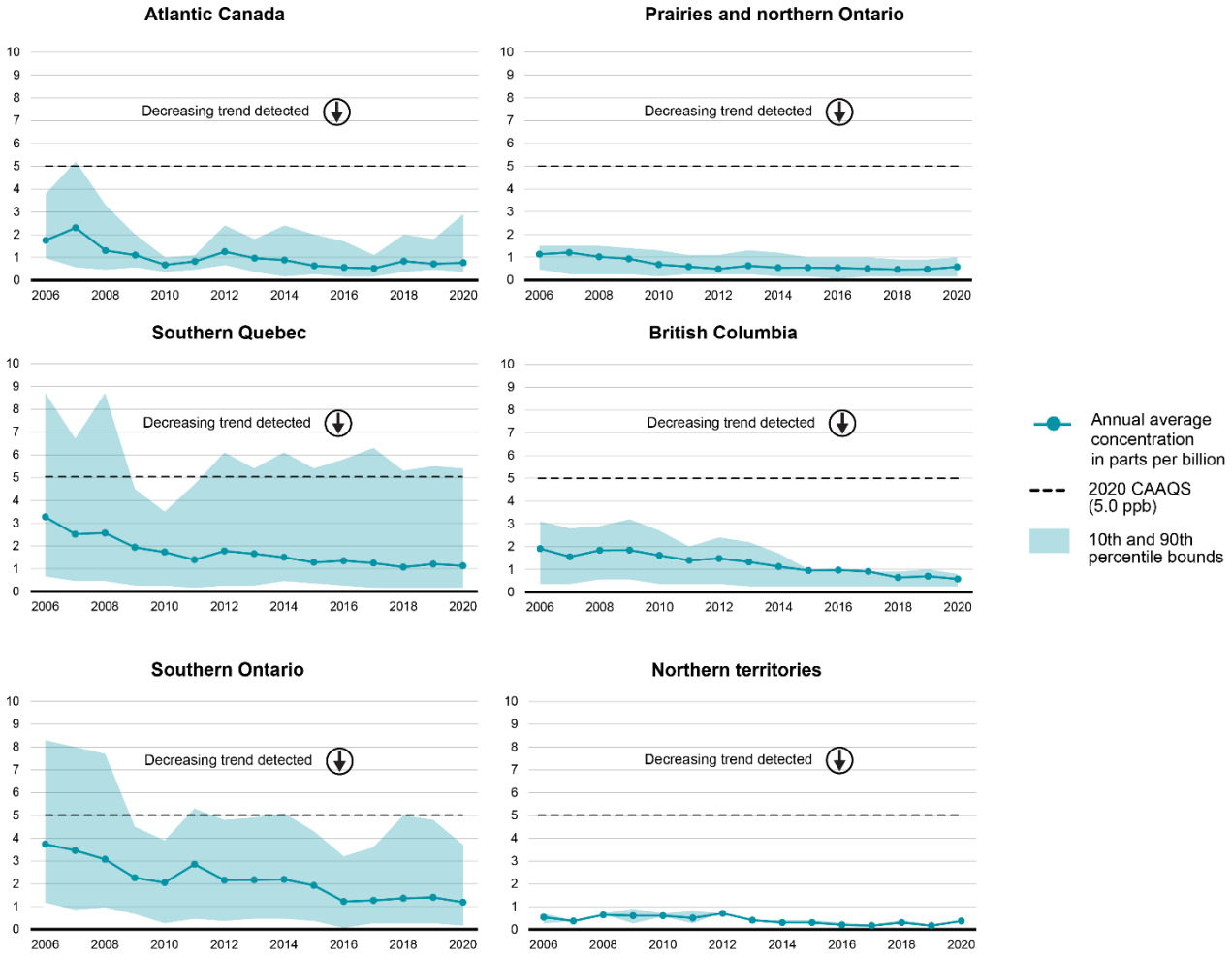
In 2020, the national average $SO_2$ concentration was 0.7 ppb, which was 2.0% lower than 2019 level. From 2006 to 2020, a decreasing trend of around 0.1 ppb per year was detected. National concentrations decreased by 61.7% (1.2 ppb) between 2006 and 2020. This trend is mainly attributable to reductions in sulphur oxide ($SO_X$) emissions in Canada resulting from technological upgrades and closures of non-ferrous metal smelters (including aluminium smelters) and pulp and paper facilities, the phase-out of coal-fired electricity, better emission control technologies within the oil and gas sector, and the implementation of federal regulations related to sulphur content in fuels.

## Regional average sulphur dioxide concentrations

### Key results

- From 2006 to 2020, decreasing trends were detected for all 6 regions
- Since 2006, regional average $SO_2$ concentrations remained below the 2020 standard of 5.0 ppb in all regions; however, concentrations at a few monitoring stations exceeded the standard in all regions except the northern territories region

**Figure 27. Regional average sulphur dioxide concentrations, Canada, 2006 to 2020**






Data for Figure 27

**Note:** The regional average $SO_2$ concentration indicator is based on the annual average of the hourly concentrations recorded at 6 monitoring stations in the Atlantic Canada region, 9 in the southern Quebec region, 10 in the southern Ontario region, 32 in the Prairies and northern Ontario region, 24 in British Columbia and 3 in the northern territories region. The comparison to the Canadian Ambient Air Quality Standard is provided for illustrative purposes only. For more information, consult the Air quality indicator definitions in the Data sources and methods section.
**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal.

In 2020, southern Ontario and southern Quebec regions had the highest regional average $SO_2$ concentrations, with values of 1.2 ppb and 1.1 ppb, respectively. The Atlantic Canada region followed with a regional average concentration of 0.8 ppb. The Prairies and northern Ontario region and British Columbia had average concentrations of 0.6 ppb each. The northern territories region had the lowest regional average concentration, with 0.4 ppb.

The northern territories, the Prairies and northern Ontario and Atlantic Canada regions had higher concentrations in 2020 than in 2019, with increases of 120.0% (0.2 ppb), 21.4% (0.1 ppb) and 7.0% (0.1 ppb),

respectively. The other regions recorded a decrease between 2019 and 2020. British Columbia had the largest reduction in concentrations, with a decrease of 17.4% (0.1 ppb), while the southern Ontario and southern Quebec regions reported decreases of 15.0% (0.2 ppb) and 6.3% (0.1 ppb), respectively.

From 2006 to 2020, a decreasing trend of:

- 0.2 ppb per year was detected for southern Ontario
- 0.1 ppb per year was detected for both British Columbia and southern Quebec regions
- 0.07 ppb per year was detected for Atlantic Canada
- 0.04 ppb per year was detected for the Prairies and northern Ontario and the northern territories regions

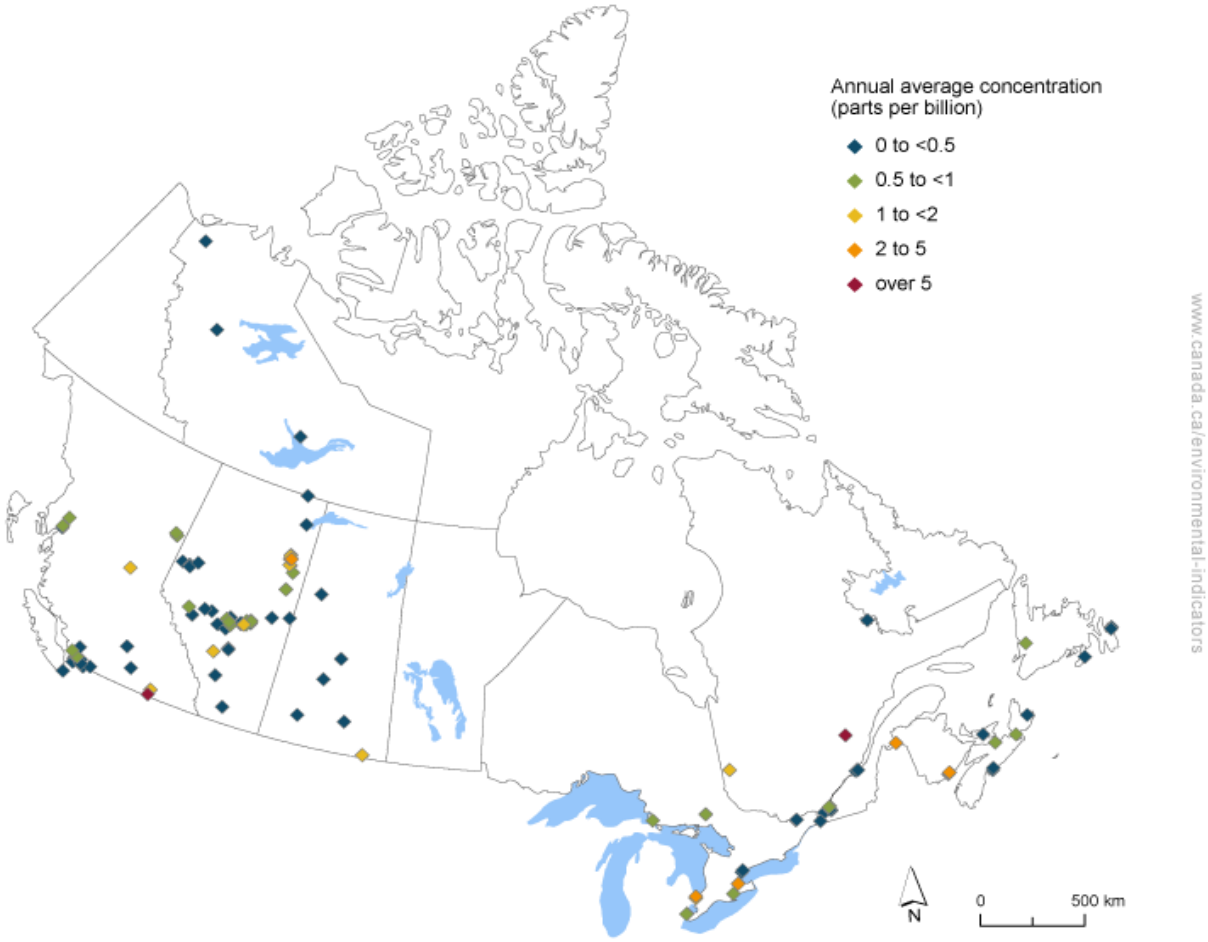
## Average sulphur dioxide concentrations at monitoring stations

The National Air Pollution Surveillance program measures air pollutant concentrations at monitoring stations across Canada. The Canadian Environmental Sustainability Indicators provide access to this information through an interactive map. The map allows users to explore annual average $SO_2$ concentrations at specific monitoring stations.

In 2020, average $SO_2$ concentrations were recorded at 123 monitoring stations across Canada. Of these stations:

- 2 stations recorded concentrations above 5.0 ppb; 1 station in Quebec and 1 in British Columbia reported concentrations of 5.4 ppb and 5.9 ppb, respectively.
- 74 stations had concentrations below 0.5 ppb. Most of these stations were located in Alberta (22) and British Columbia (21)

**Figure 28. Average sulphur dioxide concentrations by monitoring station, Canada, 2020**




Navigate data using the interactive map

**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal.

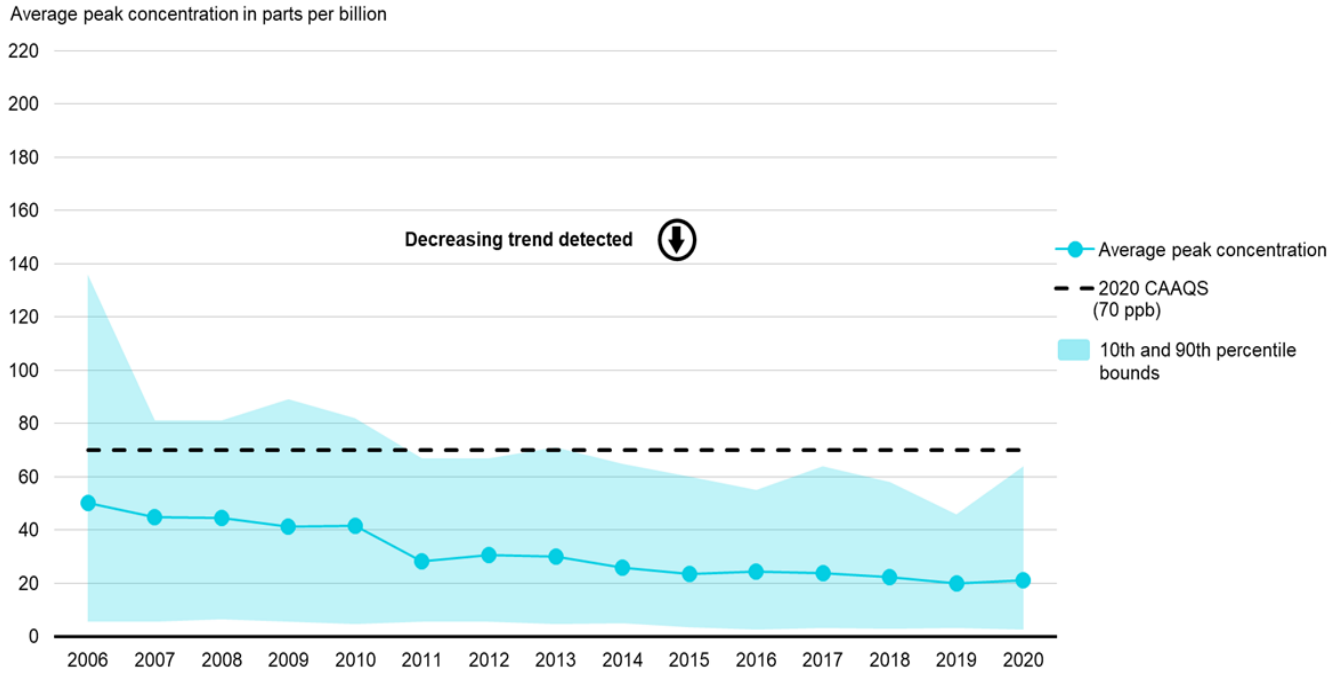
## National average peak sulphur dioxide concentrations

### Key results

From 2006 to 2020,

- a decreasing trend was detected in the national average peak $SO_2$ concentration
- national average peak concentration remained below the 2020 standard of 70 ppb for all years; however, concentrations at some monitoring stations were above the standard

**Figure 29. National average peak sulphur dioxide concentrations, Canada, 2006 to 2020**




Data for Figure 29

**Note:** The national average peak $SO_2$ concentration indicator is based on the annual 99th percentile of the daily maximum 1-hour average concentrations recorded at 84 monitoring stations across Canada. The comparison to the Canadian Ambient Air Quality Standard is provided for illustrative purposes only. For more information, consult the Air quality indicator definitions in the Data sources and methods section.
**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal.

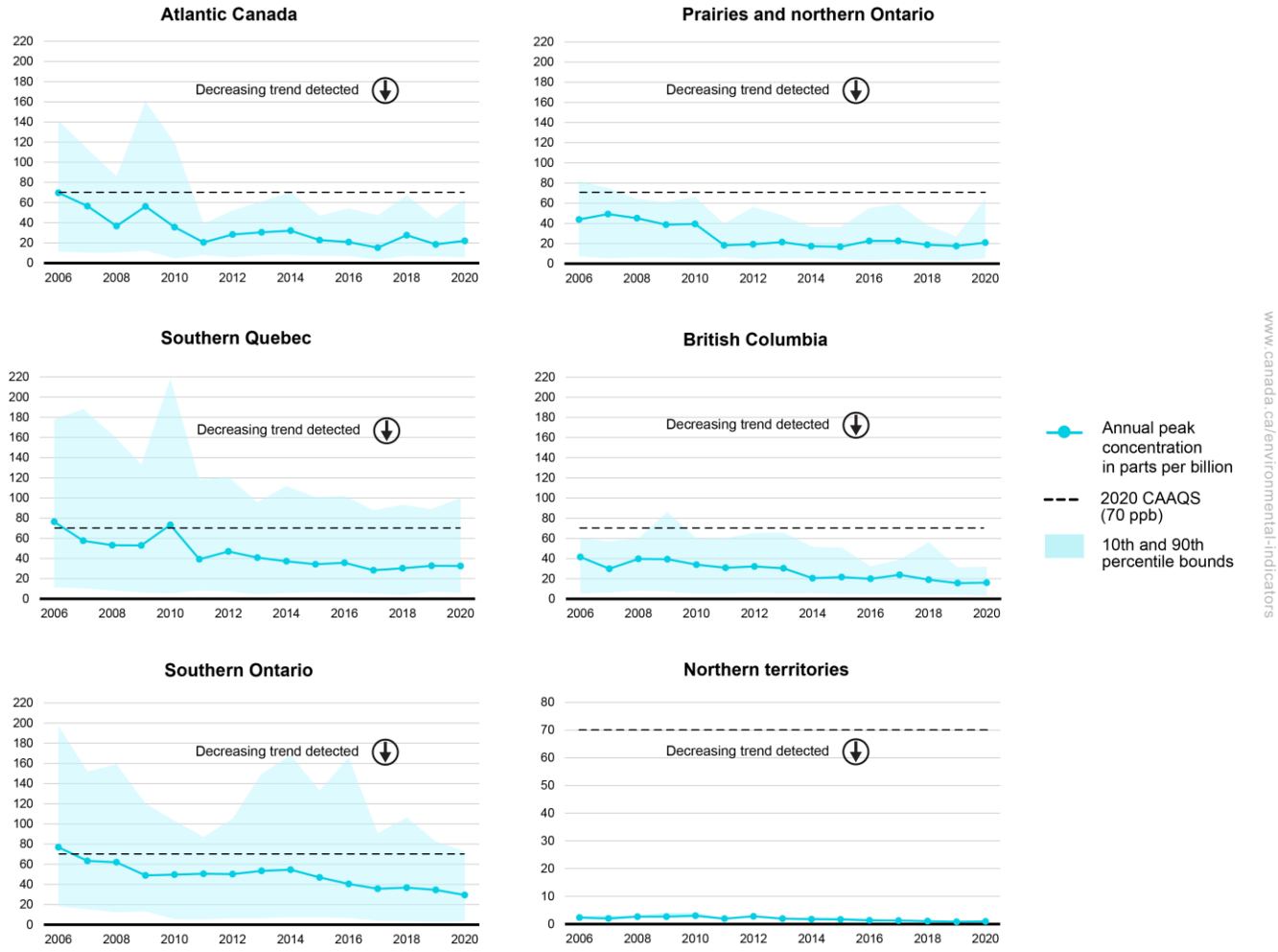
In 2020, the national average peak $SO_2$ concentration was 21.1 ppb, which was 4.9% higher than 2019 level. From 2006 to 2020, a decreasing trend of 2.1 ppb per year was detected. National concentrations decreased by 58.0% (29.1ppb) between 2006 and 2020. This trend is mainly attributable to reductions in sulphur oxide ($SO_X$) emissions in Canada and the United States resulting from technological upgrades and closures of non-ferrous metal smelters, the phase-out of coal-fired electricity, better emission control technologies within the oil and gas sector and the implementation of federal regulations related to sulphur content in fuels.

## Regional average peak sulphur dioxide concentrations

### Key results

- From 2006 to 2020, decreasing trends were detected for all 6 regions
- Since 2007, regional average peak $SO_2$ concentrations remained below the 2020 standard of 70 ppb in all regions
- Concentrations at a few monitoring stations exceeded the standard in all regions except northern territories region

**Figure 30. Regional average peak sulphur dioxide concentrations, Canada, 2006 to 2020**




Data for Figure 30

**Note:** The regional average peak $SO_2$ concentration indicator is based on the annual 99th percentile of the daily maximum 1-hour average concentrations recorded at 6 monitoring stations in the Atlantic Canada region, 9 in the southern Quebec region, 10 in the southern Ontario region, 32 in the Prairies and northern Ontario region, 24 in British Columbia and 3 in the northern territories region. The comparison to the Canadian Ambient Air Quality Standard is provided for illustrative purposes only. For more information, consult the Air quality indicator definitions in the Data sources and methods section.
**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal.

In 2020, the southern Quebec region had the highest regional average peak $SO_2$ concentration, at 32.5 ppb. The southern Ontario, the Atlantic Canada, the Prairies and northern Ontario regions, and British Columbia followed with concentrations of 29.4 ppb, 22.0 ppb, 20.9 ppb and 16.1 ppb, respectively. The northern territories region had recorded very low regional average peak concentration, at 1.0 ppb.

Between 2019 and 2020, the Prairies and northern Ontario, the Atlantic Canada and the northern territories regions reported the largest increase in average peak concentration of 19.1% (3.3 ppb), 18.6% (3.5 ppb) and 16.0% (0.1 ppb), respectively. At a lesser extent, British Columbia concentrations increased by 2.7% (0.4 ppb). By contrast, southern Ontario, and southern Quebec regions reported reductions in average peak concentrations, with decreases of 14.7% (5.1 ppb) and 0.6% (0.2 ppb), respectively.

rom 2006 to 2020, a decreasing trend of:

- 2.6 ppb per year was detected for the Atlantic Canada region
- 2.5 ppb per year was detected for both the southern Ontario and southern Quebec regions
- 2.0 ppb per year was detected for the Prairies and northern Ontario region

- 1.9 ppb per year was detected for British Columbia
- 0.1 ppb per year was detected for the northern territories region

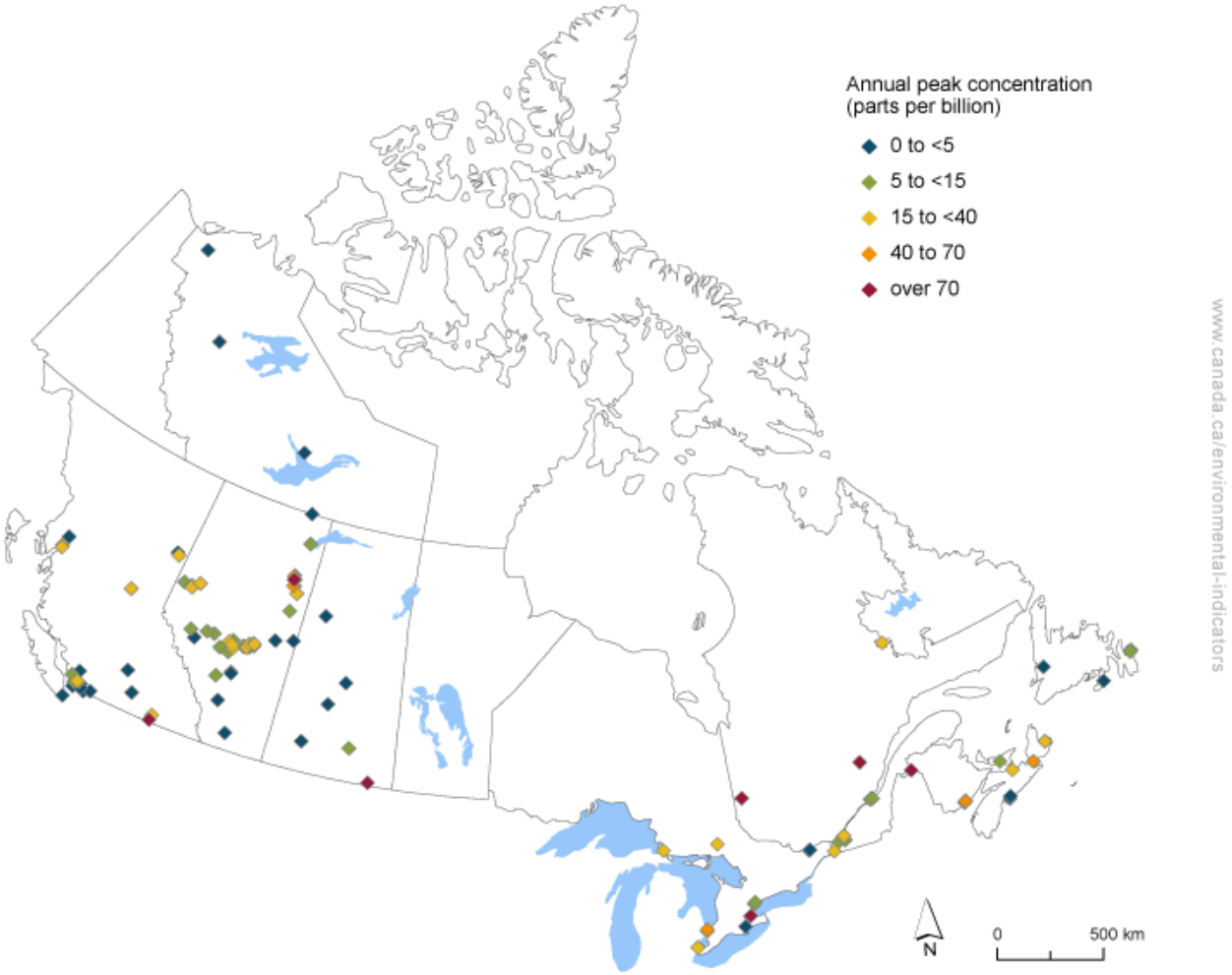
## Peak sulphur dioxide concentrations at monitoring stations

The National Air Pollution Surveillance program measures air pollutant concentrations at monitoring stations across Canada. The Canadian Environmental Sustainability Indicators provide access to this information through an interactive map. The map allows users to explore peak $SO_2$ concentrations at specific monitoring stations.

In 2020, peak $SO_2$ concentrations were recorded at 123 monitoring stations across Canada:

- 8 stations recorded concentrations above 70 ppb, ranging from 72.6 ppb to 206.8 ppb. Of these stations, 1 was located each in New Brunswick, Saskatchewan, British Columbia, and Ontario, 2 were each located in Quebec and Alberta
- 41 stations had concentrations below 5 ppb. Of these, 33 stations were located in western and northern Canada: British Columbia (18), Alberta (7), Saskatchewan (4) and Northern Territories (4)

**Figure 31. Peak sulfur dioxide concentrations by monitoring station, Canada, 2020**




Navigate data using the interactive map

**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal.

# Volatile organic compounds[9]

The volatile organic compounds (VOCs) are carbon-containing gases and vapours that are found in many common products such as gasoline and solvents. They are emitted from the oil and gas industry, solvent usage, and transportation. Exposure to some VOCs can cause cancer and other serious health problems. However, short-term exposure to high levels of them can result in fatigue, nausea, dizziness, headaches, breathing problems and irritation of the eyes, nose, and throat. VOCs contribute to the formation of fine particulate matter ($PM_{2.5}$) and ozone ($O_3$), which are the main components of smog.

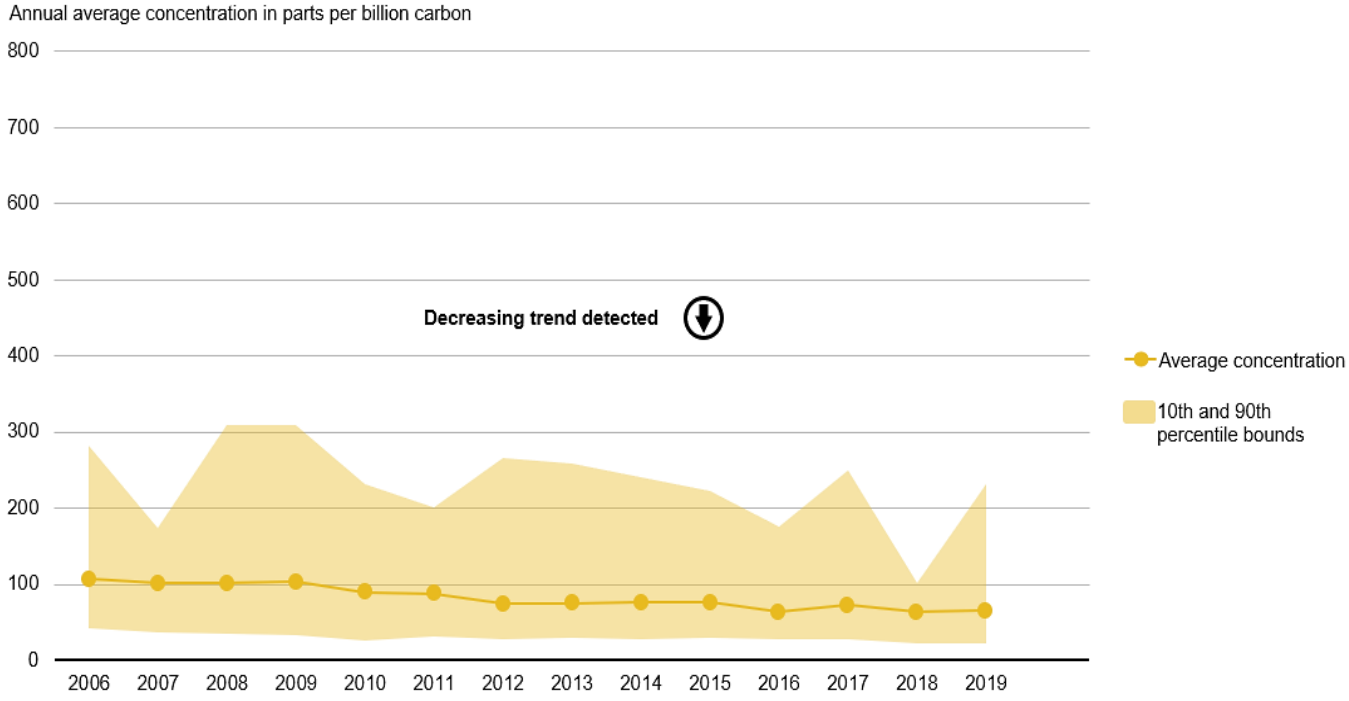
The national and regional VOC indicators cover the period from 2006 to 2019 only as no station met the data completeness criteria for 2020.

## National average volatile organic compound concentrations

### Key results

- From 2006 to 2019, a decreasing trend was detected in the national average VOC concentrations

**Figure 32. National average volatile organic compound concentrations, Canada, 2006 to 2019**




Data for Figure 32

**Note:** VOC sampling in 2020 was limited and no station met the data completeness criteria for that year. Therefore, no VOC concentration is being reported for 2020 in this indicator. The national average VOC concentration indicator is based on the annual average of the daily time-integrated concentrations (24-hour for urban stations and 4-hour for rural stations) recorded at 30 monitoring stations across Canada. For more information, consult the Air quality indicator definitions in the Data sources and methods section.
**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal.

In 2019, the national average VOC concentration was 65.5 parts per billion carbon (ppbC), which was 3.0% (1.9 ppbC) higher than in 2018. From 2006 to 2019, a decreasing trend of 3.5 ppbC per year was detected. Over this period, national concentrations decreased by 39.0% (41.5 ppbC). This is consistent with the reduction in VOC emissions from cars and trucks, which is attributable to the introduction of new technologies, cleaner fuels and more stringent emissions standards and from reduction measures related to the production and use of paints, solvents and cleaners.

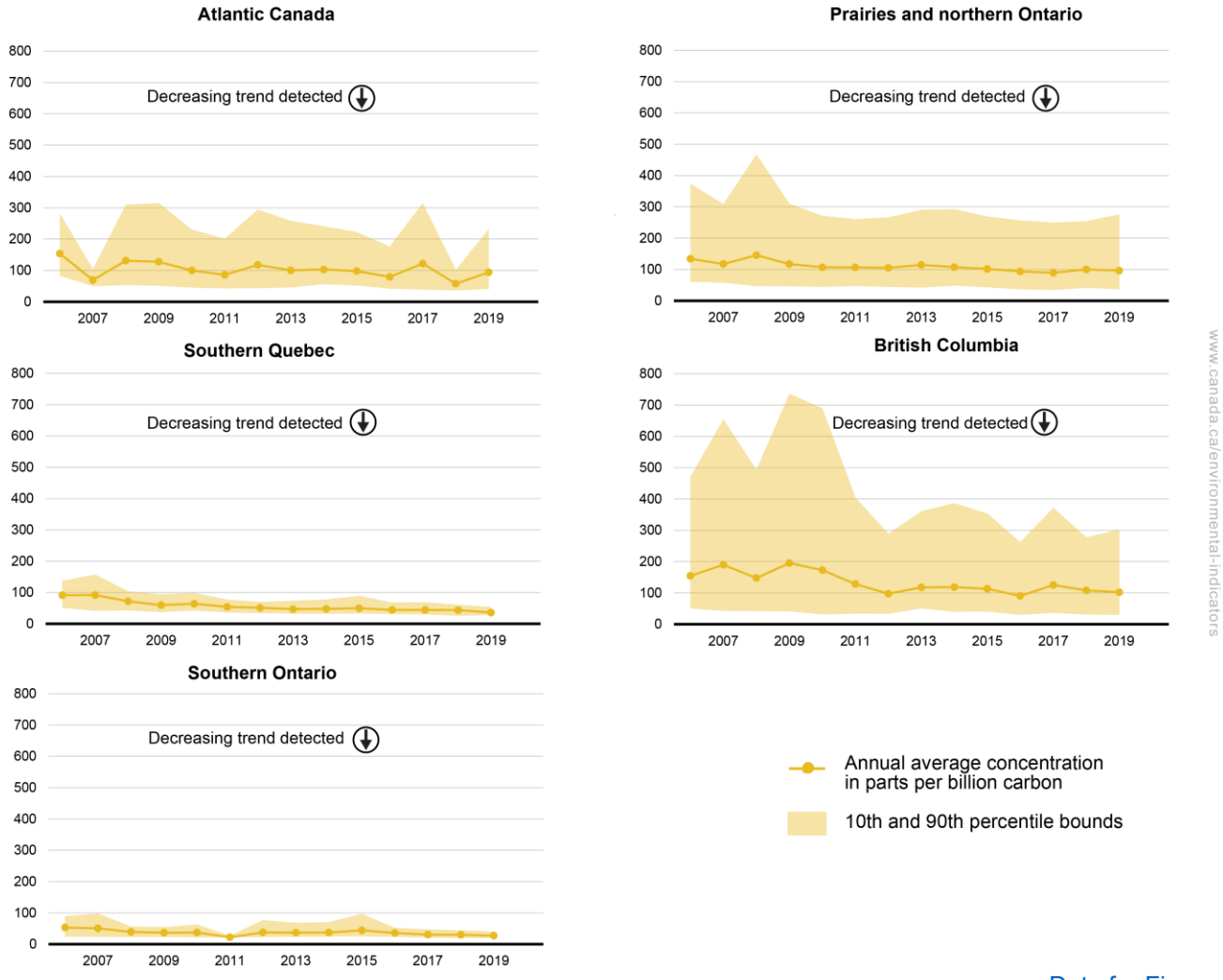
[9] VOC sampling in 2020 was limited and no station met the data completeness criteria for that year. Therefore, no VOC concentration is being reported for 2020 in this indicator.

## Regional average volatile organic compound concentrations

### Key results

- From 2006 to 2019, decreasing trends were detected for all 5 regions

**Figure 33. Regional average volatile organic compound concentrations, Canada, 2006 to 2019**




Data for Figure 33

**Note:** VOC sampling in 2020 was limited and no station met the data completeness criteria for that year. Therefore, no VOC concentration is being reported for 2020 in this indicator. The average VOC concentration indicator is based on the annual average of the daily time-integrated concentrations (24-hour for urban stations and 4-hour for rural stations) recorded at 4 monitoring stations in the Atlantic Canada region, 6 in the southern Quebec region, 9 in the southern Ontario region, 5 in the Prairies and northern Ontario region and 6 in British Columbia. There were not enough stations to report results for the northern territories region. For more information, consult the Air quality indicator definitions in the Data sources and methods section.
**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal.

In 2019, British Columbia had the highest regional average VOC concentration, at 102.4 ppbC. The Prairies and northern Ontario and the Atlantic Canada regions followed with concentrations of 96.3 ppbC and 94.1 ppbC, respectively. The southern Ontario region had the lowest regional average concentration, at 27.3 ppbC.

All regions had lower concentrations in 2019 than in 2018 except for the Atlantic Canada region. Between 2018 and 2019, the southern Quebec region had the largest reduction in concentrations, with a decrease of 17.3% (7.5 ppbC). The southern Ontario, British Columbia and Prairies and northern Ontario regions reported decreases of 9.0% (2.7 ppbC), 5.3% (5.7 ppbC) and 3.7% (3.7 ppbC), respectively, over the same period. The Atlantic Canada region reported a 63.2% (36.4 ppbC) increase in concentrations from 2018 to 2019. However,

this increase could be explained by the low concentration recorded in 2018 due to the absence of data from one station during that year.

From 2006 to 2019, a decreasing trend of:

- 5.3 ppbC per year was detected for British Columbia
- 3.4 ppbC per year was detected for the Atlantic Canada region
- 3.1 ppbC per year was detected for the southern Quebec region
- 2.8 ppbC per year was detected for the Prairies and northern Ontario region
- 1.1 ppbC per year was detected for the southern Ontario region

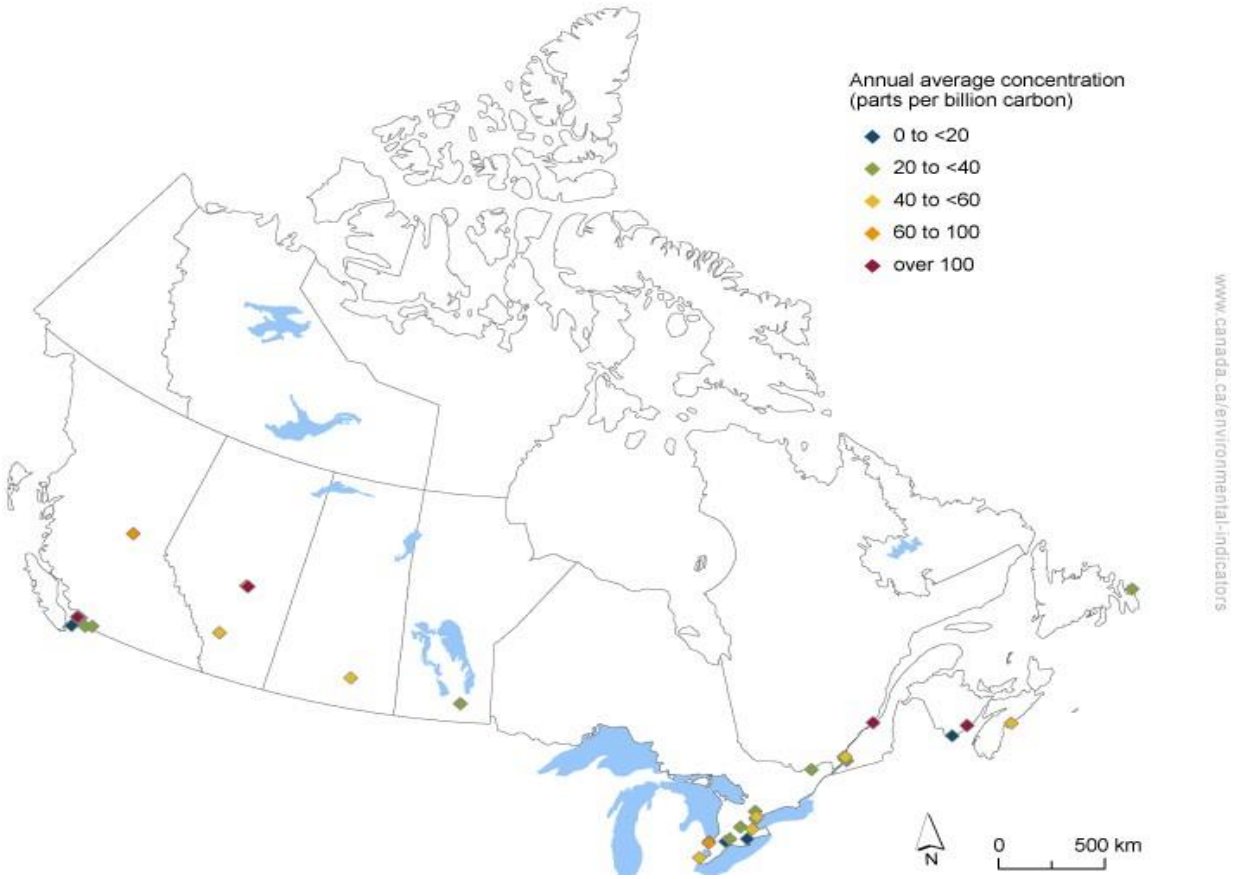
## Average volatile organic compounds concentrations at monitoring stations

The National Air Pollution Surveillance program measures air pollutant concentrations at monitoring stations across Canada. The Canadian Environmental Sustainability Indicators provide access to this information through an interactive map. The map allows users to explore average VOC concentrations at specific monitoring stations.

In 2019, average VOC concentrations were recorded at 37 monitoring stations across Canada:

- 5 stations recorded concentrations above 100 ppbC, ranging from 112.3 ppbC to 301.8 ppbC. Of these stations, 1 station was located in each New Brunswick, Quebec, and Alberta and 2 stations were in British Columbia
- 4 stations had concentrations below 20.0 ppbC. Of these, 1 station was located in each New Brunswick and British Columbia, and 2 in Ontario

**Figure 34. Average volatile organic compounds concentrations by monitoring station, Canada, 2019**




Navigate data using the interactive map

**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal.

# About the indicators

## What the indicators measure

The Air quality indicators track ambient concentrations of fine particulate matter ($PM_{2.5}$), ground-level ozone ($O_3$), sulphur dioxide ($SO_2$), nitrogen dioxide ($NO_2$) and volatile organic compounds (VOCs) at the national, regional and urban area levels and at local monitoring stations. The national and regional indicators are presented with their corresponding 2020 Canadian Ambient Air Quality Standards (CAAQS, the standards). The comparisons to the standards are for illustrative purposes only.

## Why these indicators are important

Canadians are exposed to air pollutants daily and this exposure can result in adverse health effects in the short and long term. Exposure to some pollutants, even at low levels, has been linked to increased health problems, leading to increased hospitalizations, emergency room visits and premature deaths. The Government of Canada estimates that each year 42 premature deaths per 100 000 Canadians can be linked to air pollution for a total of 15 300 premature deaths annually. The total economic valuation of the health impacts attributable to air pollution in Canada is $120 billion per year (based on 2016 currency).[10]

Ground-level $O_3$ and $PM_{2.5}$ are key components of smog and 2 of the most widespread air pollutants. Exposure to $O_3$ can cause throat irritation, coughing, shortness of breath and aggravation of existing conditions such as asthma. Over time, exposure to $O_3$ may lead to the development of asthma, reduced lung function and other lung conditions. Exposure to $PM_{2.5}$ can lead to the onset or development of respiratory and cardiovascular adverse effects, such as asthma attacks, chronic bronchitis, heart attacks and may lead to the development of lung cancer.

Exposure to $SO_2$ and $NO_2$ can irritate the lungs, reduce lung function and aggravate respiratory conditions, especially in people with asthma. Long-term exposure to $NO_2$ may contribute to allergies and asthma development.

Adverse health effects from exposure to VOCs varies greatly from little effects on health, to moderate effects such as eye, nose and throat irritations, headaches, nausea, dizziness and the worsening of asthma symptoms, to more severe effects such as damage to the liver, kidneys and central nervous system. Some VOCs meet the definition of toxic under the *Canadian Environmental Protection Act, 1999*. Over a lifetime, exposure to these pollutants can increase the risk of developing cancer[11] and other serious health effects.

Beside their direct effects on health, VOCs and $NO_2$ contribute to the formation of $O_3$ and $PM_{2.5}$. $NO_2$ has major impacts on acid deposition (sometimes termed "acid rain") and eutrophication. Similarly, $SO_2$ is a major contributor to acid deposition. $PM_{2.5}$ can damage vegetation and structures and contributes to haze and reduced visibility. $O_3$ can also impact vegetation by damaging leaves, decrease the productivity of some crops and may contribute to forest decline. $O_3$ can damage synthetic materials and textiles, cause cracks in rubber, accelerate fading of dyes and speed deterioration of some paints and coatings.

Improved air quality can reduce the incidence of heart attacks, hospital visits, allergy and child asthma attacks and prevents lost school and workdays. Cleaner air can also reduce damage to crops, forests, surface waters and infrastructure such as buildings and bridges.[12]

### Related initiatives

These indicators support the measurement of progress towards the 2022 to 2026 Federal Sustainable Development Strategy Goal 11: Improve access to affordable housing, clean air, transportation, parks, and green spaces, as well as cultural heritage in Canada.

In addition, the indicators contribute to the Sustainable Development Goals of the 2030 Agenda for Sustainable Development. The indicators are linked to the 2030 Agenda's Goal 11: Sustainable Cities and Communities and

[10] Health Canada (2021) Health Impacts of Air Pollution in Canada: Estimates of morbidity and premature mortality outcomes – 2021 Report. Retrieved on October 18, 2023.
[11] International Agency for Research on Cancer (2013) IARC: Outdoor air pollution a leading environmental cause of cancer deaths (PDF; 73.4kB)
[12] Canadian Council of Ministers of the Environment (2017) State of the Air. Retrieved on October 18, 2023.

Target 11.6: "By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management."

### Related indicators

The Population exposure to outdoor air pollutants indicator tracks the proportion of the population living in areas where outdoor concentrations of air pollutants are less than or equal to the 2020 Canadian Air Ambient Quality Standards.

The International comparison of urban air quality indicators present and compare the air quality in selected Canadian urban areas with a population greater than one million to the air quality in selected international urban areas having comparable data.

The Air pollutant emissions indicators track emissions from human activities of 6 key air pollutants: sulphur oxides ($SO_X$), nitrogen oxides ($NO_X$), volatile organic compounds (VOCs), ammonia ($NH_3$), carbon monoxide (CO) and fine particulate matter ($PM_{2.5}$). Black carbon, which is a component of $PM_{2.5}$, is also reported. For each air pollutant, data are provided at the national, provincial/territorial and facility level and by major source.

The Air health trends indicator provides an overview of the public health impacts attributable to outdoor air pollution in Canada.

## Data sources and methods

### Data sources

The Air quality indicators are calculated from the air pollutant concentrations in the Canada-wide Air Quality Database. The database is maintained by Environment and Climate Change Canada's National Air Pollution Surveillance Program. It contains data collected through the following monitoring networks:

- the National Air Pollution Surveillance Network, a collaboration established in 1969 between Environment and Climate Change Canada and provincial, territorial and regional (Metro Vancouver, Ville de Montréal) governments
- the Canadian Air and Precipitation Monitoring Network operated by ECCC, for ground-level ozone. The Canadian Air and Precipitation Monitoring Network stations were established to research and monitor air pollution outside urban areas

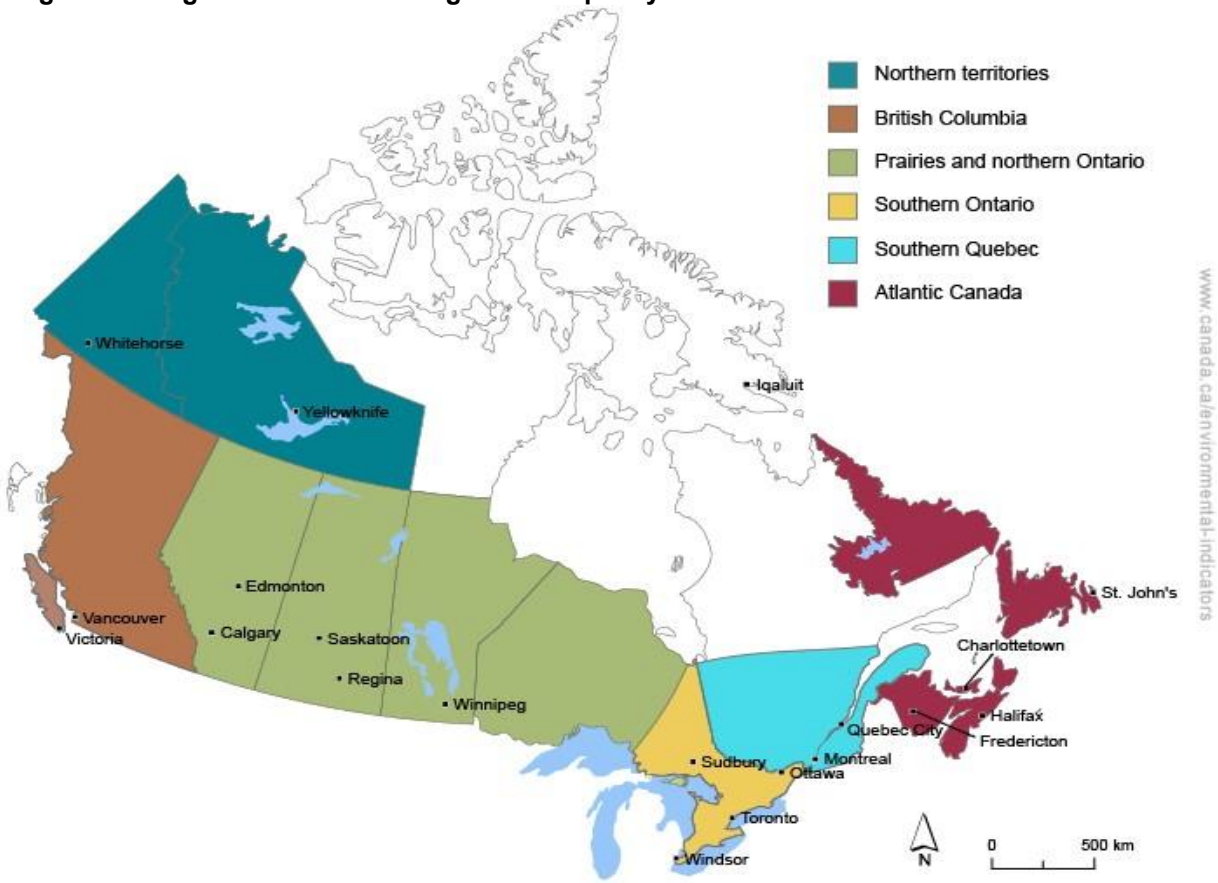
#### More information

Air quality monitoring stations are located across the country but are more concentrated in urban areas and in Canada's south. The indicators for $PM_{2.5}$, $O_3$, $SO_2$, $NO_2$ and VOCs are provided nationally and by region. The regions used for these indicators are listed and shown in the following table and map.

**Table 1. Regions used for the regional Air quality indicators**

| Region | Region code |
|---|---|
| Atlantic Canada | ATL |
| Southern Quebec | SQC |
| Southern Ontario | SON |
| Prairies and northern Ontario | PNO |
| British Columbia | BCO |
| Northern territories | TER |

**Figure 35. Regions used for the regional Air quality indicators**




The Air quality indicators are also reported for the largest urban areas across Canada and the capitals of the provinces and territories when sufficient data are available. An urban area follows the definition of the Statistic Canada's population centre. Ambient levels of $PM_{2.5}$, $O_3$, $SO_2$, $NO_2$ and VOCs measured by monitoring station are also shown in the Canadian Environmental Sustainability Indicators interactive maps.

### Data quality assurance and quality control for the National Air Pollutant Surveillance program

Monitoring agencies contributing to the National Air Pollution Surveillance program all strive to adhere to established quality assurance and quality control standards, which are developed by Environment and Climate Change Canada in consultation with the provincial, territorial, and regional governments participating in the program.

Ensuring data quality involves identifying the appropriate data quality objectives and methodologies that can be used to meet these objectives. The key data quality objectives for the National Air Pollution Surveillance program are:

- Representativeness: the degree to which data measurements represent a pollutant concentration of interest
- Comparability: the measure of confidence with which one data set or method can be compared to another at other participating National Air Pollutant Surveillance program sites across Canada
- Accuracy: the assessment of the overall agreement of a measurement with a known value (Table 2). Such assessment can include analysis of agreement among repeated measurements (precision) and measures of positive or negative systematic errors (bias)
- Completeness: the assessment as to whether enough information is being collected to ensure confidence in conclusions or decisions made based on data

**Table 2. Accuracy data quality objectives for air pollutant samples**

| Parameter | Accuracy |
|---|---|
| Fine particulate matter | ± 15% |
| Ground-level ozone | ± 15% |
| Nitrogen dioxide | ± 15% |
| Sulphur dioxide | ± 15% |
| Volatile organic compounds | Species-dependent |

Routine assessments of network operations provide assurance that the monitoring systems and data processing procedures produce an acceptable level of data quality to meet National Air Pollution Surveillance guidelines and to identify areas where improvements may be required. Three (3) main streams of audits and assessment are used in the National Air Pollution Surveillance network:

- Performance and systems audits: conducted externally either by an ECCC auditor or by another agency separate from the monitoring agency. These audits are performed using independently verified reference standards and provide an unbiased quantitative assessment to defend the quality of the data
- Interagency measurement program: involves analysis by the monitoring agency of an unknown sample concentration provided by ECCC. These tests help verify instrument accuracy and help determine data comparability across sites
- Data quality assessments: involve the statistical analysis of environmental data to determine if collected and reported data meet network and data quality objectives

Additional audits and assessments are performed by ECCC's air quality laboratories in Ottawa for the analysis of integrated VOC samples. Consult the National Air Pollution Surveillance Program: Ambient Air Monitoring and Quality Assurance/Quality Control Guidelines (PDF; 2.8 MB) for more information.

## Methods

The Air quality indicators are calculated using air pollutant concentrations measured at monitoring sites and stored in the Canada-wide Air Quality Database. Specific calculations are performed for each pollutant to establish indicators for the assessment of air quality at the national, regional and urban area levels (Table 3). Subsequent statistical analyses are conducted to determine the presence of a significant trend over a 15-year period for each national and regional air quality indicator.

### More information

**Table 3. Air quality indicators definitions**

| Indicator | Definition | Concentration measurement unit |
|---|---|---|
| Average $PM_{2.5}$ | Annual average of the daily 24-hour average concentrations | $\mu g/m^3$ |
| Peak $PM_{2.5}$ | Annual 98th percentile of the daily 24-hour average concentrations | $\mu g/m^3$ |
| Average $O_3$ | Annual average of the daily maximum 8-hour average concentrations | ppb |
| Peak $O_3$ | Annual 4th-highest of the daily maximum 8-hour average concentrations | ppb |
| Average $NO_2$ | Annual average of the hourly concentrations | ppb |
| Peak $NO_2$ | Annual 98th percentile of the daily maximum 1-hour average concentrations | ppb |
| Average $SO_2$ | Annual average of the hourly concentrations | ppb |
| Peak $SO_2$ | Annual 99th percentile of the daily maximum 1-hour average concentrations | ppb |
| Average VOC | Annual average of the daily time-integrated concentrations (24-hour urban, 4-hour rural) | ppbC |

**Note:** Units: $\mu g/m^3$ = micrograms per cubic metre, ppb = parts per billion, ppbC = parts per billion carbon.

Average indicators are used to capture prolonged or repeated exposures over longer periods or chronic exposure while peak indicators are used to capture immediate or acute short-term exposures.

## Canadian Ambient Air Quality Standards

In October 2012, the ministers of the environment, with the exception of Quebec,[13] agreed to begin implementing the Air Quality Management System. This system provides a comprehensive, cross Canada framework for collaborative action to further protect human health and the environment through continuous improvement of air quality. Under the system, the Canadian Ambient Air Quality Standards (CAAQS, the standards) are drivers for air quality improvements across the country. The CAAQS are health- and environment-based air quality objectives for pollutant concentrations in outdoor air. Together with the management levels,[14] the CAAQS act as a benchmark to support continuous improvement of air quality. The standards are not "pollute-up-to levels" and the Air Quality Management System encourages governments to take action to improve air quality, considering that some pollutants can affect human health even at concentrations below the standards.

Under the *Canadian Environmental Protection Act, 1999*, the 2020 CAAQS were established for:

- $PM_{2.5}$ and $O_3$ in May 2013
- $SO_2$ in October 2017
- $NO_2$ in December 2017

The 2020 Canadian Ambient Air Quality Standards are presented in Table 4. Calculation of the Air quality indicators mostly follows the same data-handling conventions as those used in calculating the concentrations to use for comparison to the standards. Formal comparison to the standards to determine if concentrations exceed a standard can only be done using ambient concentrations as measured at individual monitoring stations and not using national or regional average concentrations. As such, comparisons of the indicator values (such as the national and regional average concentrations) to the standards are provided for illustrative purposes only and not for assessing whether the standards are achieved. Indicator values that are below a standard do not imply that concentrations at individual monitoring stations are also below the standard. Furthermore, the indicators are not adjusted for exceptional events (such as wildfires) or for pollution from transboundary flows.

**Table 4. Canadian Ambient Air Quality Standards for fine particulate matter, ground-level ozone, nitrogen dioxide and sulphur dioxide**

| Pollutant | Averaging time | 2020 Standard (numerical value) | Statistical form |
|---|---|---|---|
| $PM_{2.5}$ | Annual | 8.8 µg/m$^3$ | The 3-year average of the annual average of the daily 24-hour average concentrations |
| $PM_{2.5}$ | 24-hour | 27 µg/m$^3$ | The 3-year average of the annual 98th percentile of the daily 24-hour average concentrations |
| $O_3$ | 8-hour | 62 ppb | The 3-year average of the annual 4thhighest daily maximum 8-hour average concentrations |
| $NO_2$ | Annual | 17.0 ppb | The arithmetic average over a single calendar year of all 1-hour average concentrations |
| $NO_2$ | 1-hour | 60 ppb | The 3-year average of the annual 98th percentile of the daily maximum 1-hour average concentrations |

[13] Although Quebec supports the general objectives of the Air Quality Management System, it will not implement the System since it includes federal industrial emission requirements that duplicate Quebec's regulation. However, Quebec is collaborating with other jurisdictions on developing elements of the system, notably air zones and airsheds.

[14] Management levels refer to the air zone management framework and threshold values. More information can be found in the Canadian Council of Ministers of the Environment's Guidance document on air zone management (PDF; 226 KB). Retrieved on October 6, 2023.

| | | | |
|---|---|---|---|
| $SO_2$ | Annual | 5.0 ppb | The arithmetic average over a single calendar year of all 1-hour average concentrations |
| $SO_2$ | 1-hour | 70 ppb | The 3-year average of the annual 99th percentile of the daily maximum 1-hour average concentrations |

## Data collection and validation

Data obtained from National Air Pollution Surveillance monitoring stations are converted to a format compatible with the Canada-wide Air Quality Database. All data in the Canada-wide Air Quality Database have a comparable level of quality because jurisdictions adhere to established quality assurance and quality control procedures as outlined in the National Air Pollution Surveillance Monitoring and Quality Assurance/Quality Control Guidelines (PDF; 2.8 MB). These procedures include site and sampling system design, use of monitoring methods that meet defined minimum performance specifications, operation, maintenance and calibrations and data validation techniques. National Air Pollution Surveillance monitoring organizations are responsible for submitting quality-assured data, as per the specifications in the Guidelines, to the Canada-wide Air Quality Database. Data submitted to the National Air Pollution Surveillance database are in the hour-ending format (that is, minute data collected between 01:01 and 02:00 are averaged and reported as the 02:00 hour).

## Data completeness criteria

The following criteria are used to determine which stations have sufficient hourly and daily measurements in each year to be considered valid for inclusion in the indicators.

**Fine particulate matter ($PM_{2.5}$)**

For the annual average $PM_{2.5}$ indicator:

- a daily 24-hour average concentration was considered valid if at least 75% (18 hours) of the 1-hour concentrations were available on a given day
- an annual average concentration was considered valid if at least 75% of the daily average concentrations were available for the year and at least 60% of the daily average concentrations were available in each quarter[15] of a calendar year

For the peak (98$^{th}$ percentile) 24-hour $PM_{2.5}$ indicator:

- a daily 24-hour average concentration was considered valid if at least 75% (18 hours) of the 1-hour concentrations were available on a given day
- a 98th percentile of the daily average concentration was considered valid if at least 75% of the daily average concentrations were available for the year and at least 60% of the daily average concentrations were available in each quarter of a calendar year
- a station was also included if the 98$^{th}$ percentile of the daily average concentration exceeded the 24-hour standard of 27 micrograms per cubic metre (µg/m$^3$), even if the above data completeness criteria were not satisfied

**Ground-level ozone ($O_3$)**

For the annual average $O_3$ indicator:

- rolling (or moving) 8-hour average concentrations were calculated for each hour of the day from the 1-hour average concentrations, resulting in up to 24 8-hour average concentrations per day. The 8-hour average concentrations are reported to the end hour.
- to be valid a rolling 8-hour average concentration must have at least 6 1-hour average concentrations
- a daily maximum 8-hour average concentration was considered valid if at least 75% (18) of the 8-hour rolling average concentrations were available in the day

[15] The quarters are as follows: quarter 1 from January 1 to March 31; quarter 2 from April 1 to June 30; quarter 3 from July 1 to September 30 and quarter 4 from October 1 to December 31.

- the annual maximum 8-hour average concentration was considered valid if at least 75% of all daily maximum 8-hour average concentrations were available for the period from April 1 to September 30

For the peak (4th-highest) 8-hour $O_3$ indicator:

- rolling (or moving) 8-hour average concentrations were calculated for each hour of the day from the 1-hour average concentrations, resulting in up to 24 8-hour average concentrations per day. The 8-hour average concentrations are reported to the end hour.
- to be valid a rolling 8-hour average concentration must have at least 6 1-hour average concentrations
- a daily maximum 8-hour average concentration was considered valid if at least 75% (18) of the 8-hour rolling average concentrations were available in the day
- the annual 4th-highest daily maximum 8-hour average concentration was considered valid if there were at least 75% of all daily maximum 8-hour average concentrations in the period from April 1 to September 30
- a station was also included if the annual 4th-highest daily maximum 8-hour average concentration exceeded the 8-hour standard of 62 parts per billion (ppb), even if the above data completeness criteria were not satisfied

**Nitrogen dioxide ($NO_2$)**

For the annual average $NO_2$ indicator:

- an annual average concentration was considered valid if at least 75% of all the 1-hour average concentrations were available for the year and at least 60% were available in each quarter
- a station was also included if the annual average concentration exceeded the 1-hour standard of 17.0 ppb, and at least 50% of the $NO_2$ 1-hour values are available in each calendar quarter.

For the peak (98th percentile) 1-hour $NO_2$ indicator:

- the daily maximum 1-hour average concentration was considered valid if at least 75% (18) of the hourly concentrations were available on a given day
- the 98th percentile of the daily maximum 1-hour average concentrations was considered valid if at least 75% of the daily maximum 1-hour average concentrations for the year were available and at least 60% in each quarter were available
- a station was also included if it exceeded the 1-hour standard of 60 ppb, even if the above data completeness criteria were not satisfied

**Sulphur dioxide ($SO_2$)**

For the annual average $SO_2$ indicator:

- an annual average concentration was considered valid if at least 75% of all the 1-hour average concentrations were available for the year and at least 60% were available in each quarter
- a station was also included if the annual average concentration exceeded the 1-hour standard of 5.0 ppb, and at least 50% of the $SO_2$ 1-hour values are available in each calendar quarter

For the peak (99th percentile) 1-hour $SO_2$ indicator:

- the daily maximum 1-hour average concentration was considered valid if at least 75% (18 hours) of the hourly concentrations were available on a given day
- the annual 99th percentile of the daily maximum 1-hour average concentrations was considered valid if at least 75% of all the daily maximum 1-hour average concentrations for the year were available and at least 60% in each quarter were available
- a station was also included if it exceeded the 1-hour standard of 70 ppb, even if the above data completeness criteria were not satisfied

**Volatile organic compounds (VOCs)**

There are fewer data available for VOCs and therefore the data completeness criteria for this indicator are different. At urban monitoring stations, VOC samples are usually collected over a 24-hour period

once every 6 days; conversely at rural stations, samples are collected over a 4-hour sampling period (12:00 to 16:00) once every 3 days.[16]

For the annual average VOC indicator:

- a daily average concentration was considered valid if data for a consecutive period of 24 hours (± 1 hour) at an urban station and for a consecutive 4 hours (± 0.5 hours) at a rural station were available on a given day and a quarter (3 months) had at least 5 samples
- a station was only included if there were 3 valid quarters in the year

After the data completeness criteria have been met, the pollutant concentrations are calculated for the selected stations.

**Table 5. Number of stations that satisfied the data completeness criteria for 2020**

| Air pollutant | Number of stations |
|---|---|
| Average $PM_{2.5}$ | 213 |
| Average peak (98th percentile) 24-hour $PM_{2.5}$ | 214 |
| Average $O_3$ | 216 |
| Average peak (4th-highest) 8-hour $O_3$ | 216 |
| Average $NO_2$ | 186 |
| Average peak (98th percentile) 1-hour $NO_2$ | 186 |
| Average $SO_2$ | 123 |
| Average peak (99th percentile) 1-hour $SO_2$ | 123 |
| VOCs | 0[A] |

**Note:** [A] Since no station satisfied the data completeness criteria for 2020, VOC concentrations are presented up to 2019 only. In 2019, 37 stations met the criteria.

## Pollutant-specific calculations

### Fine particulate matter

Fine particulate matter concentrations are expressed in micrograms per cubic metre (µg/m$^3$). The $PM_{2.5}$ average and peak (98th percentile) 24-hour indicators are based on the 24-hour daily average concentrations (daily average) for the whole year. The daily average value for $PM_{2.5}$ is measured from midnight to midnight.

For a given station, the average indicator is calculated by summing all valid daily averages and dividing by the number of valid days. The peak (98th percentile) 24-hour indicator is obtained by determining the 98th percentile value of all 24-hour daily values for a given year. The 98th percentile value corresponds to the concentration for which 98% of all the daily 24-hour values are less than or equal to it and 2% are greater than or equal to it. For example, the 98th percentile value of 25 µg/m$^3$ at a given station means that 98% of all daily 24-hour average concentrations are less than or equal to 25 µg/m$^3$ and only 2% are greater than or equal to 25 µg/m$^3$. In a year with a complete dataset, the 98th percentile corresponds to the 8th highest value. The following table provides the rank of the 98th percentile value based on the number of available daily measurements.[17]

**Table 6. 98th percentile rank based on the number of available measurements**

| Number of available daily measurements in a year | 98th percentile rank |
|---|---|
| 274 to 300 | 6th highest |
| 301 to 350 | 7th highest |
| 351 to 366 | 8th highest |

[16] As of 2018, all rural stations were switched to a once-every-6-day collection schedule.

[17] To obtain the 98th percentile values shown in this table, the calculation method proposed in section 4.1.2 of the Canadian Council of Ministers of the Environment's Guidance Document on Achievement Determination Canadian Ambient Air Quality Standards for Fine Particulate Matter and Ozone (PDF; 270 kB) was used.

The urban area, regional and national indicators (average and peak [98th percentile] 24-hour) for $PM_{2.5}$ are calculated by averaging the station-level annual average and station-level annual peak values for all stations that met the completeness criteria within either the urban area, the region or Canada as a whole.

**Ground-level ozone**

Ozone concentrations are expressed in parts per billion (ppb). There are 24 consecutive 8-hour average concentrations (8-hour rolls) that can possibly be calculated for each day. The highest value of the 24 8-hour average concentrations per day is the daily maximum. An illustration of the calculation running 8-hour average concentrations and the selection of the daily maximum is provided in Figure 36.

**Figure 36. Calculation of the ground-level ozone daily maximum 8-hour average concentration**

| Date | Hour | 1-hour (parts per billion) | 8-hour (parts per billion) | Daily maximum 8-hour (parts per billion) |
|---|---|---|---|---|
| 03/25 | 17:00 | 44 | | |
| | 18:00 | 45 | | |
| | 19:00 | 44 | | |
| | 20:00 | 42 | | |
| | 21:00 | 39 | | |
| | 22:00 | 33 | | |
| | 23:00 | 20 | | |
| | 24:00 | 14 | | |
| 03/26 | 01:00 | 11 | 31.0 | 45.6 |
| | 02:00 | 11 | 26.8 | |
| | 03:00 | 15 | 23.1 | |
| | 04:00 | 13 | 19.5 | |
| | 05:00 | 19 | 17.0 | |
| | 06:00 | 21 | 15.5 | |
| | 07:00 | 19 | 15.4 | |
| | 08:00 | 11 | 15.0 | |
| | 09:00 | 30 | 17.4 | |
| | 10:00 | 36 | 20.5 | |
| | 11:00 | 39 | 23.5 | |
| | 12:00 | 42 | 27.1 | |
| | 13:00 | 44 | 30.3 | |
| | 14:00 | 46 | 33.4 | |
| | 15:00 | 47 | 36.9 | |
| | 16:00 | 47 | 41.4 | |
| | 17:00 | 47 | 43.5 | |
| | 18:00 | 46 | 44.8 | |
| | 19:00 | 46 | 45.6 | |
| | 20:00 | 42 | 45.6 | |
| | 21:00 | 39 | 45.0 | |
| | 22:00 | 38 | 44.0 | |
| | 23:00 | 38 | 42.9 | |
| | 24:00 | 35 | 41.4 | |

For each station, the average $O_3$ indicator is calculated by taking the average of the daily maximum 8-hour (ending) averages for the period from January 1 to December 31. The urban area, regional and national averages for $O_3$ are obtained by averaging the station-level annual averages for selected stations within the urban area, the region or Canada as a whole.

For each station, the peak (4th-highest) 8-hour $O_3$ indicator is based on the 4th-highest of the daily maximum 8-hour average concentrations measured over a given year. All of the daily maximum 8-hour average concentrations are ordered in an array from highest to lowest, with equal values repeated as often as they occur. Each value is assigned a rank. For a given year, the 4th-highest ranking value in the array is identified as the annual peak (4th-highest) 8-hour $O_3$ concentration for that station.

The urban area, regional and national average peak $O_3$ indicators are obtained by averaging all 4th-highest values from all stations that met the completeness criteria within either the urban area, the region or Canada as a whole.

**Nitrogen dioxide**

Nitrogen dioxide concentrations are expressed in parts per billion (ppb). The $NO_2$ average indicator is based on the annual average of all 1-hour concentrations while the peak (98th percentile) 1-hour

indicator is based on the annual 98th percentile of the daily maximum 1-hour average concentrations. The daily maximum 1-hour average value for $NO_2$ is measured from midnight to midnight.

For a given station, the average indicator is calculated by summing all valid 1-hour averages and dividing by the number of total hours. The peak (98th percentile) 1-hour indicator is obtained by determining the 98th percentile value of all daily maximum 1-hour average for a given year. The 98th percentile value corresponds to the concentration for which 98% of all the daily maximum values are less than or equal to it and 2% is greater than or equal to it. For example, the 98th percentile value of 25 ppb at a given station means that 98% of all daily maximum 1-hour average concentrations are less than or equal to 25 ppb and only 2% are greater than or equal to 25 ppb.
The national, regional and urban area indicators (average and peak [98th percentile] 1-hour) for $NO_2$ are calculated by averaging the station-level annual average and station-level annual peak values for all stations that met the completeness criteria within either the urban area, the region or Canada as a whole.

**Sulphur dioxide**

Sulphur dioxide concentrations are expressed in parts per billion (ppb). The $SO_2$ average indicator is based on the annual average of the 1-hour concentrations, while the peak (99th percentile) 1-hour indicator is based on the annual 99th percentile of the daily maximum 1-hour average concentrations. The daily maximum 1-hour average value for $SO_2$ is measured from midnight to midnight.

For a given station, the average indicator is calculated by summing all valid 1-hour averages and dividing by the number of total hours. The peak (99th percentile) 1-hour indicator is obtained by determining the 99th percentile value of all daily maximum 1-hour concentrations for a given year. The 99th percentile value corresponds to the concentration for which 99% of all the daily maximum 1-hour concentrations are less than or equal to and 1% are greater than or equal to it. For example, the 99th percentile value of 65 ppb at a given station means that 99% of all daily maximum 1-hour average concentrations are less than or equal to 65 ppb and only 1% are greater than or equal to 65 ppb. In a year with a complete dataset, the 99th percentile corresponds to the 4th highest value. The following table provides the rank of the 99th percentile value based on the number of available daily measurements.

**Table 7. 99th percentile rank based on the number of available measurements**

| Number of available daily measurements in a year | 99th percentile rank |
|---|---|
| 274 to 300 | 3rd highest |
| 301 to 366 | 4th highest |

The national and regional indicators (average and peak [99th percentile] 1-hour) for $SO_2$ are calculated by averaging the station-level annual average and station-level annual peak values for all stations that met the completeness criteria within the region or throughout Canada.

**Volatile organic**

Volatile organic compounds are reported as a daily sum of individual compounds, as described in Annex C. The number of compounds included in the reported sum may slightly vary subject to the analytical validity of the individual compound concentrations. Urban VOC station indicators are calculated from the average of daily total VOC concentrations (24-hour time-integrated concentrations) while rural VOC station indicators are calculated from the average of daily 4-hour total VOC concentrations (time-integrated samples collected from 12:00 to 16:00). The daily 24-hour average concentrations are based on measurements taken from midnight to midnight. For a station, the average indicator is calculated by taking the average of the daily total concentrations for a given year.

The national and regional indicators for VOCs are obtained by averaging the station-level annual averages from all stations that met the completeness criteria within the region and throughout Canada.

While the concentration unit for individual VOCs is usually expressed as micrograms per cubic metre ($\mu g/m^3$), parts per billion carbon (ppbC) are used in this indicator to assess the quantity of mixed VOC species.

### Station selection criteria for inclusion in national and regional indicators (time-series)

Station-level indicators were calculated for the years 2006 to 2020 for all air pollutants. Each station was then assessed for its suitability (sufficient data, no large gaps at the beginning or end) for inclusion in the national and regional time series. The specific criteria are as follows:

- for the national and regional time series, a station is included if it satisfies the data completeness criteria for at least 11 of the 15 years.
- stations are included if data are available for at least 1 of 3 years at the beginning or end of the time series, this measure avoids the use of data from stations that were commissioned or decommissioned at the beginning or end of the time series.

In addition to the time series selection criteria, a minimum of 3 monitoring stations are required to calculate the indicator for a region, for a given year's trend.

### Station selection results

The following table indicates the number of monitoring stations that satisfied the selection criteria (data completeness and time series) for the 2020 reporting year and were thus included in the time series for the national and regional Air quality indicators (Table 8). Further details are available in a list of selected stations.

**Table 8. Number of stations selected for the national and regional Air quality indicators trend**

| Air pollutant indicator | Canada | Atlantic Canada | Southern Quebec | Southern Ontario | Prairies and northern Ontario | British Columbia | Northern territories |
|---|---|---|---|---|---|---|---|
| Average $PM_{2.5}$ | 146 | 12 | 36 | 38 | 33 | 25 | 0 |
| Average peak (98th percentile) 24-hour $PM_{2.5}$ | 147 | 12 | 36 | 38 | 33 | 25 | 3 |
| Average $O_3$ | 163 | 18 | 40 | 41 | 32 | 30 | 0 |
| Average peak (4th-highest) 8-hour $O_3$ | 163 | 18 | 40 | 41 | 32 | 30 | 0 |
| Average $NO_2$ | 118 | 8 | 16 | 30 | 34 | 28 | 0 |
| Average peak (98th percentile) 1-hour $NO_2$ | 118 | 8 | 16 | 30 | 34 | 28 | 0 |
| Average $SO_2$ | 84 | 6 | 9 | 10 | 32 | 24 | 3 |
| Average peak (99th percentile) 1-hour $SO_2$ | 84 | 6 | 9 | 10 | 32 | 24 | 3 |
| Average VOCs | 30 | 4 | 6 | 9 | 5 | 6 | 0 |

**Note:** The sum of the regional stations may not match the national station numbers because a minimum of 3 monitoring stations are required to calculate the indicator for a region. Where there were not enough stations in the northern territories region, results from stations located in this region (Yukon and the Northwest Territories) were only included in the national totals.

Local (station-level) indicators for $O_3$, $PM_{2.5}$, $NO_2$, and $SO_2$ are also presented in the Canadian Environmental Sustainability Indicators interactive maps. All stations displayed on the map satisfy annual data completeness criteria for the year 2020.

### Imputation

Stations that do not have enough measurements to meet the 15-year time series criteria are excluded from the national and regional indicators. However, in some cases, monitoring stations are located close enough to others to allow data from neighbouring stations to be used to supplement missing data. Stations that were moved but remain relatively close to their previous location were also included.

## Monitoring equipment

#### Fine particulate matter monitoring equipment

Several types of equipment (Annex B) are used to monitor ambient $PM_{2.5}$ concentrations:

$PM_{2.5}$ Pre-Federal Equivalency Method (FEM) and Non-Federal Equivalency Method Instruments

- Non-FEM: Rupprecht & Patashnick tapered element oscillating microbalance (TEOM) monitor or TEOM® Series 1400/1400a with sample equilibrium system (SES) monitor.
- Pre-FEM: Met One BAM-1020 Beta Attenuation Mass monitor (prior to 2008)
- Pre-FEM: Thermo Scientific TEOM 1400a with the Series 8500C Filter Dynamics Measurement System (FDMS) monitor (prior to 2010)
- Pre-FEM: Thermo Scientific 5030 SHARP (Synchronized Hybrid Ambient Realtime Particulate) monitor (prior to 2010)

$PM_{2.5}$ Designated Federal Equivalency Method (FEM) Instruments

- FEM: Thermo Scientific TEOM 1400a with the Series 8500C Filter Dynamics Measurement System (FDMS) monitor.
- FEM: Met One BAM-1020 Beta Attenuation Mass monitor.
- FEM: Thermo Scientific 5030 or 5030i SHARP (Synchronized Hybrid Ambient Realtime Particulate) monitor
- FEM: GRIMM Environmental Dust Monitor model EDM 180
- FEM: Teledyne Advanced Pollution Instrumentation Model T640 PM mass monitor.

The Thermo Scientific TEOM 1400a with 8500C FDMS (2010), Met One BAM-1020 (2008), Thermo Scientific SHARP (2010), GRIMM 180 (2011) and Teledyne T640 (2016) monitors have been approved by the United States Environmental Protection Agency as Class III Federal Equivalent Methods and have been deployed across the National Air Pollution Surveillance network replacing non-FEM tapered element oscillating microbalance instruments, which in some circumstances may under report the $PM_{2.5}$ mass concentrations relative to the National Air Pollution Surveillance $PM_{2.5}$ Reference Method. Since 2005, the tapered element oscillating microbalance monitors have gradually been replaced by the federal equivalent methods monitors. The federal equivalent methods monitors measure a portion (semi-volatile) of the $PM_{2.5}$ mass not captured by the older instruments. Because of these measurement differences between the new and the old monitoring equipment, concentrations measured with the new monitors may not be directly comparable with the measurements from years in which older instruments were used.

**Ground-level ozone monitoring equipment**

Ozone measurements are made using ultraviolet photometry. Sample air passes through a beam of light from an ultraviolet lamp, which is absorbed by $O_3$. The amount of ultraviolet light absorbed is proportional to the amount of $O_3$ in the sample.

**Nitrogen dioxide monitoring equipment**

Nitrogen dioxide is calculated by subtraction following the measurement of total of nitrogen oxides ($NO_X$) and nitrogen monoxide (NO). Nitrogen monoxide (NO) concentrations are determined photometrically by measuring the light intensity from the chemiluminescent reaction of NO mixed with excess $O_3$. The chemiluminescence method detects only NO, therefore, $NO_2$ must first be converted to NO for measurement purposes. Sample flow is either directed through a converter to reduce $NO_2$ to NO, or it bypasses the converter to allow detection of only NO. The sample stream with reduced $NO_2$ is a measurement of NO plus $NO_2$, which is expressed as $NO_X$ (that is, $NO_X = NO_2 + NO$). The difference between $NO_X$ and NO detection is taken as the $NO_2$ concentration (that is, $NO_2 = NO_X - NO$).

**Sulphur dioxide monitoring equipment**

Sulphur dioxide measurements are made using pulse-fluorescence ultraviolet adsorption instruments. This technology is based on the principle that $SO_2$ molecules absorb ultraviolet light at one wavelength and emit ultraviolet light at a different wavelength. The intensity of the emitted light is proportional to the number of $SO_2$ molecules in the sample gas.

**Volatile organic compound monitoring equipment**

A combined gas chromatography-flame ionization detector system is used for quantification of VOCs containing 2 carbons, while a combined gas chromatography-mass selective detector system operating in selected ion monitoring mode is used for quantification of VOCs containing 3 to 12 carbons.

Approximately 120 VOCs (including a number of biogenic species such as isoprene and pinenes) are targeted for quantification in the samples, but not all VOCs are detectable in each sample. The total concentration of VOCs in parts per billion carbon is calculated from the total mass of 77 of these species when detectable in the sample. The list of VOCs targeted for quantification is provided in Annex C. Air samples are collected in either 6-litre or 3.2-litre stainless steel canisters. The canisters are then shipped to the Environment and Climate Change Canada analysis laboratory in Ottawa.

### Statistical analysis

Non-parametric statistical tests were carried out on temporal concentration data to detect the presence of a linear trend and, if present, to determine the orientation (positive or negative) and magnitude of the rate of change (slope). The standard Mann-Kendall trend test was used to detect trend presence and orientation, while the Sen's pairwise slope method was used to estimate the slope. Both tests were applied to the national and regional data for $PM_{2.5}$, $O_3$, $NO_2$, $SO_2$ and VOCs. A trend was reported when the Mann-Kendall test indicated the presence of a trend at the 95% confidence level over the 15-year time series. Results of the tests are available in Annex D, with "Significant" expressing the presence and level of confidence of a trend and "Q" the slope.

### Percentile bounds

A percentile is a statistical measure used to indicate the value below which a percentage of the data falls. For example, the 10th percentile is the value below which 10% of the data may be found. Likewise, the 90th percentile is the value below which 90% of the data may be found.

A percentile range is the difference between 2 determined percentiles. The 10th to 90th percentile range is the most common and is referred to as the 10th to 90th percentile bounds in the Air quality indicators. If sufficient data values are available, the bounds capture 80% of the data. When few data values are available, the calculated percentile range may vary greatly from one year to the next or may not be visible for a given year. This can be observed in the results for the northern territories region or for some regions in the regional VOC indicator.

### Calculation of the urban area indicators

The urban areas used in the indicators are defined by population centre determined by Statistics Canada. A population centre is an area consisting of a population of at least 1 000 and a population density of 400 persons or more per square kilometre, based on population counts from the current Census of Population. All areas outside the population centres are classified as rural areas.

All the monitoring stations located within the population centre are considered in the calculation only if they meet the same data completeness criteria used for the national and regional indicators. Refer to the section on data completeness criteria for more information.

Annual ambient levels from all monitoring stations found within the urban area are averaged. The average is a simple arithmetic average and is not weighted by the population covered by each station. This calculation is repeated for each indicator. For more information on the stations considered, consult the list of stations used for the urban area indicators.

The indicators only report 25 urban areas for the most populated communities in Canada and the provincial and territorial capitals when sufficient data was available. Data for the $SO_2$ and VOC indicators were considered too sparse to allow for appropriate urban area comparisons.

## Recent changes

The stations used to calculate the indicators vary slightly between different iterations of the indicators. For more information, consult the caveats and limitations section below. Some air quality data of previous years were reassessed and corrected.

## Caveats and limitations

In 2020, no monitoring station met the data completeness criteria for volatile organic compound (VOC) concentrations. Therefore, the analysis for this pollutant and its trend relate to data from 2006 to 2019.

## Data completeness

Some data collected at stations cannot be used in calculating the indicators because they do not meet the data completeness criteria. These criteria are based on standard practices supported by expert opinion and are used by a number of organizations, such as the World Health Organization, the Canadian Council of Ministers of the Environment and the United States Environmental Protection Agency. The criteria allow for some gaps in data.

### More information

#### Revisions to station selections

Monitoring stations are selected based on the 15-year time series criteria for the calculation of the Air quality indicators. As this is a rolling 15-year time period, the number of stations selected may vary from 1 iteration of the indicators to the next and may change the historical trends. Caution should be exercised when comparing different iterations of the Air quality indicators.

#### Regional air quality indicators

The number of available monitoring stations and pollutants measured varies from region to region. In certain years, regions that have close to the minimum number of monitoring stations required may report an unusual value if a particular monitoring station did not meet the completeness criteria for that year. This is especially true when the value obtained is an outlier from those obtained at other stations (value overshadows all other stations in the region). For this reason, the regional indicator may be subject to annual fluctuations in some regions (for example, the northern territories).

#### Effect of new fine particulate matter measurement technologies

Since 2005, the Rupprecht & Potashnick tapered element oscillating microbalance (TEOM) monitors used in the National Air Pollution Surveillance program have gradually been replaced by newer monitoring technologies (federal equivalency method-approved instruments). Many studies conducted in Canada, the United States and other countries have found that the TEOM monitors under-report concentrations compared with the newer monitors, especially when the air contains a large proportion of semi-volatile particulate matter. This may be the case during cooler seasons when the air contains a greater proportion of ammonium nitrate and semi-volatile organic compounds.

Some of the year-to-year variations in the $PM_{2.5}$ air quality indicator may be due, in part, to the introduction of the newer monitoring technologies across the National Air Pollution Surveillance Network rather than to changes in actual ambient concentrations only. As such, trends in $PM_{2.5}$ concentrations may not be a true reflection of the changes that have occurred over the time period concerned.

# Resources

## References


Canadian Council of Ministers of the Environment (2012) Guidance document on achievement determination canadian ambient air quality standards for fine particulate matter and ozone (PDF; 270 kB). Retrieved on October 18, 2023

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Environment and Climate Change Canada (2023) National Air Pollution Surveillance Program. Retrieved on October 18, 2023.

## Related information

Canada's Air
Canadian Smog Science Assessment Highlights and Key Messages
Smog: causes and effects

# Annexes

## Annex A. Data tables for the figures presented in this document

**Table A.1. Data for Figure 1. Relative air pollutant concentration changes, Canada, 2006 to 2020**

| Year | $PM_{2.5}$ average concentration (percentage change from 2006 level) | $PM_{2.5}$ peak (98th percentile) 24-hour concentration (percentage change from 2006 level) | $O_3$ average 8-hour concentration (percentage chang from 2006 level) | $O_3$ peak (4th highest) 8-hour concentration (percentage change from 2006 level) | $NO_2$ average concentration (percentage change from 2006 level) | $NO_2$ peak (98th percentile) 1-hour concentration (percentage change from 2006 level) | $SO_2$ average concentration (percentage change from 2006 level) | $SO_2$ peak (99th percentile) 1-hour concentration (percentage change from 2006 level) | VOC average concentration (percentage change from 2006 level) |
|---|---|---|---|---|---|---|---|---|---|
| 2006 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2007 | -1.79 | 4.72 | 0.92 | 5.23 | -2.74 | -0.48 | -5.15 | -10.66 | -4.77 |
| 2008 | 0.69 | -4.28 | -0.76 | -2.22 | -7.98 | 0.02 | -9.83 | -10.93 | -5.08 |
| 2009 | -3.21 | -10.67 | -2.14 | -6.79 | -10.71 | -1.76 | -22.03 | -17.60 | -3.71 |
| 2010 | 12.47 | 19.93 | 1.69 | -2.77 | -15.99 | -6.71 | -33.83 | -16.80 | -16.19 |
| 2011 | 6.62 | -2.37 | 1.73 | -6.61 | -18.82 | -7.93 | -34.94 | -43.84 | -18.07 |
| 2012 | 5.44 | -4.99 | 3.52 | -0.74 | -23.88 | -15.35 | -35.95 | -38.93 | -30.65 |
| 2013 | 16.11 | -0.33 | 1.48 | -7.86 | -23.85 | -12.29 | -38.99 | -40.22 | -29.74 |
| 2014 | 21.00 | 12.37 | 1.15 | -11.45 | -24.24 | -8.92 | -44.40 | -48.66 | -28.95 |
| 2015 | 20.45 | 14.26 | 1.88 | -4.43 | -27.81 | -13.14 | -51.88 | -53.01 | -29.08 |
| 2016 | 5.13 | -0.05 | -0.15 | -6.99 | -31.19 | -17.45 | -55.74 | -51.27 | -40.29 |
| 2017 | 13.42 | 29.75 | 3.48 | -7.46 | -29.69 | -16.71 | -57.91 | -52.24 | -32.20 |
| 2018 | 23.97 | 60.02 | 4.11 | -3.09 | -30.13 | -13.88 | -62.03 | -55.71 | -40.60 |
| 2019 | 3.56 | -8.66 | 0.86 | -12.95 | -32.01 | -14.00 | -60.88 | -59.97 | -38.79 |
| 2020 | -0.03 | -2.77 | -0.07 | -11.83 | -40.88 | -22.04 | -61.68 | -57.99 | n/a |

**Note:** n/a = not available. No VOC concentration was available for 2020. For more information, consult the Data sources and methods section.
**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal and the Canadian Air and Precipitation Monitoring Network.

**Table A. 2. Data for Figure 2. National average fine particulate matter concentrations, Canada, 2006 to 2020**

| Year | Average concentration (µg/m$^3$) | 10th percentile (µg/m$^3$) | 90th percentile (µg/m$^3$) |
|---|---|---|---|
| 2006 | 6.0 | 4.0 | 8.0 |
| 2007 | 5.9 | 3.6 | 8.2 |
| 2008 | 6.0 | 3.9 | 8.9 |
| 2009 | 5.8 | 3.8 | 8.4 |
| 2010 | 6.7 | 3.9 | 10.1 |
| 2011 | 6.4 | 3.7 | 9.6 |
| 2012 | 6.3 | 3.9 | 9.4 |
| 2013 | 6.9 | 4.3 | 9.2 |
| 2014 | 7.2 | 4.8 | 9.5 |
| 2015 | 7.2 | 4.9 | 9.3 |
| 2016 | 6.3 | 4.1 | 8.2 |
| 2017 | 6.8 | 4.5 | 8.5 |
| 2018 | 7.4 | 4.9 | 10.6 |
| 2019 | 6.2 | 4.5 | 7.8 |
| 2020 | 6.0 | 4.2 | 7.4 |
| **2020 standard** | **8.8** | n/a | n/a |
| **Annual trend** | **No trend** | n/a | n/a |

**Note** n/a = not applicable, µg/m$^3$ = micrograms per cubic metre. The national average $PM_{2.5}$ concentration indicator is based on the annual average of the daily 24-hour average concentrations recorded at 146 monitoring stations across Canada. The comparison to the Canadian Ambient Air Quality Standard is provided for illustrative purposes only. For more information, consult the Air quality indicator definitions in the Data sources and methods section.
**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal.

**Table A. 3. Data for Figure 3. Regional average fine particulate matter concentrations, Canada, 2006 to 2020**

| Year | Atlantic Canada | | | Southern Quebec | | |
|---|---|---|---|---|---|---|
| | Average concentration ($\mu g/m^3$) | 10th percentile ($\mu g/m^3$) | 90th percentile ($\mu g/m^3$) | Average concentration ($\mu g/m^3$) | 10th percentile ($\mu g/m^3$) | 90th percentile ($\mu g/m^3$) |
| 2006 | 4.7 | 3.0 | 8.7 | 6.7 | 4.8 | 7.9 |
| 2007 | 4.4 | 2.8 | 6.9 | 6.8 | 4.9 | 8.4 |
| 2008 | 5.1 | 3.3 | 6.3 | 7.8 | 4.3 | 12.7 |
| 2009 | 5.8 | 3.7 | 7.6 | 7.5 | 3.6 | 12.4 |
| 2010 | 5.2 | 2.8 | 7.2 | 7.8 | 4.7 | 11.4 |
| 2011 | 6.2 | 5.1 | 8.5 | 7.7 | 4.0 | 10.5 |
| 2012 | 5.4 | 3.9 | 6.9 | 7.7 | 3.9 | 11.8 |
| 2013 | 5.9 | 4.5 | 7.0 | 7.5 | 4.6 | 10.2 |
| 2014 | 6.4 | 5.2 | 8.1 | 7.2 | 4.9 | 9.5 |
| 2015 | 6.1 | 3.9 | 7.6 | 7.0 | 5.0 | 9.1 |
| 2016 | 5.6 | 4.5 | 6.7 | 6.2 | 4.0 | 8.4 |
| 2017 | 5.5 | 3.9 | 7.1 | 6.5 | 4.3 | 8.5 |
| 2018 | 5.1 | 4.3 | 5.8 | 6.5 | 4.3 | 8.8 |
| 2019 | 5.0 | 4.4 | 5.5 | 6.2 | 4.5 | 7.7 |
| 2020 | 5.1 | 4.5 | 5.7 | 6.3 | 4.3 | 7.6 |
| **2020 standard** | **8.8** | n/a | n/a | **8.8** | n/a | n/a |
| **Annual trend** | **No trend** | n/a | n/a | **-0.11** | n/a | n/a |

| Year | Southern Ontario | | | Prairies and northern Ontario | | |
|---|---|---|---|---|---|---|
| | Average concentration ($\mu g/m^3$) | 10th percentile ($\mu g/m^3$) | 90th percentile ($\mu g/m^3$) | Average concentration ($\mu g/m^3$) | 10th percentile ($\mu g/m^3$) | 90th percentile ($\mu g/m^3$) |
| 2006 | 7.2 | 5.2 | 8.8 | 4.8 | 3.9 | 6.4 |
| 2007 | 7.2 | 5.0 | 9.1 | 4.6 | 3.4 | 5.7 |
| 2008 | 6.6 | 4.4 | 8.3 | 4.7 | 3.1 | 6.4 |
| 2009 | 5.5 | 3.8 | 6.7 | 5.0 | 3.7 | 7.8 |
| 2010 | 5.9 | 4.0 | 7.7 | 8.0 | 4.6 | 14.5 |
| 2011 | 6.0 | 4.2 | 7.7 | 6.9 | 3.6 | 10.4 |
| 2012 | 5.9 | 4.1 | 7.4 | 6.5 | 4.1 | 9.4 |
| 2013 | 7.7 | 5.6 | 9.2 | 6.4 | 3.8 | 8.6 |
| 2014 | 8.0 | 5.8 | 9.8 | 6.7 | 4.6 | 9.0 |
| 2015 | 7.8 | 5.7 | 9.4 | 6.9 | 4.1 | 9.2 |
| 2016 | 6.5 | 4.8 | 8.1 | 6.8 | 4.0 | 9.5 |
| 2017 | 6.4 | 4.6 | 7.8 | 6.5 | 4.5 | 8.2 |
| 2018 | 6.8 | 5.4 | 8.2 | 8.7 | 6.1 | 11.6 |
| 2019 | 6.4 | 4.5 | 7.8 | 6.2 | 4.8 | 7.8 |
| 2020 | 6.2 | 4.5 | 7.1 | 5.2 | 3.9 | 6.7 |
| **2020 standard** | **8.8** | n/a | n/a | **8.8** | n/a | n/a |
| **Annual trend** | **No trend** | n/a | n/a | **No trend** | n/a | n/a |

| Year | British Columbia | | |
|---|---|---|---|
| | Average concentratio (µg/m$^3$) | 10th percentile (µg/m$^3$) | 90th percentile (µg/m$^3$) |
| 2006 | 5.3 | 3.7 | 6.9 |
| 2007 | 4.8 | 3.9 | 6.4 |
| 2008 | 4.8 | 4.0 | 6.5 |
| 2009 | 5.0 | 3.9 | 6.7 |
| 2010 | 5.3 | 3.4 | 8.8 |
| 2011 | 4.5 | 3.3 | 6.5 |
| 2012 | 4.9 | 3.3 | 7.1 |
| 2013 | 6.0 | 3.9 | 8.9 |
| 2014 | 6.8 | 4.6 | 9.1 |
| 2015 | 7.2 | 5.0 | 9.6 |
| 2016 | 5.8 | 3.9 | 8.4 |
| 2017 | 8.7 | 5.9 | 14.2 |
| 2018 | 9.2 | 5.4 | 15.4 |
| 2019 | 6.3 | 4.5 | 8.6 |
| 2020 | 6.8 | 5.8 | 8.2 |
| **2020 standard** | **8.8** | n/a | n/a |
| **Annual trend** | **0.21** | n/a | n/a |

**Note:** n/a = not applicable, µg/m$^3$ = micrograms per cubic metre. The regional average $PM_{2.5}$ concentration indicator is based on the annual average of the daily 24-hour average concentrations recorded at 12 monitoring stations in the Atlantic Canada region, 36 in the southern Quebec region, 38 in the southern Ontario region, 33 in the Prairies and northern Ontario region and 25 in British Columbia. There were not enough stations to report results for the northern territories region. The comparison to the Canadian Ambient Air Quality Standard is provided for illustrative purposes only. For more information, consult the Air quality indicator definitions in the Data sources and methods section.
**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal.

**Table A.2. Data for Figure 4. Average fine particulate matter concentrations, selected Canadian urban areas, 2020**

| Urban area | 2020 (micrograms per cubic metre) |
|---|---|
| Quebec, QC | 8.4 |
| Windsor, ON | 7.9 |
| Victoria, BC | 7.7 |
| Kelowna, BC | 7.6 |
| Hamilton, ON | 7.3 |
| Montreal, QC | 7.2 |
| Regina, SK | 7.1 |
| Toronto, ON | 6.9 |
| Saskatoon, SK | 6.9 |
| Kitchener, ON | 6.6 |
| Gatineau, QC | 6.6 |
| London, ON | 6.5 |
| Charlottetown, PE | 6.5 |
| Vancouver, BC | 6.5 |
| St. Catharines-Niagara Falls, ON | 6.3 |
| Calgary, AB | 6.3 |
| Oshawa, ON | 6.2 |
| Ottawa, ON | 6.1 |
| Edmonton, AB | 6.0 |
| Fredericton, NB | 5.8 |
| Winnipeg, MB | 5.6 |
| Whitehorse, YT | 5.6 |
| St. John's, NL | 5.3 |
| Halifax, NS | 5.0 |
| Yellowknife, NT | 4.4 |

**Note:** Population centres were used to define the urban areas used for this indicator. The indicators only report 25 urban areas for the most populated communities in Canada and the provincial and territorial capitals when data meeting the completeness criteria was available. All concentrations available since 2006 for each urban areas are presented in a separate data table.
**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal.

**Table A.3. Data for Figure 6. National average peak fine particulate matter concentrations, Canada, 2006 to 2020**

| Year | Average peak (98th percentile) 24-hour concentration ($\mu g/m^3$) | 10th percentile ($\mu g/m^3$) | 90th percentile ($\mu g/m^3$) |
|---|---|---|---|
| 2006 | 18.9 | 12.3 | 25.2 |
| 2007 | 19.8 | 11.2 | 28.9 |
| 2008 | 18.1 | 11.1 | 25.9 |
| 2009 | 16.9 | 11.5 | 25.1 |
| 2010 | 22.6 | 12.6 | 33.7 |
| 2011 | 18.4 | 10.7 | 26.4 |
| 2012 | 17.9 | 11.3 | 27.0 |
| 2013 | 18.8 | 12.9 | 25.0 |
| 2014 | 21.2 | 12.7 | 29.1 |
| 2015 | 21.6 | 13.7 | 31.3 |
| 2016 | 18.9 | 10.1 | 21.8 |
| 2017 | 24.5 | 11.4 | 39.3 |
| 2018 | 30.2 | 12.3 | 62.4 |
| 2019 | 17.2 | 10.5 | 23.4 |
| 2020 | 18.4 | 11.2 | 27.3 |
| **2020 standard** | **27** | n/a | n/a |
| **Annual trend** | **No trend** | n/a | n/a |

**Note:** n/a = not applicable, $\mu g/m^3$ = micrograms per cubic metre. The national average peak $PM_{2.5}$ concentration indicator is based on the annual 98th percentile of the daily 24-hour average concentrations recorded at 147 monitoring stations across Canada. The comparison to the Canadian Ambient Air Quality Standard is provided for illustrative purposes only. For more information, consult the Air quality indicator definitions in the Data sources and methods section.
**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal.

**Table A.4. Data for Figure 7. Regional average peak fine particulate matter concentrations, Canada, 2006 to 2020**

| Year | Atlantic Canada | | | Southern Quebec | | |
|---|---|---|---|---|---|---|
| | Average peak (98th percentile) concentration ($\mu g/m^3$) | 10th percentile ($\mu g/m^3$) | 90th percentile ($\mu g/m^3$) | Average peak (98th percentile) concentration ($\mu g/m^3$) | 10th percentile ($\mu g/m^3$) | 90th percentile ($\mu g/m^3$) |
| 2006 | 14.1 | 7.2 | 23.4 | 21.4 | 16.4 | 25.7 |
| 2007 | 14.8 | 7.1 | 26.1 | 22.2 | 16.6 | 26.5 |
| 2008 | 15.3 | 9.0 | 19.0 | 22.4 | 14.0 | 32.6 |
| 2009 | 15.8 | 10.6 | 18.7 | 22.0 | 11.5 | 33.0 |
| 2010 | 15.3 | 11.1 | 22.0 | 24.5 | 17.6 | 32.0 |
| 2011 | 16.1 | 11.7 | 18.8 | 20.4 | 12.2 | 26.8 |
| 2012 | 13.7 | 10.0 | 17.9 | 21.9 | 12.0 | 29.8 |
| 2013 | 16.9 | 14.9 | 19.0 | 20.6 | 13.2 | 26.5 |
| 2014 | 14.7 | 12.5 | 16.8 | 18.1 | 12.0 | 23.6 |
| 2015 | 14.8 | 9.8 | 21.9 | 19.0 | 13.0 | 24.4 |
| 2016 | 11.7 | 9.7 | 13.8 | 15.5 | 9.9 | 21.2 |
| 2017 | 12.3 | 10.1 | 15.7 | 16.6 | 10.5 | 22.7 |
| 2018 | 11.1 | 8.9 | 13.4 | 18.2 | 12.1 | 23.5 |
| 2019 | 10.8 | 9.3 | 12.3 | 16.4 | 11.8 | 20.4 |
| 2020 | 11.3 | 9.5 | 14.2 | 18.5 | 11.3 | 24.5 |
| **2020 standard** | **27** | n/a | n/a | **27** | n/a | n/a |
| **Annual trend** | **-0.32** | n/a | n/a | **-0.42** | n/a | n/a |

| Year | Southern Ontario | | | Prairies and northern Ontario | | |
|---|---|---|---|---|---|---|
| | Average peak (98th percentile) concentration ($\mu g/m^3$) | 10th percentile ($\mu g/m^3$) | 90th percentile ($\mu g/m^3$) | Average peak (98th percentile) concentration ($\mu g/m^3$) | 10th percentile ($\mu g/m^3$) | 90th percentile ($\mu g/m^3$) |
| 2006 | 23.3 | 18.7 | 28.0 | 15.1 | 12.3 | 18.3 |
| 2007 | 27.2 | 21.2 | 31.1 | 13.4 | 10.3 | 16.4 |
| 2008 | 20.9 | 17.0 | 24.1 | 13.7 | 9.8 | 20.0 |
| 2009 | 14.9 | 11.3 | 17.5 | 14.8 | 11.5 | 22.5 |
| 2010 | 21.0 | 13.6 | 25.0 | 25.9 | 14.6 | 42.4 |
| 2011 | 17.9 | 13.8 | 22.8 | 23.1 | 11.4 | 49.3 |
| 2012 | 17.0 | 13.3 | 20.6 | 18.5 | 12.1 | 23.5 |
| 2013 | 19.7 | 15.0 | 22.9 | 18.3 | 12.5 | 26.5 |
| 2014 | 20.9 | 14.0 | 25.5 | 23.9 | 15.3 | 33.7 |
| 2015 | 20.2 | 14.3 | 24.4 | 28.9 | 16.3 | 45.5 |
| 2016 | 16.2 | 12.3 | 19.7 | 31.1 | 11.4 | 33.1 |
| 2017 | 16.2 | 12.1 | 19.3 | 25.0 | 14.9 | 34.0 |
| 2018 | 18.5 | 14.0 | 21.2 | 47.8 | 27.7 | 64.2 |
| 2019 | 17.2 | 12.5 | 20.8 | 21.1 | 14.1 | 27.7 |
| 2020 | 15.7 | 12.2 | 18.5 | 15.4 | 11.8 | 19.0 |
| **2020 standard** | **27** | n/a | n/a | **27** | n/a | n/a |
| **Annual trend** | **-0.42** | n/a | n/a | **0.92** | n/a | n/a |

| Year | British Columbia | | | Northern territories | | |
|---|---|---|---|---|---|---|
| | Average peak (98th percentile) concentration (µg/m³) | 10th percentile (µg/m³) | 90th percentile (µg/m³) | Average peak (98th percentile) concentration (µg/m³) | 10th percentile (µg/m³) | 90th percentile (µg/m³) |
| 2006 | 15.9 | 11.1 | 21.6 | 5.7 | 4.6 | 6.7 |
| 2007 | 14.3 | 9.4 | 20.6 | 12.0 | 11.2 | 12.8 |
| 2008 | 14.5 | 11.0 | 21.3 | 15.9 | 7.6 | 28.5 |
| 2009 | 16.5 | 12.0 | 22.9 | 16.7 | 11.2 | 22.2 |
| 2010 | 22.3 | 10.2 | 50.7 | 10.9 | 6.3 | 15.4 |
| 2011 | 12.5 | 7.7 | 18.0 | 16.7 | 7.5 | 25.8 |
| 2012 | 15.2 | 10.2 | 19.9 | 14.0 | 8.9 | 17.8 |
| 2013 | 15.6 | 10.2 | 22.8 | 20.6 | 10.1 | 31.9 |
| 2014 | 21.3 | 14.5 | 31.5 | 70.4 | 9.8 | 130.9 |
| 2015 | 20.5 | 13.7 | 29.2 | 21.6 | 15.0 | 31.6 |
| 2016 | 14.7 | 9.7 | 21.8 | 14.0 | 6.8 | 19.7 |
| 2017 | 53.3 | 23.5 | 86.6 | 17.7 | 11.4 | 21.8 |
| 2018 | 54.5 | 25.1 | 117.2 | 11.4 | 9.4 | 12.8 |
| 2019 | 16.2 | 9.9 | 23.1 | 18.9 | 10.3 | 28.7 |
| 2020 | 30.8 | 17.1 | 50.3 | 14.9 | 10.5 | 22.3 |
| **2020 standard** | **27** | n/a | n/a | **27** | n/a | n/a |
| **Annual trend** | **0.84** | n/a | n/a | **No trend** | n/a | n/a |

**Note:** n/a = not applicable, µg/m³ = micrograms per cubic metre. The regional average peak $PM_{2.5}$ concentration indicator is based on the annual 98th percentile of the daily 24-hour average concentrations recorded at 12 monitoring stations in the Atlantic Canada region, 36 in the southern Quebec region, 38 in the southern Ontario region, 33 in the Prairies and northern Ontario region, 25 in British Columbia and 3 in the northern territories region. The comparison to the Canadian Ambient Air Quality Standard is provided for illustrative purposes only. For more information, consult the Air quality indicator definitions in the Data sources and methods section.
**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal.

**Table A.5. Data for Figure 8. Average peak fine particulate matter concentrations, selected Canadian urban areas, 2020**

| Urban area | 2020 (micrograms per cubic metre) |
|---|---|
| Victoria, BC | 47.6 |
| Vancouver, BC | 36.7 |
| Quebec, QC | 26.6 |
| Kelowna, BC | 23.1 |
| Whitehorse, YT | 22.3 |
| Montreal, QC | 21.5 |
| Gatineau, QC | 19.3 |
| Edmonton, AB | 19.3 |
| Calgary, AB | 18.9 |
| Toronto, ON | 17.9 |
| Hamilton, ON | 17.9 |
| Kitchener, ON | 17.5 |
| Regina, SK | 17.0 |
| Ottawa, ON | 17.0 |
| Windsor, ON | 16.9 |
| Oshawa, ON | 16.2 |
| London, ON | 16.1 |
| St. Catharines - Niagara Falls, ON | 15.3 |
| Fredericton, NB | 15.0 |
| Saskatoon, SK | 14.5 |
| Winnipeg, MB | 14.2 |
| Charlottetown, PE | 13.7 |
| Yellowknife, NT | 11.8 |
| Halifax, NS | 11.2 |
| St. John's, NL | 10.8 |

**Note:** The indicators only report 25 urban areas for the most populated communities in Canada and the provincial and territorial capitals when data meeting the completeness criteria was available. All concentrations available since 2006 for each urban areas are presented in a separate data table.
**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal.

**Table A.6. Data for Figure 10. National average ozone concentrations, Canada, 2006 to 2020**

| Year | Average concentration (ppb) | 10th percentile (ppb) | 90th percentile (ppb) |
|---|---|---|---|
| 2006 | 32.7 | 26 | 39 |
| 2007 | 33.0 | 26 | 40 |
| 2008 | 32.4 | 27 | 39 |
| 2009 | 32.0 | 26 | 37 |
| 2010 | 33.2 | 27 | 39 |
| 2011 | 33.3 | 28 | 39 |
| 2012 | 33.8 | 28 | 39 |
| 2013 | 33.2 | 26 | 38 |
| 2014 | 33.1 | 28 | 38 |
| 2015 | 33.3 | 27 | 38 |
| 2016 | 32.6 | 27 | 39 |
| 2017 | 33.8 | 29 | 38 |
| 2018 | 34.0 | 29 | 38 |
| 2019 | 33.0 | 27 | 37 |
| 2020 | 32.7 | 28 | 37 |
| **Annual trend** | **No trend** | n/a | n/a |

**Note:** n/a = not applicable, ppb = parts per billion. The national average $O_3$ concentration indicator is based on the annual average of the daily maximum 8-hour average concentrations recorded at 163 monitoring stations across Canada. There is no comparison with CAAQS given no standard exists for $O_3$. For more information, consult the Air quality indicator definitions in the Data sources and methods section.
**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal and the Canadian Air and Precipitation Monitoring Network.

**Table A.7. Data for Figure 11. Regional average ozone concentrations, Canada, 2006 to 2020**

| Year | Atlantic Canada | | | Southern Quebec | | |
|---|---|---|---|---|---|---|
| | Average concentration (ppb) | 10th percentile (ppb) | 90th percentile (ppb) | Average concentration (ppb) | 10th percentile (ppb) | 90th percentile (ppb) |
| 2006 | 33.9 | 31 | 38 | 31.0 | 28 | 35 |
| 2007 | 32.9 | 27 | 37 | 32.3 | 29 | 35 |
| 2008 | 33.2 | 31 | 36 | 31.2 | 29 | 35 |
| 2009 | 31.7 | 30 | 35 | 30.4 | 26 | 34 |
| 2010 | 33.0 | 31 | 35 | 33.2 | 29 | 37 |
| 2011 | 32.7 | 31 | 36 | 32.3 | 29 | 35 |
| 2012 | 32.9 | 30 | 35 | 33.6 | 30 | 37 |
| 2013 | 33.6 | 31 | 37 | 33.9 | 31 | 36 |
| 2014 | 33.4 | 29 | 36 | 33.1 | 30 | 36 |
| 2015 | 33.4 | 30 | 36 | 33.8 | 31 | 36 |
| 2016 | 32.3 | 30 | 34 | 33.1 | 31 | 35 |
| 2017 | 34.7 | 32 | 37 | 33.5 | 31 | 36 |
| 2018 | 34.4 | 31 | 37 | 34.8 | 32 | 37 |
| 2019 | 33.9 | 30 | 37 | 33.8 | 31 | 36 |
| 2020 | 33.7 | 31 | 37 | 33.3 | 32 | 35 |
| **Annual trend** | **No trend** | n/a | n/a | **0.20** | n/a | n/a |

| Year | Southern Ontario | | | Prairies and northern Ontario | | |
|---|---|---|---|---|---|---|
| | Average concentration (ppb) | 10th percentile (ppb) | 90th percentile (ppb) | Average concentration (ppb) | 10th percentile (ppb) | 90th percentile (ppb) |
| 2006 | 36.4 | 33 | 40 | 33.3 | 25 | 40 |
| 2007 | 38.9 | 35 | 43 | 32.5 | 26 | 39 |
| 2008 | 37.4 | 33 | 41 | 32.3 | 27 | 39 |
| 2009 | 35.5 | 32 | 39 | 33.5 | 29 | 40 |
| 2010 | 37.7 | 34 | 41 | 32.8 | 29 | 38 |
| 2011 | 36.6 | 33 | 39 | 35.4 | 31 | 40 |
| 2012 | 38.1 | 35 | 41 | 33.4 | 28 | 39 |
| 2013 | 36.6 | 34 | 39 | 33.9 | 29 | 38 |
| 2014 | 36.7 | 33 | 40 | 32.9 | 28 | 37 |
| 2015 | 36.8 | 34 | 40 | 33.3 | 28 | 37 |
| 2016 | 37.4 | 34 | 40 | 31.8 | 28 | 35 |
| 2017 | 36.4 | 33 | 39 | 35.1 | 31 | 38 |
| 2018 | 36.7 | 34 | 39 | 35.0 | 31 | 38 |
| 2019 | 35.9 | 33 | 38 | 33.6 | 30 | 36 |
| 2020 | 35.7 | 33 | 38 | 33.0 | 30 | 36 |
| **Annual trend** | **No trend** | n/a | n/a | **No trend** | n/a | n/a |

| Year | British Columbia | | |
|---|---|---|---|
| | Average concentration (ppb) | 10th percentile (ppb) | 90th percentile (ppb) |
| 2006 | 28.6 | 24 | 33 |
| 2007 | 25.9 | 21 | 31 |
| 2008 | 26.9 | 23 | 32 |
| 2009 | 27.9 | 24 | 33 |
| 2010 | 27.5 | 25 | 32 |
| 2011 | 27.9 | 24 | 33 |
| 2012 | 29.0 | 25 | 34 |
| 2013 | 26.3 | 22 | 32 |
| 2014 | 28.0 | 24 | 32 |
| 2015 | 27.7 | 23 | 32 |
| 2016 | 26.6 | 23 | 31 |
| 2017 | 28.9 | 24 | 34 |
| 2018 | 28.2 | 24 | 32 |
| 2019 | 26.7 | 22 | 32 |
| 2020 | 27.3 | 21 | 30 |
| **Annual trend** | **No trend** | n/a | n/a |

**Note:** n/a = not applicable, ppb = parts per billion. The regional average $O_3$ concentration indicator is based on the annual average of the daily maximum 8-hour average concentrations recorded at 18 monitoring stations in the Atlantic Canada region, 40 in the southern Quebec region, 41 in the southern Ontario region, 32 in the Prairies and northern Ontario region, and 30 in British Columbia. There were not enough stations to report results for the northern territories region. There is no comparison with CAAQS given no standard exists for $O_3$. For more information, consult the Air quality indicator definitions in the Data sources and methods section.
**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal and the Canadian Air and Precipitation Monitoring Network.

**Table A.8. Data for Figure 12. Average ozone concentrations of selected Canadian urban areas, 2020**

| Urban area | 2020 (parts per billion) |
|---|---|
| St. Catharines - Niagara Falls, ON | 39.0 |
| London, ON | 37.0 |
| Hamilton, ON | 36.5 |
| Kitchener, ON | 36.0 |
| Windsor, ON | 35.5 |
| Oshawa, ON | 35.0 |
| Gatineau, QC | 35.0 |
| Calgary, AB | 34.6 |
| Fredericton, NB | 34.0 |
| Toronto, ON | 33.9 |
| Regina, SK | 33.0 |
| Ottawa, ON | 33.0 |
| Halifax, NS | 33.0 |
| Montreal, QC | 32.6 |
| Quebec, QC | 32.4 |
| Whitehorse, YT | 32.0 |
| Saskatoon, SK | 32.0 |
| Edmonton, AB | 31.9 |
| Winnipeg, MB* | 31.0 |
| St. John's, NL | 30.5 |
| Charlottetown, PE | 30.0 |
| Victoria, BC | 29.5 |
| Kelowna, BC | 29.0 |
| Yellowknife, NT | 27.0 |
| Vancouver, BC | 26.6 |

**Note:** * The concentration is from 2017 and reported for information purposes, as no valid data was available for more recent years. The indicator only reports 25 urban areas for the most populated communities in Canada and the provincial and territorial capitals when data meeting the completeness criteria was available. All concentrations available since 2006 for each urban areas are presented in a separate data table.
**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal and the Canadian Air and Precipitation Monitoring Network.

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**Table A.9. Data for Figure 14. National average peak ozone concentrations, Canada, 2006 to 2020**

| Year | Average peak (4th-highest) 8-hour concentration (ppb) | 10th percentile (ppb) | 90th percentile (ppb) |
|---|---|---|---|
| 2006 | 61.6 | 48.5 | 74.5 |
| 2007 | 64.4 | 48.4 | 81.5 |
| 2008 | 60.0 | 49.7 | 73.9 |
| 2009 | 57.6 | 49.0 | 68.9 |
| 2010 | 59.5 | 48.0 | 71.5 |
| 2011 | 57.3 | 47.3 | 69.0 |
| 2012 | 60.7 | 48.0 | 76.6 |
| 2013 | 56.6 | 46.8 | 65.8 |
| 2014 | 54.4 | 46.3 | 64.0 |
| 2015 | 58.7 | 49.0 | 67.3 |
| 2016 | 56.8 | 44.8 | 69.3 |
| 2017 | 57.3 | 47.8 | 66.8 |
| 2018 | 59.4 | 49.4 | 68.1 |
| 2019 | 53.6 | 45.9 | 62.1 |
| 2020 | 54.1 | 44.9 | 65.3 |
| **2020 standard** | **62** | n/a | n/a |
| **Annual trend** | **-0.48** | n/a | n/a |

**Note:** n/a = not applicable, ppb = parts per billion. The national average peak $O_3$ concentration indicator is based on the annual 4th-highest of the daily maximum 8-hour average concentrations recorded at 163 monitoring stations across Canada. The comparison to the Canadian Ambient Air Quality Standard is provided for illustrative purposes only. For more information, consult the Air quality indicator definitions in the Data sources and methods section.
**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal and the Canadian Air and Precipitation Monitoring Network.

**Table A.10. Data for Figure 15. Regional average peak ozone concentrations, Canada, 2006 to 2020**

| Year | Atlantic Canada | | | Southern Quebec | | |
|---|---|---|---|---|---|---|
| | Average peak 8-hour concentration (ppb) | 10th percentile (ppb) | 90th percentile (ppb) | Average peak 8-hour concentration (ppb) | 10th percentile (ppb) | 90th percentile (ppb) |
| 2006 | 56.4 | 48.3 | 65.0 | 61.2 | 57.0 | 67.1 |
| 2007 | 55.7 | 46.9 | 63.8 | 67.2 | 59.8 | 71.9 |
| 2008 | 53.4 | 49.4 | 58.3 | 58.7 | 53.0 | 65.3 |
| 2009 | 53.8 | 47.8 | 60.5 | 55.3 | 51.0 | 58.6 |
| 2010 | 51.3 | 45.5 | 59.3 | 60.4 | 54.3 | 64.9 |
| 2011 | 50.6 | 47.0 | 55.3 | 55.1 | 50.0 | 60.1 |
| 2012 | 51.5 | 46.5 | 57.9 | 60.9 | 55.1 | 66.6 |
| 2013 | 50.8 | 46.1 | 55.4 | 57.2 | 54.3 | 60.1 |
| 2014 | 48.8 | 44.5 | 51.4 | 53.5 | 49.9 | 57.0 |
| 2015 | 52.0 | 49.0 | 57.9 | 59.4 | 54.5 | 63.9 |
| 2016 | 48.5 | 42.9 | 54.3 | 57.3 | 52.9 | 61.5 |
| 2017 | 54.8 | 46.8 | 66.8 | 56.0 | 50.0 | 61.9 |
| 2018 | 52.4 | 46.8 | 59.3 | 58.0 | 54.0 | 62.0 |
| 2019 | 49.3 | 45.8 | 52.3 | 52.0 | 49.5 | 54.9 |
| 2020 | 48.3 | 44.0 | 52.8 | 55.6 | 50.0 | 60.6 |
| **2020 standard** | **62** | n/a | n/a | **62** | n/a | n/a |
| **Annual trend** | **-0.47** | n/a | n/a | **-0.44** | n/a | n/a |

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| Year | Southern Ontario | | | Prairies and northern Ontario | | |
|---|---|---|---|---|---|---|
| | Average peak 8-hour concentration (ppb) | 10th percentile (ppb) | 90th percentile (ppb) | Average peak 8-hour concentration (ppb) | 10th percentile (ppb) | 90th percentile (ppb) |
| 2006 | 73.9 | 67.3 | 81.0 | 58.1 | 44.8 | 67.5 |
| 2007 | 80.3 | 72.9 | 90.6 | 56.7 | 48.5 | 65.5 |
| 2008 | 71.7 | 64.7 | 77.3 | 57.8 | 49.9 | 65.4 |
| 2009 | 66.5 | 61.4 | 70.6 | 57.2 | 50.0 | 63.5 |
| 2010 | 70.6 | 64.3 | 78.0 | 57.5 | 51.1 | 65.9 |
| 2011 | 67.0 | 59.0 | 77.9 | 60.1 | 54.3 | 64.5 |
| 2012 | 75.7 | 67.4 | 81.5 | 55.5 | 48.6 | 60.6 |
| 2013 | 64.8 | 59.9 | 68.0 | 56.8 | 52.4 | 62.0 |
| 2014 | 62.7 | 57.8 | 68.8 | 53.4 | 49.6 | 58.5 |
| 2015 | 66.0 | 62.8 | 70.3 | 59.7 | 52.6 | 66.4 |
| 2016 | 67.6 | 62.6 | 72.5 | 59.0 | 53.5 | 61.5 |
| 2017 | 64.0 | 55.5 | 68.1 | 55.4 | 51.3 | 58.4 |
| 2018 | 66.5 | 59.9 | 73.3 | 61.0 | 55.1 | 67.0 |
| 2019 | 58.6 | 52.3 | 67.8 | 58.7 | 53.6 | 64.9 |
| 2020 | 63.3 | 56.0 | 67.8 | 51.2 | 47.0 | 55.9 |
| **2020 standard** | **62** | n/a | n/a | **62** | n/a | n/a |
| **Annual trend** | **-0.87** | n/a | n/a | **No trend** | n/a | n/a |

| Year | British Columbia | | |
|---|---|---|---|
| | Average peak 8-hour concentration (ppb) | 10th percentile (ppb) | 90th percentile (ppb) |
| 2006 | 52.7 | 42.8 | 65.4 |
| 2007 | 50.0 | 42.0 | 58.5 |
| 2008 | 51.8 | 46.0 | 59.1 |
| 2009 | 51.1 | 43.6 | 61.0 |
| 2010 | 49.8 | 43.4 | 56.9 |
| 2011 | 47.3 | 41.4 | 52.8 |
| 2012 | 50.2 | 41.8 | 57.9 |
| 2013 | 47.3 | 42.9 | 54.3 |
| 2014 | 48.6 | 41.4 | 54.1 |
| 2015 | 50.8 | 44.6 | 58.0 |
| 2016 | 44.7 | 38.8 | 49.9 |
| 2017 | 53.5 | 43.1 | 65.6 |
| 2018 | 54.6 | 45.4 | 68.1 |
| 2019 | 46.4 | 41.0 | 51.6 |
| 2020 | 47.2 | 39.8 | 55.3 |
| **2020 standard** | **62** | n/a | n/a |
| **Annual trend** | **No trend** | n/a | n/a |

**Note:** n/a = not applicable, ppb = parts per billion. The regional average peak $O_3$ concentration indicator is based on the annual 4th-highest of the daily maximum 8-hour average concentrations recorded at 18 monitoring stations in the Atlantic Canada region, 40 in the southern Quebec region, 41 in the southern Ontario region, 32 in the Prairies and northern Ontario region, and 30 in British Columbia. There were not enough stations to report results for the northern territories region. The comparison to the Canadian Ambient Air Quality Standard is provided for illustrative purposes only. For more information, consult the Air quality indicator definitions in the Data sources and methods section.
**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal and the Canadian Air and Precipitation Monitoring Network.

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**Table A.11. Data for Figure 16. Average peak ozone concentrations, selected Canadian urban areas, 2020**

| Urban area | 2020 (parts per billion) |
|---|---|
| Windsor, ON | 66.9 |
| Oshawa, ON | 66.8 |
| Hamilton, ON | 65.8 |
| Toronto, ON | 64.5 |
| St. Catharines - Niagara Falls, ON | 64.3 |
| London, ON | 62.8 |
| Kitchener, ON | 61.6 |
| Gatineau, QC | 57.8 |
| Montreal, QC | 56.6 |
| Ottawa, ON | 55.1 |
| Quebec, QC | 54.3 |
| Edmonton, AB | 52.9 |
| Whitehorse, YT | 52.1 |
| Calgary, AB | 51.9 |
| Winnipeg, MB* | 51.1 |
| Regina, SK | 50.6 |
| Halifax, NS | 48.8 |
| Saskatoon, SK | 47.6 |
| Vancouver, BC | 47.1 |
| Victoria, BC | 46.3 |
| Kelowna, BC | 45.3 |
| Fredericton, NB | 45.1 |
| Charlottetown, PE | 44.4 |
| St. John's, NL | 44.1 |
| Yellowknife, NT | 41.8 |

**Note:** * The concentration is from 2017 and reported for information purposes, as no valid data was available for more recent years. The indicator only reports 25 urban areas for the most populated communities in Canada and the provincial and territorial capitals when data meeting the completeness criteria was available. All concentrations available since 2006 for each urban areas are presented in a separate data table.
**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal and the Canadian Air and Precipitation Monitoring Network.

**Table A. 14. Data for Figure 18. National average nitrogen dioxide concentrations, Canada, 2006 to 2020**

| Year | Average concentration (ppb) | 10th percentile (ppb) | 90th percentile (ppb) |
|---|---|---|---|
| 2006 | 10.7 | 3.9 | 17.4 |
| 2007 | 10.4 | 4.2 | 17.0 |
| 2008 | 9.8 | 3.9 | 16.0 |
| 2009 | 9.6 | 3.6 | 15.1 |
| 2010 | 9.0 | 4.3 | 14.3 |
| 2011 | 8.7 | 3.4 | 14.3 |
| 2012 | 8.1 | 3.4 | 13.5 |
| 2013 | 8.1 | 3.4 | 13.6 |
| 2014 | 8.1 | 3.3 | 14.0 |
| 2015 | 7.7 | 3.2 | 12.6 |
| 2016 | 7.4 | 3.2 | 12.0 |
| 2017 | 7.5 | 2.7 | 13.3 |
| 2018 | 7.5 | 2.9 | 11.8 |
| 2019 | 7.3 | 3.0 | 12.1 |
| 2020 | 6.3 | 2.7 | 10.2 |
| **2020 standard** | **17.0** | n/a | n/a |
| **Annual trend** | **-0.27** | n/a | n/a |

**Note:** n/a = not applicable, ppb = parts per billion. The national average $NO_2$ concentration indicator is based on the annual average of the hourly concentrations recorded at 118 monitoring stations across Canada. The comparison to the Canadian Ambient Air Quality Standard is provided for illustrative purposes only. For more information, consult the Air quality indicator definitions in the Data sources and methods section.
**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal.

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**Table A.12. Data for Figure 19. Regional average nitrogen dioxide concentrations, Canada, 2006 to 2020**

| Year | Atlantic Canada | | | Southern Quebec | | |
|---|---|---|---|---|---|---|
| | Average concentration (ppb) | 10th percentile (ppb) | 90th percentile (ppb) | Average concentration (ppb) | 10th percentile (ppb) | 90th percentile (ppb) |
| 2006 | 3.3 | 1.6 | 6.3 | 12.4 | 5.0 | 21.4 |
| 2007 | 4.0 | 1.9 | 6.5 | 11.8 | 4.2 | 20.8 |
| 2008 | 5.2 | 1.8 | 8.7 | 12.0 | 4.4 | 19.3 |
| 2009 | 3.4 | 1.0 | 5.1 | 10.9 | 4.4 | 18.4 |
| 2010 | 4.1 | 1.7 | 6.9 | 10.1 | 6.6 | 12.7 |
| 2011 | 3.8 | 1.7 | 6.2 | 11.6 | 7.4 | 17.5 |
| 2012 | 3.2 | 1.5 | 6.0 | 9.6 | 6.1 | 15.9 |
| 2013 | 4.0 | 1.6 | 7.2 | 9.4 | 6.3 | 15.6 |
| 2014 | 3.6 | 1.5 | 6.2 | 8.5 | 2.7 | 15.2 |
| 2015 | 3.3 | 1.4 | 5.6 | 8.1 | 5.3 | 10.4 |
| 2016 | 2.8 | 1.2 | 5.4 | 8.1 | 3.1 | 11.6 |
| 2017 | 3.4 | 1.0 | 6.9 | 8.1 | 2.7 | 11.6 |
| 2018 | 2.8 | 1.2 | 5.3 | 8.2 | 3.1 | 11.4 |
| 2019 | 3.0 | 1.2 | 3.9 | 7.6 | 3.1 | 11.2 |
| 2020 | 2.7 | 1.1 | 3.6 | 6.7 | 3.1 | 9.8 |
| **2020 standard** | **17.0** | n/a | n/a | **17.0** | n/a | n/a |
| **Annual trend** | **-0.09** | n/a | n/a | **-0.39** | n/a | n/a |

| Year | Southern Ontario | | | Prairies and northern Ontario | | |
|---|---|---|---|---|---|---|
| | Average concentration (ppb) | 10th percentile (ppb) | 90th percentile (ppb) | Average concentration (ppb) | 10th percentile (ppb) | 90th percentile (ppb) |
| 2006 | 13.1 | 7.7 | 19.1 | 8.5 | 3.2 | 14.7 |
| 2007 | 11.8 | 5.7 | 18.2 | 8.4 | 3.4 | 15.6 |
| 2008 | 11.4 | 5.5 | 17.0 | 7.7 | 3.6 | 13.1 |
| 2009 | 10.3 | 5.6 | 15.8 | 8.2 | 3.5 | 13.4 |
| 2010 | 9.8 | 5.0 | 16.1 | 8.2 | 3.7 | 12.2 |
| 2011 | 9.8 | 4.6 | 15.4 | 7.2 | 2.9 | 11.8 |
| 2012 | 8.7 | 4.0 | 14.0 | 6.9 | 3.0 | 11.7 |
| 2013 | 8.6 | 4.7 | 13.6 | 7.2 | 2.9 | 11.7 |
| 2014 | 8.9 | 4.5 | 14.2 | 7.2 | 2.9 | 11.8 |
| 2015 | 8.7 | 4.8 | 13.9 | 6.4 | 2.6 | 10.3 |
| 2016 | 8.1 | 4.4 | 13.3 | 6.4 | 3.2 | 9.7 |
| 2017 | 7.8 | 4.4 | 13.0 | 6.3 | 2.2 | 10.7 |
| 2018 | 7.4 | 3.8 | 11.8 | 7.1 | 2.9 | 11.8 |
| 2019 | 7.4 | 3.9 | 12.5 | 6.7 | 2.5 | 11.0 |
| 2020 | 6.2 | 3.5 | 9.9 | 6.0 | 2.6 | 9.5 |
| **2020 standard** | **17.0** | n/a | n/a | **17.0** | n/a | n/a |
| **Annual trend** | **-0.39** | n/a | n/a | **-0.16** | n/a | n/a |

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| Year | British Columbia | | |
|---|---|---|---|
| | Average concentration (ppb) | 10th percentile (ppb) | 90th percentile (ppb) |
| 2006 | 12.5 | 8.5 | 17.0 |
| 2007 | 11.7 | 7.9 | 16.1 |
| 2008 | 11.5 | 7.9 | 15.2 |
| 2009 | 11.4 | 7.2 | 15.5 |
| 2010 | 9.9 | 7.1 | 13.4 |
| 2011 | 9.7 | 6.7 | 13.3 |
| 2012 | 10.1 | 6.4 | 14.0 |
| 2013 | 9.7 | 5.9 | 14.4 |
| 2014 | 9.7 | 6.2 | 14.0 |
| 2015 | 9.8 | 6.5 | 13.8 |
| 2016 | 9.0 | 5.7 | 12.4 |
| 2017 | 9.9 | 5.8 | 14.1 |
| 2018 | 9.3 | 5.7 | 12.9 |
| 2019 | 9.1 | 5.6 | 13.6 |
| 2020 | 7.9 | 5.0 | 11.0 |
| **2020 standard** | **17.0** | n/a | n/a |
| **Annual trend** | **-0.23** | n/a | n/a |

**Note:** n/a = not applicable, ppb = parts per billion. The regional average $NO_2$ concentration indicator is based on the annual average of the hourly concentrations recorded at 8 monitoring stations in the Atlantic Canada region, 16 in the southern Quebec region, 30 in the southern Ontario region, 34 in the Prairies and northern Ontario region and 28 in British Columbia. There were not enough stations to report results for the northern territories region. The comparison to the Canadian Ambient Air Quality Standard is provided for illustrative purposes only. For more information, consult the Air quality indicator definitions in the Data sources and methods section.
**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal.

**Table A.13. Data for Figure 20. Average nitrogen dioxide concentrations, selected Canadian urban areas, 2020**

| Urban area | 2020 (parts per billion) |
|---|---|
| Calgary, AB | 12.2 |
| Edmonton, AB | 10.8 |
| Vancouver, BC | 9.7 |
| Toronto, ON | 9.5 |
| Hamilton, ON | 8.6 |
| Windsor, ON | 8.5 |
| Winnipeg, MB | 8.0 |
| Saskatoon, SK | 7.4 |
| Regina, SK | 7.4 |
| Montreal, QC | 7.4 |
| Whitehorse, YT | 6.4 |
| Ottawa, ON | 5.9 |
| Quebec, QC | 5.9 |
| Kelowna, BC | 5.8 |
| St. Catharines - Niagara Falls ON | 5.3 |
| Victoria, BC | 5.1 |
| Kitchener, ON | 4.9 |
| Gatineau, QC | 4.5 |
| London, ON | 4.5 |
| Halifax, NS | 3.9 |
| Oshawa, ON | 3.6 |
| Fredericton, NB | 2.7 |
| Yellowknife, NT | 2.1 |
| Charlottetown, PE | 1.6 |
| St. John's, NL | 1.1 |

**Note:** The indicators only report 25 urban areas for the most populated communities in Canada and the provincial and territorial capitals when data meeting the completeness criteria was available. All concentrations available since 2006 for each urban areas are presented in a separate data table.
**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal.

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**Table A.14. Data for Figure 22. National average peak nitrogen dioxide concentrations, Canada, 2006 to 2020**

| Year | Average peak (98th percentile) 1-hour concentration (ppb) | 10th percentile (ppb) | 90th percentile (ppb) |
|---|---|---|---|
| 2006 | 43.5 | 27.0 | 59.0 |
| 2007 | 43.3 | 28.0 | 58.0 |
| 2008 | 43.5 | 28.0 | 59.0 |
| 2009 | 42.7 | 26.0 | 57.0 |
| 2010 | 40.6 | 29.0 | 55.0 |
| 2011 | 40.0 | 25.0 | 53.0 |
| 2012 | 36.8 | 25.0 | 47.0 |
| 2013 | 38.2 | 24.9 | 49.7 |
| 2014 | 39.6 | 25.6 | 53.7 |
| 2015 | 37.8 | 23.0 | 49.4 |
| 2016 | 35.9 | 23.7 | 47.3 |
| 2017 | 36.2 | 20.8 | 47.7 |
| 2018 | 37.5 | 23.4 | 48.7 |
| 2019 | 37.4 | 22.0 | 49.1 |
| 2020 | 33.9 | 21.8 | 45.5 |
| **2020 standard** | **60** | n/a | n/a |
| **Annual trend** | **-0.64** | n/a | n/a |

**Note:** n/a = not applicable, ppb = parts per billion. The national average peak $NO_2$ concentration indicator is based on the annual 98th percentile of the daily maximum 1-hour average concentrations recorded at 118 monitoring stations across Canada. The comparison to the Canadian Ambient Air Quality Standard is provided for illustrative purposes only. For more information, consult the Air quality indicator definitions in the Data sources and methods section.
**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal.

**Table A.15. Data for Figure 23. Regional average peak nitrogen dioxide concentrations, Canada, 2006 to 2020**

| Year | Atlantic Canada | | | Southern Quebec | | |
|---|---|---|---|---|---|---|
| | Average peak (98th percentile) 1-hour concentration (ppb) | 10th percentile (ppb) | 90th percentile (ppb) | Average peak (98th percentile) 1-hour concentration (ppb) | 10th percentile (ppb) | 90th percentile (ppb) |
| 2006 | 35.2 | 24.0 | 66.0 | 46.4 | 38.0 | 56.0 |
| 2007 | 31.0 | 22.0 | 38.0 | 49.3 | 38.0 | 65.0 |
| 2008 | 34.5 | 20.0 | 40.0 | 54.3 | 42.0 | 65.0 |
| 2009 | 31.8 | 18.0 | 39.0 | 49.3 | 38.0 | 60.0 |
| 2010 | 33.2 | 24.0 | 42.5 | 44.5 | 41.0 | 47.0 |
| 2011 | 30.7 | 16.0 | 49.4 | 49.5 | 42.0 | 55.0 |
| 2012 | 26.3 | 11.0 | 39.0 | 41.2 | 33.0 | 48.0 |
| 2013 | 29.9 | 14.3 | 44.3 | 42.2 | 37.2 | 49.0 |
| 2014 | 30.2 | 15.0 | 38.7 | 41.9 | 26.6 | 53.7 |
| 2015 | 29.9 | 12.0 | 49.4 | 43.1 | 37.6 | 50.5 |
| 2016 | 24.5 | 11.9 | 34.3 | 40.7 | 27.9 | 47.3 |
| 2017 | 24.6 | 10.2 | 35.7 | 41.0 | 21.2 | 48.8 |
| 2018 | 27.8 | 13.0 | 38.2 | 41.7 | 27.1 | 48.7 |
| 2019 | 25.4 | 21.2 | 32.0 | 41.1 | 26.7 | 47.9 |
| 2020 | 26.8 | 20.6 | 33.2 | 38.9 | 24.6 | 46.3 |
| **2020 standard** | **60** | n/a | n/a | **60** | n/a | n/a |
| **Annual trend** | **-0.63** | n/a | n/a | **-0.63** | n/a | n/a |

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| Year | Southern Ontario | | | Prairies and northern Ontario | | |
|---|---|---|---|---|---|---|
| | Average peak (98th percentile) 1-hour concentration (ppb) | 10th percentile (ppb) | 90th percentile (ppb) | Average peak (98th percentile) 1-hour concentration (ppb) | 10th percentile (ppb) | 90th percentile (ppb) |
| 2006 | 51.2 | 37.0 | 63.0 | 41.1 | 26.0 | 60.0 |
| 2007 | 47.6 | 34.0 | 58.0 | 42.4 | 26.0 | 61.0 |
| 2008 | 48.3 | 34.0 | 59.0 | 40.7 | 27.0 | 56.0 |
| 2009 | 46.6 | 35.0 | 55.0 | 41.5 | 26.0 | 58.0 |
| 2010 | 44.1 | 31.0 | 56.0 | 41.4 | 29.0 | 55.0 |
| 2011 | 44.5 | 36.0 | 56.0 | 39.4 | 24.0 | 52.9 |
| 2012 | 38.5 | 26.0 | 49.0 | 37.1 | 25.7 | 47.4 |
| 2013 | 40.8 | 29.2 | 49.0 | 40.2 | 25.5 | 55.5 |
| 2014 | 45.4 | 36.6 | 57.1 | 38.8 | 24.0 | 55.8 |
| 2015 | 43.9 | 37.1 | 54.7 | 35.2 | 21.6 | 47.9 |
| 2016 | 39.4 | 27.0 | 52.6 | 35.1 | 23.0 | 50.2 |
| 2017 | 37.0 | 28.3 | 45.4 | 34.6 | 18.0 | 49.9 |
| 2018 | 39.0 | 29.0 | 46.9 | 37.9 | 21.4 | 55.8 |
| 2019 | 41.0 | 30.4 | 51.8 | 37.2 | 20.5 | 53.9 |
| 2020 | 34.7 | 23.9 | 42.5 | 35.2 | 17.5 | 50.4 |
| **2020 standard** | **60** | n/a | n/a | **60** | n/a | n/a |
| **Annual trend** | **-0.94** | n/a | n/a | **-0.46** | n/a | n/a |

| Year | British Columbia | | |
|---|---|---|---|
| | Average peak (98th percentile) 1-hour concentration (ppb) | 10th percentile (ppb) | 90th percentile (ppb) |
| 2006 | 41.2 | 32.0 | 49.0 |
| 2007 | 38.9 | 31.0 | 47.0 |
| 2008 | 39.7 | 31.0 | 47.0 |
| 2009 | 40.0 | 30.0 | 49.0 |
| 2010 | 35.6 | 28.2 | 41.0 |
| 2011 | 34.6 | 25.0 | 42.3 |
| 2012 | 36.1 | 25.5 | 43.5 |
| 2013 | 34.2 | 24.9 | 43.2 |
| 2014 | 36.1 | 25.6 | 46.2 |
| 2015 | 34.8 | 26.0 | 42.4 |
| 2016 | 34.1 | 23.7 | 43.7 |
| 2017 | 38.2 | 26.8 | 49.9 |
| 2018 | 36.5 | 25.6 | 46.8 |
| 2019 | 36.0 | 23.9 | 43.8 |
| 2020 | 31.6 | 22.4 | 39.5 |
| **2020 standard** | **60** | n/a | n/a |
| **Annual trend** | **-0.40** | n/a | n/a |

**Note:** n/a = not applicable, ppb = parts per billion. The regional average peak $NO_2$ concentration indicator is based on the annual 98th percentile of the daily maximum 1-hour average concentrations recorded at 8 monitoring stations in the Atlantic Canada region, 16 in the southern Quebec region, 30 in the southern Ontario region, 34 in the Prairies and northern Ontario region and 28 in British Columbia. There were not enough stations to report results for the northern territories region. The comparison to the Canadian Ambient Air Quality Standard is provided for illustrative purposes only. For more information, consult the Air quality indicator definitions in the Data sources and methods section.
**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal.

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**Table A.16. Data for Figure 24. Average peak nitrogen dioxide concentrations, selected Canadian urban areas, 2020**

| Urban area | 2020 (parts per billion) |
|---|---|
| Calgary, AB | 56.3 |
| Edmonton, AB | 49.9 |
| Toronto, ON | 42.8 |
| Regina, SK | 42.3 |
| Montreal, QC | 41.2 |
| Whitehorse, YT | 41.1 |
| Saskatoon, SK | 41.1 |
| Ottawa, ON | 39.5 |
| Hamilton, ON | 38.3 |
| Windsor, ON | 37.6 |
| Quebec, QC | 37.3 |
| Vancouver, BC | 34.8 |
| Gatineau, QC | 34.3 |
| Fredericton, NB | 33.1 |
| Winnipeg, MB | 32.0 |
| St. Catharines - Niagara Falls, ON | 31.9 |
| Kitchener, ON | 31.8 |
| Victoria, BC | 27.9 |
| Kelowna, BC | 27.1 |
| Halifax, NS | 27.1 |
| Yellowknife, NT | 26.1 |
| Charlottetown, PE | 25.6 |
| London, ON | 23.9 |
| Oshawa, ON | 20.9 |
| St. John's, NL | 20.9 |

**Note: Note:** The indicators only report 25 urban areas for the most populated communities in Canada and the provincial and territorial capitals when data meeting the completeness criteria was available. All concentrations available since 2006 for each urban areas are presented in a separate data table.
**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal.

**Table A.17. Data for Figure 26. National average sulphur dioxide concentrations, Canada, 2006 to 2020**

| Year | Average concentration (ppb) | 10th percentile (ppb) | 90th percentile (ppb) |
|---|---|---|---|
| 2006 | 1.9 | 0.3 | 4.8 |
| 2007 | 1.8 | 0.3 | 4.7 |
| 2008 | 1.7 | 0.4 | 3.6 |
| 2009 | 1.5 | 0.3 | 3.3 |
| 2010 | 1.2 | 0.3 | 2.8 |
| 2011 | 1.2 | 0.3 | 2.9 |
| 2012 | 1.2 | 0.2 | 2.8 |
| 2013 | 1.1 | 0.2 | 2.4 |
| 2014 | 1.0 | 0.2 | 2.4 |
| 2015 | 0.9 | 0.2 | 1.9 |
| 2016 | 0.8 | 0.1 | 1.8 |
| 2017 | 0.8 | 0.1 | 1.2 |
| 2018 | 0.7 | 0.2 | 1.4 |
| 2019 | 0.7 | 0.1 | 1.3 |
| 2020 | 0.7 | 0.2 | 1.2 |
| **2020 standard** | **5.0** | n/a | n/a |
| **Annual trend** | **-0.08** | n/a | n/a |

**Note:** n/a = not applicable, ppb = parts per billion. The national average $SO_2$ concentration indicator is based on the annual average of the hourly concentrations recorded at 84 monitoring stations across Canada. The comparison to the Canadian Ambient Air Quality Standard is provided for illustrative purposes only. For more information, consult the Air quality indicator definitions in the Data sources and methods section.
**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal.

**Table A.18. Data for Figure 27. Regional average sulphur dioxide concentrations, Canada, 2006 to 2020**

| Year | Atlantic Canada | | | Southern Quebec | | |
|---|---|---|---|---|---|---|
| | Average concentration (ppb) | 10th percentile (ppb) | 90th percentile (ppb) | Average concentration (ppb) | 10th percentile (ppb) | 90th percentile (ppb) |
| 2006 | 1.8 | 0.9 | 3.8 | 3.3 | 0.6 | 8.7 |
| 2007 | 2.3 | 0.5 | 5.2 | 2.5 | 0.4 | 6.7 |
| 2008 | 1.3 | 0.4 | 3.3 | 2.6 | 0.4 | 8.7 |
| 2009 | 1.1 | 0.5 | 2.0 | 1.9 | 0.2 | 4.5 |
| 2010 | 0.7 | 0.3 | 1.0 | 1.7 | 0.2 | 3.5 |
| 2011 | 0.8 | 0.4 | 1.1 | 1.4 | 0.1 | 4.7 |
| 2012 | 1.3 | 0.6 | 2.4 | 1.8 | 0.2 | 6.1 |
| 2013 | 1.0 | 0.3 | 1.8 | 1.7 | 0.2 | 5.4 |
| 2014 | 0.9 | 0.1 | 2.4 | 1.5 | 0.4 | 6.1 |
| 2015 | 0.6 | 0.2 | 2.0 | 1.3 | 0.3 | 5.4 |
| 2016 | 0.6 | 0.1 | 1.7 | 1.3 | 0.2 | 5.8 |
| 2017 | 0.5 | 0.1 | 1.1 | 1.2 | 0.1 | 6.3 |
| 2018 | 0.8 | 0.3 | 2.0 | 1.1 | 0.1 | 5.3 |
| 2019 | 0.7 | 0.4 | 1.8 | 1.2 | 0.1 | 5.5 |
| 2020 | 0.8 | 0.3 | 2.9 | 1.1 | 0.1 | 5.4 |
| **2020 standard** | **5.0** | n/a | n/a | **5.0** | n/a | n/a |
| **Annual trend** | **-0.07** | n/a | n/a | **-0.11** | n/a | n/a |

| Year | Southern Ontario | | | Prairies and northern Ontario | | |
|---|---|---|---|---|---|---|
| | Average concentration (ppb) | 10th percentile (ppb) | 90th percentile (ppb) | Average Concentration (ppb) | 10th percentile (ppb) | 90th percentile (ppb) |
| 2006 | 3.7 | 1.1 | 8.3 | 1.1 | 0.4 | 1.5 |
| 2007 | 3.5 | 0.8 | 8.0 | 1.2 | 0.2 | 1.5 |
| 2008 | 3.1 | 0.9 | 7.7 | 1.0 | 0.2 | 1.5 |
| 2009 | 2.3 | 0.6 | 4.5 | 0.9 | 0.2 | 1.4 |
| 2010 | 2.1 | 0.2 | 3.9 | 0.7 | 0.1 | 1.3 |
| 2011 | 2.9 | 0.4 | 5.3 | 0.6 | 0.2 | 1.1 |
| 2012 | 2.2 | 0.3 | 4.8 | 0.5 | 0.2 | 1.1 |
| 2013 | 2.2 | 0.4 | 4.9 | 0.6 | 0.2 | 1.3 |
| 2014 | 2.2 | 0.4 | 5.1 | 0.5 | 0.1 | 1.2 |
| 2015 | 1.9 | 0.3 | 4.3 | 0.5 | 0.1 | 1.0 |
| 2016 | 1.2 | 0.0 | 3.2 | 0.5 | 0.0 | 1.0 |
| 2017 | 1.3 | 0.2 | 3.6 | 0.5 | 0.1 | 1.0 |
| 2018 | 1.4 | 0.2 | 5.0 | 0.5 | 0.1 | 0.9 |
| 2019 | 1.4 | 0.2 | 4.8 | 0.5 | 0.1 | 0.9 |
| 2020 | 1.2 | 0.1 | 3.7 | 0.6 | 0.1 | 1.0 |
| **2020 standard** | **5.0** | n/a | n/a | **5.0** | n/a | n/a |
| **Annual trend** | **-0.17** | n/a | n/a | **-0.04** | n/a | n/a |

| Year | British Columbia | | | Northern territories | | |
|---|---|---|---|---|---|---|
| | Average concentration (ppb) | 10th percentile (ppb) | 90th percentile (ppb) | Average concentration (ppb) | 10th percentile (ppb) | 90th percentile (ppb) |
| 2006 | 1.9 | 0.3 | 3.1 | 0.5 | 0.2 | 0.7 |
| 2007 | 1.6 | 0.3 | 2.8 | 0.4 | 0.3 | 0.4 |
| 2008 | 1.8 | 0.5 | 2.9 | 0.6 | 0.6 | 0.7 |
| 2009 | 1.8 | 0.5 | 3.2 | 0.6 | 0.2 | 0.9 |
| 2010 | 1.6 | 0.3 | 2.7 | 0.6 | 0.5 | 0.7 |
| 2011 | 1.4 | 0.3 | 2.0 | 0.5 | 0.2 | 0.8 |
| 2012 | 1.5 | 0.3 | 2.4 | 0.7 | 0.7 | 0.7 |
| 2013 | 1.3 | 0.2 | 2.2 | 0.4 | 0.4 | 0.4 |
| 2014 | 1.1 | 0.2 | 1.7 | 0.3 | 0.2 | 0.4 |
| 2015 | 1.0 | 0.2 | 1.0 | 0.3 | 0.2 | 0.4 |
| 2016 | 1.0 | 0.2 | 1.0 | 0.2 | 0.1 | 0.3 |
| 2017 | 0.9 | 0.2 | 0.9 | 0.2 | 0.1 | 0.2 |
| 2018 | 0.6 | 0.2 | 0.9 | 0.3 | 0.2 | 0.4 |
| 2019 | 0.7 | 0.2 | 1.0 | 0.2 | 0.1 | 0.2 |
| 2020 | 0.6 | 0.2 | 0.8 | 0.4 | 0.3 | 0.4 |
| **2020 standard** | **5.0** | n/a | n/a | **5.0** | n/a | n/a |
| **Annual trend** | **-0.10** | n/a | n/a | **-0.03** | n/a | n/a |

**Note:** n/a = not applicable, ppb = parts per billion. The regional average $SO_2$ concentration indicator is based on the annual average of the hourly concentrations recorded at 6 monitoring stations in the Atlantic Canada region, 9 in the southern Quebec region, 10 in the southern Ontario region, 32 in the Prairies and northern Ontario region, 24 in British Columbia and 3 in the northern territories region. The comparison to the Canadian Ambient Air Quality Standard is provided for illustrative purposes. For more information, consult the Air quality indicator definitions in the Data sources and methods section.
**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal.

**Table A.19. Data for Figure 29. National average peak sulphur dioxide concentrations, Canada, 2006 to 2020**

| Year | Average peak (99th percentile) 1-hour concentration (ppb) | 10th percentile (ppb) | 90th percentile (ppb) |
|---|---|---|---|
| 2006 | 50.2 | 5.0 | 136.0 |
| 2007 | 44.8 | 5.0 | 81.0 |
| 2008 | 44.7 | 6.0 | 81.0 |
| 2009 | 41.3 | 5.0 | 89.0 |
| 2010 | 41.7 | 4.0 | 82.0 |
| 2011 | 28.2 | 5.0 | 67.0 |
| 2012 | 30.6 | 5.0 | 67.0 |
| 2013 | 30.0 | 4.0 | 71.0 |
| 2014 | 25.8 | 4.4 | 64.8 |
| 2015 | 23.6 | 3.0 | 60.2 |
| 2016 | 24.4 | 2.0 | 55.0 |
| 2017 | 24.0 | 2.6 | 64.0 |
| 2018 | 22.2 | 2.4 | 58.0 |
| 2019 | 20.1 | 2.7 | 45.9 |
| 2020 | 21.1 | 2.0 | 64.0 |
| **2020 standard** | **70** | n/a | n/a |
| **Annual trend** | **-2.11** | n/a | n/a |

**Note:** n/a = not applicable, ppb = parts per billion. The national average peak $SO_2$ concentration indicator is based on the annual 99th percentile of the daily maximum 1-hour average concentrations recorded at 84 monitoring stations across Canada. The comparison to the Canadian Ambient Air Quality Standard is provided for illustrative purposes only. For more information, consult the Air quality indicator definitions in the Data sources and methods section.
**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal.

**Table A.20. Data for Figure 30. Regional average peak sulphur dioxide concentrations, Canada, 2006 to 2020**

| Year | Atlantic Canada | | | Southern Quebec | | |
|---|---|---|---|---|---|---|
| | Average peak (99th percentile) 1-hour concentration (ppb) | 10th percentile (ppb) | 90th percentile (ppb) | Average peak (99th percentile) 1-hour concentration (ppb) | 10th percentile (ppb) | 90th percentile (ppb) |
| 2006 | 69.7 | 10.0 | 141.0 | 76.4 | 10.0 | 178.0 |
| 2007 | 56.5 | 9.0 | 113.0 | 57.5 | 9.0 | 188.0 |
| 2008 | 36.8 | 9.0 | 86.0 | 53.1 | 7.0 | 163.0 |
| 2009 | 56.2 | 11.0 | 160.0 | 52.9 | 5.0 | 133.0 |
| 2010 | 35.7 | 3.4 | 119.1 | 73.3 | 4.0 | 218.0 |
| 2011 | 20.5 | 6.7 | 38.8 | 39.2 | 7.0 | 118.0 |
| 2012 | 28.4 | 4.4 | 52.1 | 46.9 | 6.0 | 121.0 |
| 2013 | 30.5 | 6.5 | 60.9 | 40.8 | 3.1 | 95.6 |
| 2014 | 32.2 | 6.7 | 70.3 | 37.2 | 4.4 | 111.8 |
| 2015 | 22.8 | 5.8 | 46.9 | 34.2 | 5.2 | 100.6 |
| 2016 | 20.8 | 5.7 | 54.1 | 35.7 | 5.2 | 102.0 |
| 2017 | 15.3 | 2.3 | 47.4 | 28.3 | 4.0 | 87.8 |
| 2018 | 27.7 | 5.8 | 67.0 | 30.2 | 2.4 | 93.0 |
| 2019 | 18.6 | 5.1 | 44.1 | 32.7 | 5.7 | 88.8 |
| 2020 | 22.0 | 4.5 | 63.0 | 32.5 | 4.9 | 100.1 |
| **2020 standard** | **70** | n/a | n/a | **70** | n/a | n/a |
| **Annual trend** | **-2.61** | n/a | n/a | **-2.51** | n/a | n/a |

| Year | Southern Ontario | | | Prairies and northern Ontario | | |
|---|---|---|---|---|---|---|
| | Average peak (99th percentile) 1-hour concentration (ppb) | 10th percentile (ppb) | 90th percentile (ppb) | Average peak (99th Percentile) 1-hour concentration (ppb) | 10th percentile (ppb) | 90th percentile (ppb) |
| 2006 | 76.9 | 17.0 | 197.0 | 43.8 | 6.0 | 82.0 |
| 2007 | 63.3 | 14.0 | 152.0 | 49.2 | 4.0 | 75.0 |
| 2008 | 62.0 | 11.0 | 159.0 | 45.1 | 5.0 | 64.0 |
| 2009 | 48.9 | 12.0 | 120.0 | 38.7 | 5.0 | 61.0 |
| 2010 | 49.7 | 4.0 | 103.0 | 39.4 | 4.0 | 66.0 |
| 2011 | 50.6 | 4.0 | 87.0 | 18.3 | 5.0 | 39.5 |
| 2012 | 50.2 | 5.0 | 105.0 | 19.3 | 3.0 | 56.0 |
| 2013 | 53.4 | 5.1 | 149.6 | 21.4 | 4.0 | 48.0 |
| 2014 | 54.5 | 6.2 | 168.1 | 17.3 | 4.0 | 36.0 |
| 2015 | 46.9 | 6.1 | 133.0 | 17.0 | 3.0 | 36.0 |
| 2016 | 40.5 | 5.4 | 165.6 | 22.5 | 2.0 | 55.0 |
| 2017 | 35.7 | 2.6 | 90.6 | 22.6 | 3.0 | 59.0 |
| 2018 | 36.8 | 2.3 | 106.3 | 18.8 | 2.5 | 38.0 |
| 2019 | 34.5 | 1.5 | 82.4 | 17.5 | 2.0 | 27.0 |
| 2020 | 29.5 | 2.2 | 72.6 | 20.9 | 4.0 | 64.0 |
| **2020 standard** | **70** | n/a | n/a | **70** | n/a | n/a |
| **Annual trend** | **-2.50** | n/a | n/a | **-2.02** | n/a | n/a |

| Year | British Columbia | | | Northern territories | | |
|---|---|---|---|---|---|---|
| | Average peak (99th percentile) 1-hour concentration (ppb) | 10th percentile (ppb) | 90th percentile (ppb) | Average peak (99th percentile) 1-hour concentration (ppb) | 10th percentile (ppb) | 90th percentile (ppb) |
| 2006 | 41.6 | 4.0 | 60.0 | 2.3 | 2.0 | 3.0 |
| 2007 | 29.9 | 5.0 | 57.0 | 2.0 | 1.0 | 3.0 |
| 2008 | 39.7 | 7.0 | 60.0 | 2.7 | 2.0 | 3.0 |
| 2009 | 39.3 | 6.0 | 86.0 | 2.7 | 2.0 | 4.0 |
| 2010 | 33.9 | 3.8 | 59.9 | 3.0 | 2.0 | 4.0 |
| 2011 | 30.9 | 3.8 | 60.1 | 2.0 | 1.8 | 2.1 |
| 2012 | 32.2 | 5.0 | 65.4 | 2.8 | 2.8 | 2.8 |
| 2013 | 30.3 | 4.1 | 65.6 | 2.0 | 1.9 | 2.0 |
| 2014 | 20.5 | 4.4 | 51.5 | 1.8 | 1.0 | 2.5 |
| 2015 | 21.6 | 3.6 | 50.8 | 1.7 | 1.1 | 2.3 |
| 2016 | 20.0 | 3.1 | 32.2 | 1.3 | 0.9 | 2.0 |
| 2017 | 23.8 | 3.6 | 38.9 | 1.3 | 1.1 | 1.4 |
| 2018 | 19.0 | 3.0 | 56.1 | 1.1 | 0.9 | 1.3 |
| 2019 | 15.7 | 3.0 | 31.2 | 0.8 | 0.7 | 1.0 |
| 2020 | 16.1 | 1.9 | 31.9 | 1.0 | 0.9 | 1.1 |
| **2020 standard** | **70** | n/a | n/a | **70** | n/a | n/a |
| **Annual trend** | **-1.87** | n/a | n/a | **-0.14** | n/a | n/a |

**Note:** n/a = not applicable, ppb = parts per billion. The regional average peak $SO_2$ concentration indicator is based on the annual 99th percentile of the daily maximum 1-hour average concentrations recorded at 6 monitoring stations in the Atlantic Canada region, 9 in the southern Quebec region, 10 in the southern Ontario region, 32 in the Prairies and northern Ontario region, 24 in British Columbia and 3 in the northern territories region. The comparison to the Canadian Ambient Air Quality Standard is provided for illustrative purposes only and should not be used for evaluating overall air quality in Canada. For more information, consult the Air quality indicator definitions in the Data sources and methods section.
**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal.

**Table A.21. Data for Figure 32. National average volatile organic compound concentrations, Canada, 2006 to 2019**

| Year | Average concentration (ppbC) | 10th percentile (ppbC) | 90th percentile (ppbC) |
|---|---|---|---|
| 2006 | 106.9 | 40.7 | 281.9 |
| 2007 | 101.8 | 34.5 | 173.8 |
| 2008 | 101.5 | 34.0 | 309.5 |
| 2009 | 103.0 | 31.1 | 310.1 |
| 2010 | 89.6 | 25.1 | 231.0 |
| 2011 | 87.6 | 29.7 | 201.3 |
| 2012 | 74.2 | 25.3 | 266.3 |
| 2013 | 75.1 | 27.5 | 258.0 |
| 2014 | 76.0 | 25.4 | 241.0 |
| 2015 | 75.8 | 28.2 | 222.7 |
| 2016 | 63.8 | 25.6 | 176.1 |
| 2017 | 72.5 | 25.8 | 249.3 |
| 2018 | 63.5 | 21.3 | 102.1 |
| 2019 | 65.5 | 20.0 | 231.4 |
| **Annual trend** | **-3.48** | n/a | n/a |

**Note:** n/a = not applicable, ppbC = parts per billion Carbon. VOC sampling in 2020 was limited and no station met the data completeness criteria for that year. Therefore, no VOC concentration is being reported for 2020 in this indicator. The national average VOC concentration indicator is based on the annual average of the daily time-integrated concentrations (24-hour for urban stations and 4-hour for rural stations) recorded at 30 monitoring stations across Canada. For more information, consult the Air quality indicator definitions in the Data sources and methods section.
**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal.

**Table A.22. Data for Figure** 33**. Regional average volatile organic compound concentrations, Canada, 2006 to 2019**

| Year | Atlantic Canada | | | Southern Quebec | | |
|---|---|---|---|---|---|---|
| | Average concentration (ppbC) | 10th percentile (ppbC) | 90th percentile (ppbC) | Average concentration (ppbC) | 10th percentile (ppbC) | 90th percentile (ppbC) |
| 2006 | 153.7 | 77.9 | 281.9 | 91.5 | 46.3 | 137.3 |
| 2007 | 69.4 | 45.3 | 104.1 | 91.9 | 37.1 | 157.3 |
| 2008 | 131.1 | 48.3 | 309.5 | 71.9 | 38.5 | 103.7 |
| 2009 | 127.6 | 46.8 | 314.9 | 59.6 | 32.8 | 94.4 |
| 2010 | 99.9 | 40.3 | 231.0 | 64.0 | 37.9 | 98.8 |
| 2011 | 85.8 | 38.0 | 201.3 | 54.0 | 31.6 | 77.5 |
| 2012 | 117.7 | 38.7 | 294.3 | 50.8 | 29.9 | 69.6 |
| 2013 | 100.1 | 41.1 | 258.0 | 47.1 | 27.6 | 73.6 |
| 2014 | 103.0 | 51.6 | 241.0 | 47.5 | 27.7 | 77.7 |
| 2015 | 97.8 | 47.4 | 222.7 | 49.7 | 28.2 | 89.4 |
| 2016 | 79.4 | 37.1 | 176.1 | 44.2 | 26.9 | 67.8 |
| 2017 | 121.8 | 34.4 | 315.0 | 44.4 | 25.8 | 68.9 |
| 2018 | 57.7 | 31.5 | 102.0 | 43.5 | 21.3 | 60.7 |
| 2019 | 94.1 | 36.4 | 231.4 | 35.9 | 23.4 | 53.7 |
| **Annual trend** | **-3.42** | n/a | n/a | **-3.14** | n/a | n/a |

| Year | Southern Ontario | | | Prairies and northern Ontario | | |
|---|---|---|---|---|---|---|
| | Average concentration (ppbC) | 10th percentile (ppbC) | 90th percentile (ppbC) | Average concentration (ppbC) | 10th percentile (ppbC) | 90th percentile (ppbC) |
| 2006 | 53.1 | 19.9 | 89.6 | 134.2 | 55.9 | 373.6 |
| 2007 | 50.6 | 19.2 | 98.0 | 117.5 | 53.2 | 308.6 |
| 2008 | 39.1 | 18.5 | 56.6 | 145.4 | 42.2 | 467.4 |
| 2009 | 36.7 | 18.9 | 54.5 | 117.2 | 42.0 | 310.1 |
| 2010 | 37.1 | 18.0 | 63.3 | 106.8 | 39.7 | 271.3 |
| 2011 | 22.3 | 17.4 | 27.2 | 106.7 | 42.5 | 260.4 |
| 2012 | 37.6 | 18.8 | 77.0 | 105.2 | 39.5 | 266.3 |
| 2013 | 36.9 | 19.4 | 68.3 | 114.5 | 37.3 | 290.5 |
| 2014 | 37.1 | 20.2 | 70.4 | 107.4 | 44.0 | 292.2 |
| 2015 | 44.4 | 20.2 | 96.8 | 101.4 | 38.1 | 268.9 |
| 2016 | 35.8 | 19.8 | 52.5 | 93.7 | 31.9 | 256.6 |
| 2017 | 30.6 | 16.8 | 47.3 | 89.3 | 30.0 | 249.3 |
| 2018 | 30.1 | 15.6 | 44.3 | 99.9 | 36.7 | 254.2 |
| 2019 | 27.3 | 15.5 | 40.6 | 96.3 | 32.1 | 275.6 |
| **Annual trend** | **-1.09** | n/a | n/a | **-2.81** | n/a | n/a |

| Year | British Columbia | | |
|---|---|---|---|
| | Average concentration (ppbC) | 10th percentile (ppbC) | 90th percentile (ppbC) |
| 2006 | 154.6 | 45.8 | 471.0 |
| 2007 | 190.1 | 38.2 | 654.6 |
| 2008 | 147.5 | 37.6 | 492.7 |
| 2009 | 195.4 | 36.7 | 736.1 |
| 2010 | 172.8 | 26.9 | 689.3 |
| 2011 | 128.4 | 29.7 | 405.3 |
| 2012 | 97.6 | 29.3 | 288.8 |
| 2013 | 117.8 | 46.2 | 361.3 |
| 2014 | 118.5 | 35.4 | 386.6 |
| 2015 | 113.3 | 35.9 | 353.6 |
| 2016 | 90.4 | 25.6 | 262.1 |
| 2017 | 125.3 | 32.2 | 371.4 |
| 2018 | 108.2 | 26.8 | 277.8 |
| 2019 | 102.4 | 25.6 | 301.8 |
| **Annual trend** | **-5.27** | n/a | n/a |

**Note:** n/a = not applicable, ppbC = parts per billion Carbon. VOC sampling in 2020 was limited and no station met the data completeness criteria for that year. Therefore, no VOC concentration is being reported for 2020 in this indicator. The average VOC concentration indicator is based on the annual average of the daily time-integrated concentrations (24-hour for urban stations and 4-hour for rural stations) recorded at 4 monitoring stations in the Atlantic Canada region, 6 in the southern Quebec region, 9 in the southern Ontario region, 5 in the Prairies and northern Ontario region and 6 in British Columbia. There were not enough stations to report results for the northern territories region. For more information, consult the Air quality indicator definitions in the Data sources and methods section.
**Source:** Environment and Climate Change Canada (2023) National Air Pollution Surveillance (NAPS) Program - Open Government Portal.

## Annex B. Fine particulate matter measurement technological transition

Several types of equipment are used to monitor ambient $PM_{2.5}$ concentrations:

$PM_{2.5}$ Pre-Federal Equivalency Method (FEM) and Non-Federal Equivalency Method Instruments

- Non-FEM: Rupprecht & Patashnick tapered element oscillating microbalance (TEOM) monitor or TEOM® Series 1400/1400a with sample equilibrium system (SES) monitor.
- Pre-FEM: Met One BAM-1020 Beta Attenuation Mass monitor (prior to 2008)
- Pre-FEM: Thermo Scientific TEOM 1400a with the Series 8500C Filter Dynamics Measurement System (FDMS) monitor (prior to 2010)
  Pre-FEM: Thermo Scientific 5030 SHARP (Synchronized Hybrid Ambient Realtime Particulate) monitor (prior to 2010)

$PM_{2.5}$ Designated Federal Equivalency Method (FEM) Instruments

- FEM: Thermo Scientific TEOM 1400a with the Series 8500C Filter Dynamics Measurement System (FDMS) monitor
- FEM: Met One BAM-1020 Beta Attenuation Mass monitor
- FEM: Thermo Scientific 5030 or 5030i SHARP (Synchronized Hybrid Ambient Realtime Particulate) monitor
- FEM: GRIMM Environmental Dust Monitor model EDM 180
- FEM: Teledyne Advanced Pollution Instrumentation Model T640 PM mass monitor

The Thermo Scientific TEOM 1400a with 8500C FDMS (2010), Met One BAM-1020 (2008), Thermo Scientific SHARP (2010), GRIMM 180 (2011) and Teledyne T640 (2016) monitors have been approved by the United States Environmental Protection Agency as Class III Federal Equivalent Methods and have been deployed across the National Air Pollution Surveillance network replacing non-FEM tapered element oscillating microbalance instruments, which in some circumstances may under report the $PM_{2.5}$ mass concentrations relative to the National Air Pollution Surveillance $PM_{2.5}$ Reference Method. Since 2005, the tapered element oscillating microbalance monitors have gradually been replaced by the federal equivalent methods monitors. The federal equivalent methods monitors measure a portion (semi-volatile) of the $PM_{2.5}$ mass not captured by the older instruments. Because of these measurement differences between the new and the old monitoring equipment, concentrations measured with the new monitors may not be directly comparable with the measurements from years in which older instruments were used. The following table lists the stations used for the national and regional indicators that are operating with new technologies, along with the type of equipment and the year started.

**Table B.1. Stations included in the national and regional indicators that use new monitoring technologies for fine particulate matter**

| NAPS ID | Province or territory | Location | Monitor, year started |
|---|---|---|---|
| 10102 | Newfoundland and Labrador | St. John's | TEOM, 2006; BAM35, 2009; T640, 2019 |
| 10301 | Newfoundland and Labrador | Corner Brook | TEOM, 2006 |
| 10401 | Newfoundland and Labrador | Mount Pearl | TEOM, 2006; BAM35, 2009; T640, 2020 |
| 10602 | Newfoundland and Labrador | Corner Brook | BAM35, 2009; T640, 2020 |
| 30120 | Nova Scotia | Halifax | TEOM-SES, 2006; BAM35, 2007; T640, 2019 |
| 30310 | Nova Scotia | Sydney | TEOM, 2006; BAM35, 2010; T640, 2019 |
| 30901 | Nova Scotia | Pictou | BAM, 2006; BAM35, 2007; T640, 2019 |
| 40103 | New Brunswick | Fredericton | TEOM, 2006; BAM35, 2007 |
| 40104 | New Brunswick | Fredericton | BAM35, 2017; T640, 2019 |
| 40203 | New Brunswick | Saint John | BAM, 2006; BAM35, 2006; T640, 2018 |
| 40207 | New Brunswick | Saint John | BAM, 2006; BAM35, 2006; T640, 2019 |
| 40302 | New Brunswick | Moncton | TEOM, 2006; BAM35, 2007; T640, 2019 |
| 40901 | New Brunswick | Saint Andrews | TEOM, 2006; BAM35, 2007; T640, 2019 |
| 41302 | New Brunswick | Bathurst | TEOM, 2006; BAM35, 2007; T640, 2019 |
| 50103 | Quebec | Montreal | TEOM-SES, 2006; TEOM-FDMS, 2007; SHARP5030, 2016 |
| 50105 | Quebec | Montreal | TEOM-SES, 2006; TEOM-FDMS, 2007 |
| 50109 | Quebec | Montreal | TEOM-SES, 2006; TEOM-FDMS, 2008; SHARP5030, 2016 |
| 50110 | Quebec | Montreal | TEOM-SES, 2006; TEOM-FDMS, 2008 |
| 50113 | Quebec | Laval | TEOM-SES, 2006; BAM35, 2008; T640, 2018 |
| 50119 | Quebec | Longueuil | TEOM-SES, 2006; BAM35, 2008; T640, 2018 |
| 50121 | Quebec | Brossard | TEOM-SES, 2006; BAM35, 2008 |
| 50122 | Quebec | Brossard | BAM35, 2016; T640, 2018 |
| 50126 | Quebec | Montreal | TEOM-SES, 2006; TEOM-FDMS, 2008; SHARP5030, 2016 |
| 50128 | Quebec | Montreal | TEOM-SES, 2006; TEOM-FDMS, 2008; SHARP5030, 2016 |
| 50129 | Quebec | Montreal | TEOM-SES, 2006; TEOM-FDMS, 2008; SHARP5030, 2014 |
| 50131 | Quebec | Montreal | TEOM-SES, 2006; TEOM-FDMS, 2007; GRIM, 2016 |
| 50135 | Quebec | Montreal | TEOM-SES, 2013; SHARP5030, 2016 |
| 50136 | Quebec | Montreal | SHARP5030, 2016 |
| 50204 | Quebec | Gatineau | TEOM-SES, 2006; BAM35, 2009; T640, 2019 |
| 50308 | Quebec | Quebec | TEOM-SES, 2006; BAM35, 2009; T640, 2018 |
| 50310 | Quebec | Quebec | TEOM-SES, 2006; BAM35, 2009; T640, 2018 |
| 50311 | Quebec | Quebec | BAM35, 2006; T640, 2018 |
| 50404 | Quebec | Sherbrooke | TEOM-SES, 2006; BAM35, 2008; T640, 2018 |
| 50504 | Quebec | Saguenay | TEOM-SES, 2006; BAM35, 2009; T640, 2018 |
| 50604 | Quebec | Rouyn-Noranda | BAM35, 2006; T640, 2019 |
| 50801 | Quebec | Trois-Rivières | TEOM-SES, 2006; BAM35, 2008 |
| 50802 | Quebec | Trois-Rivières | BAM35, 2011 |
| 50803 | Quebec | Trois-Rivières | BAM35, 2014; T640, 2018 |
| 51501 | Quebec | St. Zephirin-de-Courval | BAM35, 2006; T640, 2019 |
| 52001 | Quebec | Charette | BAM35, 2006; T640, 2019 |
| 52201 | Quebec | Saint-Simon | BAM35, 2006; T640, 2020 |
| 52301 | Quebec | Saint-Faustin-Lac-Carré | BAM35, 2006; T640, 2019 |
| 52401 | Quebec | La Pêche | BAM35, 2006; T640, 2019 |
| 52801 | Quebec | Auclair | BAM35, 2006; T640, 2018 |
| 53201 | Quebec | La Doré | BAM35, 2006; T640, 2020 |
| 53301 | Quebec | Deschambault | BAM35, 2006; T640, 2018 |

| NAPS ID | Province or territory | Location | Monitor, year started |
|---|---|---|---|
| 53601 | Quebec | Notre-Dame-du-Rosaire | BAM35, 2006; T640, 2020 |
| 53701 | Quebec | St-Hilaire-de-Dorset | BAM35, 2006; T640, 2018 |
| 53801 | Quebec | Tingwick | BAM35, 2006; T640, 2019 |
| 53901 | Quebec | Lac Edouard | BAM35, 2006; T640, 2020 |
| 54401 | Quebec | Saint-Anicet | BAM35, 2006; T640, 2019 |
| 54901 | Quebec | La Patrie | BAM35, 2006; T640, 2019 |
| 55001 | Quebec | Ferme Neuve | BAM35, 2006; T640, 2020 |
| 55101 | Quebec | Senneterre | BAM35, 2006; T640, 2019 |
| 55301 | Quebec | Saint-Jean-sur-Richelieu | BAM35, 2006; T640, 2019 |
| 60104 | Ontario | Ottawa | TEOM-SES, 2006; SHARP5030, 2013 |
| 60204 | Ontario | Windsor | TEOM-SES, 2006; SHARP5030, 2013 |
| 60211 | Ontario | Windsor | TEOM-SES, 2006; SHARP5030, 2013 |
| 60303 | Ontario | Kingston | TEOM-SES, 2007; SHARP5030, 2013 |
| 60304 | Ontario | Kingston | SHARP5030, 2014 |
| 60410 | Ontario | Toronto | TEOM-SES, 2006; SHARP5030, 2013 |
| 60421 | Ontario | Toronto | TEOM-SES, 2006; SHARP5030, 2013 |
| 60428 | Ontario | Brampton | TEOM-SES, 2006; SHARP5030, 2013 |
| 60429 | Ontario | Toronto | TEOM-SES, 2006 |
| 60430 | Ontario | Toronto | TEOM-SES, 2006; SHARP5030, 2013 |
| 60432 | Ontario | Mississauga | TEOM-SES, 2006 |
| 60433 | Ontario | Toronto | TEOM-SES, 2006; SHARP5030, 2013 |
| 60434 | Ontario | Mississauga | TEOM-SES, 2008; SHARP5030, 2013 |
| 60435 | Ontario | Toronto | TEOM-SES, 2010; SHARP5030, 2013 |
| 60440 | Ontario | Toronto | SHARP5030, 2017 |
| 60450 | Ontario | Brampton | SHARP5030, 2017 |
| 60512 | Ontario | Hamilton | TEOM-SES, 2006; SHARP5030, 2013 |
| 60513 | Ontario | Hamilton | TEOM-SES, 2006; SHARP5030, 2013 |
| 60521 | Ontario | Hamilton | SHARP5030, 2019 |
| 60609 | Ontario | Sudbury | TEOM-SES, 2006 |
| 60610 | Ontario | Sudbury | SHARP5030, 2013 |
| 60709 | Ontario | Sault Ste. Marie | TEOM-SES, 2006; SHARP5030, 2013 |
| 60809 | Ontario | Thunder Bay | TEOM-SES, 2006; SHARP5030, 2013 |
| 60903 | Ontario | London | TEOM-SES, 2006 |
| 60904 | Ontario | London | SHARP5030, 2013 |
| 61004 | Ontario | Sarnia | TEOM-SES, 2006; SHARP5030, 2013 |
| 61009 | Ontario | Sarnia | SHARP5030, 2016 |
| 61104 | Ontario | Peterborough | TEOM-SES, 2006; SHARP5030, 2013 |
| 61201 | Ontario | Cornwall | TEOM-SES, 2006; SHARP5030, 2013 |
| 61302 | Ontario | St. Catharines | TEOM-SES, 2006; SHARP5030, 2013 |
| 61402 | Ontario | Brantford | TEOM-SES, 2006; SHARP5030, 2013 |
| 61502 | Ontario | Kitchener | TEOM-SES, 2006; SHARP5030, 2013 |
| 61603 | Ontario | Oakville | TEOM-SES, 2006; SHARP5030, 2013 |
| 61702 | Ontario | Oshawa | TEOM-SES, 2006; SHARP5030, 2013 |
| 61703 | Ontario | Oshawa | SHARP5030, 2018 |
| 61802 | Ontario | Guelph | TEOM-SES, 2006; SHARP5030, 2013 |
| 62001 | Ontario | North Bay | TEOM-SES, 2006; SHARP5030, 2013 |
| 62501 | Ontario | Tiverton | TEOM-SES, 2006; SHARP5030, 2013 |
| 62601 | Ontario | Simcoe | TEOM-SES, 2006; SHARP5030, 2013 |
| 63001 | Ontario | Burlington | TEOM-SES, 2006; SHARP5030, 2013 |
| 63301 | Ontario | Dorset | TEOM-SES, 2006; SHARP5030, 2013 |
| 63701 | Ontario | Grand Bend | TEOM-SES, 2006; SHARP5030, 2013 |
| 65001 | Ontario | Barrie | TEOM-SES, 2006; SHARP5030, 2013 |

| NAPS ID | Province or territory | Location | Monitor, year started |
|---|---|---|---|
| 65101 | Ontario | Newmarket | TEOM-SES, 2006; SHARP5030, 2013 |
| 65201 | Ontario | Parry Sound | TEOM-SES, 2006; SHARP5030, 2013 |
| 65301 | Ontario | Port Stanley | TEOM-SES, 2006; SHARP5030, 2013 |
| 65401 | Ontario | Belleville | TEOM-SES, 2006; SHARP5030, 2013 |
| 65801 | Ontario | Chatham | TEOM-SES, 2006; SHARP5030, 2013 |
| 66201 | Ontario | Petawawa | TEOM-SES, 2007; SHARP5030, 2013 |
| 70118 | Manitoba | Winnipeg | TEOM, 2006; SHARP5030, 2011 |
| 70119 | Manitoba | Winnipeg | TEOM, 2006; SHARP5030, 2011; TEOM, 2012; SHARP5030, 2013 |
| 70203 | Manitoba | Brandon | TEOM, 2006; SHARP5030, 2011 |
| 80110 | Saskatchewan | Regina | TEOM, 2006; BAM35, 2009 |
| 80111 | Saskatchewan | Regina | BAM35, 2011; T640, 2019 |
| 80211 | Saskatchewan | Saskatoon | TEOM, 2006; BAM35, 2013; T640, 2018 |
| 90120 | Alberta | Edmonton | TEOM-SES, 2006; TEOM, 2009; TEOM-FDMS, 2010; BAM35, 2016; SHARP5030, 2016 |
| 90121 | Alberta | Edmonton | TEOM-SES, 2006; TEOM, 2009; TEOM-FDMS, 2010; SHARP5030, 2015 |
| 90130 | Alberta | Edmonton | TEOM-SES, 2006; TEOM, 2009; TEOM-FDMS, 2010 |
| 90132 | Alberta | Edmonton | BAM35, 2008; TEOM-FDMS, 2009; BAM35, 2010; TEOM-FDMS, 2014; BAM35, 2015 |
| 90227 | Alberta | Calgary | TEOM-SES, 2006 |
| 90228 | Alberta | Calgary | TEOM, 2008; TEOM-FDMS, 2010; BAM35, 2012 |
| 90230 | Alberta | Calgary | BAM35, 2015; SHARP5030, 2015 |
| 90302 | Alberta | Red Deer | TEOM, 2006; TEOM-FDMS, 2010; SHARP5030, 2013 |
| 90402 | Alberta | Medicine Hat | TEOM, 2006; TEOM-FDMS, 2010; SHARP5030, 2013 |
| 90502 | Alberta | Lethbridge | TEOM-SES, 2006; TEOM, 2009; TEOM-SES, 2010; TEOM-FDMS, 2012; SHARP5030, 2016 |
| 90601 | Alberta | Fort Saskatchewan | TEOM, 2006; TEOM-SES, 2010; SHARP5030, 2013; T640, 2020 |
| 90701 | Alberta | Fort McMurray | TEOM, 2006; SHARP5030, 2012; T640, 2020 |
| 90702 | Alberta | Fort McMurray | TEOM, 2006; TEOM-SES, 2012; SHARP5030, 2013; T640, 2019 |
| 90801 | Alberta | Fort Mackay | TEOM, 2006; TEOM-SES, 2010; SHARP5030, 2011; T640, 2019 |
| 90806 | Alberta | Fort Mackay | TEOM, 2006; TEOM-SES, 2010; SHARP5030, 2012; T640, 2019; |
| 91101 | Alberta | Elk Island | TEOM, 2007; TEOM-SES, 2010; SHARP5030, 2013; T640, 2020 |
| 91301 | Alberta | Tomahawk | TEOM, 2006; TEOM-SES, 2010; SHARP5030, 2015 |
| 91501 | Alberta | Beaverlodge | TEOM, 2006; TEOM-FDMS, 2009; SHARP5030, 2014 |
| 91801 | Alberta | Fort Chipewyan | TEOM, 2006; TEOM-SES, 2010; SHARP5030, 2013; T640, 2020 |
| 91901 | Alberta | Caroline | TEOM, 2006; BAM35, 2010; SHARP5030, 2015 |
| 92001 | Alberta | Grande Prairie | TEOM, 2006; TEOM-FDMS, 2010; SHARP5030, 2012 |
| 92201 | Alberta | Lamont | BAM35, 2006; SHARP5030, 2014 |
| 92801 | Alberta | Drayton Valley | TEOM, 2006; SHARP5030, 2015 |
| 92901 | Alberta | Edson | TEOM, 2006; SHARP, 2020 |
| 93001 | Alberta | Evergreen Park | TEOM, 2006; SHARP, 2015 |
| 93101 | Alberta | Genesee | TEOM, 2006; SHARP5030, 2017 |
| 93901 | Alberta | Thorsby | TEOM, 2006; SHARP5030, 2019 |
| 94001 | Alberta | Debolt | TEOM, 2006; TEOM-SES, 2010; SHARP5030, 2015 |
| 94601 | Alberta | Anzac | TEOM-SES, 2006; SHARP5030, 2011; T640, 2020 |
| 100110 | British Columbia | Burnaby | TEOM-SES, 2006; SHARP5030, 2013 |
| 100111 | British Columbia | Port Moody | TEOM-SES, 2006; SHARP5030, 2013 |
| 100119 | British Columbia | Burnaby | TEOM-SES, 2006; SHARP5030, 2013 |
| 100134 | British Columbia | Richmond | TEOM-SES, 2006; SHARP5030, 2013 |
| 100138 | British Columbia | Vancouver | TEOM-SES, 2006; SHARP5030, 2013 |
| 100202 | British Columbia | Prince George | TEOM, 2006; SHARP5030, 2014 |
| 100304 | British Columbia | Victoria | TEOM, 2006; BAM35, 2010 |
| 100401 | British Columbia | Kamloops | BAM35, 2010; SHARP5030, 2017 |
| 100402 | British Columbia | Kamloops | TEOM, 2006 |

| NAPS ID | Province or territory | Location | Monitor, year started |
|---|---|---|---|
| 100701 | British Columbia | Kelowna | TEOM, 2006; SHARP5030, 2015 |
| 100703 | British Columbia | Kelowna | SHARP5030, 2019 |
| 101004 | British Columbia | Abbotsford | TEOM-SES, 2006 |
| 101005 | British Columbia | Abbotsford | SHARP5030, 2012 |
| 101101 | British Columbia | Chilliwack | TEOM-SES, 2006; SHARP5030, 2013 |
| 101202 | British Columbia | Pitt Meadows | TEOM-SES, 2006; SHARP5030, 2013 |
| 101301 | British Columbia | Langley | TEOM-SES, 2006; SHARP5030, 2013 |
| 101401 | British Columbia | Hope | TEOM-SES, 2006; SHARP5030, 2013 |
| 101701 | British Columbia | Quesnel | TEOM, 2006; SHARP5030, 2014 |
| 101705 | British Columbia | Quesnel | SHARP5030, 2020 |
| 102102 | British Columbia | Nanaimo | TEOM, 2006; BAM35, 2014 |
| 102401 | British Columbia | Smithers | TEOM-SES, 2006; SHARP5030, 2013 |
| 102402 | British Columbia | Smithers | SHARP5030, 2019 |
| 102701 | British Columbia | Williams Lake | TEOM, 2006; SHARP5030, 2014 |
| 102801 | British Columbia | Campbell River | TEOM, 2006; BAM35, 2014 |
| 103202 | British Columbia | Golden | TEOM, 2006; SHARP5030, 2015 |
| 103901 | British Columbia | Kitimat | TEOM, 2006; BAM35, 2014 |
| 104003 | British Columbia | Vernon | TEOM, 2006; SHARP5030, 2015 |
| 105001 | British Columbia | Whistler | TEOM, 2007; BAM35, 2015 |
| 105101 | British Columbia | Houston | TEOM, 2006; SHARP5030, 2014 |
| 105201 | British Columbia | Burns Lake | TEOM, 2006; SHARP5030, 2014 |
| 119003 | Yukon | Whitehorse | TEOM, 2007 |
| 119004 | Yukon | Whitehorse | SHARP5030, 2012; BAM35, 2015; T640, 2019 |
| 129003 | Northwest territories | Yellowknife | BAM35, 2006; T640, 2019 |
| 129202 | Northwest territories | Inuvik | BAM35, 2006 |
| 129203 | Northwest territories | Inuvik | BAM35, 2011 |

# Annex C. Volatile organic compounds targeted for quantification

**Table C.1. Volatile organic compounds targeted for quantification**

| Compound | CAS registry number |
|---|---|
| 1,2,3-Trimethylbenzene | 526-73-8 |
| 1,2,4-Trimethylbenzene | 95-63-6 |
| 1,3,5-Trimethylbenzene | 108-67-8 |
| 1,3-Butadiene | 106-99-0 |
| 1,3-Diethylbenzene | 141-93-5 |
| 1,4-Diethylbenzene | 105-05-5 |
| 1-Butene/Isobutene | 115-11-7 |
| 1-Heptene | 592-76-7 |
| 1-Hexene/2-Methyl-1-Pentene | 592-41-6/763-29-1 |
| 1-Pentene | 109-67-1 |
| 2,2,4-Trimethylpentane | 540-84-1 |
| 2,2-Dimethylbutane | 75-83-2 |
| 2,3,4-Trimethylpentane | 565-75-3 |
| 2,3-Dimethylbutane | 79-29-8 |
| 2,3-Dimethylpentane | 565-59-3 |
| 2,4-Dimethylhexane | 589-43-5 |
| 2,4-Dimethylpentane | 108-08-7 |
| 2,5-Dimethylhexane | 592-13-2 |
| 2-Ethyltoluene | 611-14-3 |
| 2-Methyl-2-butene | 513-35-9 |
| 2-Methylheptane | 592-27-8 |
| 2-Methylhexane | 591-76-4 |
| 2-Methylpentane | 107-83-5 |
| 3-Ethyltoluene | 620-14-4 |
| 3-Methyl-1-Butene | 563-45-1 |
| 3-Methylheptane | 589-81-1 |
| 3-Methylhexane | 589-34-4 |
| 3-Methylpentane | 96-14-0 |
| 4-Ethyltoluene | 622-96-8 |
| 4-Methylheptane | 589-53-7 |
| Acetylene | 74-86-2 |

| Compound | CAS registry number |
|---|---|
| a-Pinene | 80-56-8 |
| Benzene | 71-43-2 |
| b-Pinene | 127-91-3 |
| Butane | 106-97-8 |
| Camphene | 79-92-5 |
| cis-1,2-Dimethylcyclohexane | 2207-01-4 |
| cis-2-Butene | 590-18-1 |
| cis-2-Hexene | 7688-21-3 |
| cis-2-Pentene | 627-20-3 |
| cis-3-Methyl-2-pentene | 922-61-2 |
| Cyclohexane | 110-82-7 |
| Cyclopentane | 287-92-3 |
| Decane | 124-18-5 |
| d-Limonene | 5989-27-5 |
| Dodecane | 112-40-3 |
| Ethane | 74-84-0 |
| Ethylbenzene | 100-41-4 |
| Ethylene | 74-85-1 |
| Heptane | 142-82-5 |
| Hexane | 110-54-3 |
| Indane | 496-11-7 |
| Isobutane | 75-28-5 |
| Isopentane | 78-78-4 |
| Isoprene | 78-79-5 |
| iso-Propylbenzene | 98-82-8 |
| m and p-Xylene | 108-38-3 |
| Methylcyclohexane | 108-87-2 |
| Methylcyclopentane | 96-37-7 |
| Naphthalene | 91-20-3 |
| Nonane | 111-84-2 |
| n-Propylbenzene | 103-65-1 |
| Octane | 111-65-9 |
| o-Xylene | 95-47-6 |

| Compound | CAS registry number |
|---|---|
| p-Cymene | 99-87-6 |
| Pentane | 109-66-0 |
| Propane | 74-98-6 |
| Propylene | 115-07-1 |
| Styrene | 100-42-5 |
| Toluene | 108-88-3 |
| trans-2-Butene | 624-64-6 |
| trans-2-Hexene | 4050-45-7 |
| trans-2-Octene | 13389-42-9 |
| trans-2-Pentene | 646-04-8 |
| trans-3-Methyl-2-pentene | 616-12-6 |
| trans-4-Methyl-2-pentene | 674-76-0 |
| Undecane | 1120-21-4 |

# Annex D. Mann-Kendall and Sen's pairwise statistical parameters used for the analysis of trends

**Table D.1. Legend for tables in Annex D**

| Field | Description |
|---|---|
| First year | Starting year of each time series. |
| Last year | Ending year of each time series. |
| n | Number of annual values in the calculation, excluding missing values. |
| Z-test | The absolute value of Z is compared to the standard normal cumulative distribution to define if there is a trend at the selected level α of significance. A positive (negative) value indicates an upward (downward) trend. |
| Significant | The smallest significance level α at which the test shows that the null hypothesis of no trend can be rejected. For the 3 tested significance levels, the following symbols are used:<br>[A] if trend at α = 0.001 level of significance,<br>[B] if trend at α = 0.01 level of significance, and<br>[C] if trend at α = 0.05 level of significance. |
| Q | Sen's estimator for the true slope of linear trend, that is, change per unit time period (in this case a year). |
| Qmin95 | The lower limit of the 95% confidence interval of Q (α = 0.05). |
| Qmax95 | The upper limit of the 95% confidence interval of Q (α = 0.05). |
| B | Estimate of the constant B for the linear trend. |
| Bmin95 | Estimate of the constant Bmin95 for 95% confidence level of a linear trend. |
| Bmax95 | Estimate of the constant Bmax95 for 95% confidence level of a linear trend. |
| Median change | Percent rate of change per year as described by the Sen’s estimator Q divided by the constant B for the linear trend. Slopes expressed in median annual percentage change are relative to the value in the first year of each time series |

**Table D. 2. Mann-Kendall and Sen's tests results for the national and regional average fine particulate matter indicators**

| Statistic | National | Atlantic Canada | Southern Quebec | Southern Ontario | Prairies and northern Ontario | British Columbia |
|---|---|---|---|---|---|---|
| First year | 2006 | 2006 | 2006 | 2006 | 2006 | 2006 |
| Last year | 2020 | 2020 | 2020 | 2020 | 2020 | 2020 |
| n | 15 | 15 | 15 | 15 | 15 | 15 |
| Z-test | 1.39 | 0.49 | -2.47 | 0 | 1.39 | 2.87 |
| **Significant** | **No** | **No** | **Yes[C]** | **No** | **No** | **Yes[B]** |
| **Q** | **0.07** | **0.03** | **-0.1132** | **0.0006** | **0.1244** | **0.2162** |
| Qmin95 | -0.0253 | -0.1094 | -0.1639 | -0.1696 | -0.0694 | 0.1051 |
| Qmax95 | 0.1376 | 0.1161 | -0.0224 | 0.1007 | 0.2868 | 0.3917 |
| B | 5.9588 | 5.1604 | 7.8933 | 6.4723 | 5.4995 | 4.4002 |
| Bmin95 | 6.4998 | 6.4126 | 8.4192 | 8.1742 | 7.1413 | 4.9777 |
| Bmax95 | 5.7142 | 4.7369 | 7.2433 | 5.5228 | 4.3189 | 3.6984 |
| Median change | 1.17% | 0.58% | -1.43% | 0.01% | 2.26% | 4.91% |

**Table D.3. Mann-Kendall and Sen's tests results for the national and regional average peak (98th percentile) 24hour fine particulate matter indicators**

| Statistic | National | Atlantic Canada | Southern Quebec | Southern Ontario | Prairies and northern Ontario | British Columbia | Northern territories |
|---|---|---|---|---|---|---|---|
| First year | 2006 | 2006 | 2006 | 2006 | 2006 | 2006 | 2006 |
| Last year | 2020 | 2020 | 2020 | 2020 | 2020 | 2020 | 2020 |
| N | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| Z-test | 0.69 | -2.28 | -2.97 | -2.28 | 2.18 | 2.08 | 1.39 |
| **Significant** | **No** | **Yes[C]** | **Yes[B]** | **Yes[C]** | **Yes[C]** | **Yes[C]** | **No** |
| **Q** | **0.1355** | **-0.3254** | **-0.422** | **-0.4225** | **0.9213** | **0.8425** | **0.4017** |
| Qmin95 | -0.1343 | -0.4957 | -0.6833 | -0.8471 | 0.1194 | 0.0262 | -0.2473 |
| Qmax95 | 0.8105 | -0.0725 | -0.2341 | -0.1057 | 2.0311 | 2.2347 | 1.1751 |
| B | 17.863 | 15.8692 | 22.75 | 22.6429 | 14.9108 | 13.4147 | 13.2817 |
| Bmin95 | 19.8978 | 17.2518 | 24.1069 | 25.5184 | 19.5784 | 15.8722 | 17.4418 |
| Bmax95 | 14.4285 | 14.8225 | 21.5352 | 19.7505 | 9.6312 | 3.3985 | 6.9159 |
| Median change | 0.76% | -2.05% | -1.86% | -1.87% | 6.18% | 6.28% | 3.02% |

**Table D.4. Mann-Kendall and Sen's tests results for the national and regional average ground-level ozone indicators**

| Statistic | National | Atlantic Canada | Southern Quebec | Southern Ontario | Prairies and northern Ontario | British Columbia |
|---|---|---|---|---|---|---|
| First year | 2006 | 2006 | 2006 | 2006 | 2006 | 2006 |
| Last year | 2020 | 2020 | 2020 | 2020 | 2020 | 2020 |
| n | 15 | 15 | 15 | 15 | 15 | 15 |
| Z-test | 0.99 | 1.68 | 2.57 | -1.29 | 0.79 | 0.1 |
| **Significant** | **No** | **Yes[C]** | **Yes[C]** | **No** | **No** | **No** |
| **Q** | **0.0391** | **0.072** | **0.2009** | **-0.1111** | **0.0525** | **0.0294** |
| Qmin95 | -0.0366 | -0.043 | 0.0487 | -0.2358 | -0.054 | -0.1278 |
| Qmax95 | 0.1125 | 0.1768 | 0.3045 | 0.0221 | 0.2235 | 0.1456 |
| B | 32.8974 | 32.7992 | 31.2778 | 37.6612 | 32.942 | 27.4591 |
| Bmin95 | 33.3835 | 33.719 | 32.6621 | 38.9154 | 33.7301 | 28.4963 |
| Bmax95 | 32.3837 | 31.9607 | 30.7595 | 36.4815 | 32.0655 | 26.6054 |
| Median change | 0.12% | 0.22% | 0.64% | -0.30% | 0.16% | 0.11% |

**Table D.5. Mann-Kendall and Sen's tests results for the national and regional average peak (4th-highest) 8-hour ground-level ozone indicators**

| Statistic | National | Atlantic Canada | Southern Quebec | Southern Ontario | Prairies and northern Ontario | British Columbia |
|---|---|---|---|---|---|---|
| First year | 2006 | 2006 | 2006 | 2006 | 2006 | 2006 |
| Last year | 2020 | 2020 | 2020 | 2020 | 2020 | 2020 |
| n | 15 | 15 | 15 | 15 | 15 | 15 |
| Z-test | -2.77 | -2.47 | -2.08 | -2.87 | -0.3 | -1.29 |
| **Significant** | **Yes[B]** | **Yes[C]** | **Yes[C]** | **Yes[B]** | **No** | **No** |
| **Q** | **-0.4781** | **-0.4687** | **-0.4441** | **-0.8777** | **-0.1268** | **-0.294** |
| Qmin95 | -0.8036 | -0.7752 | -0.9737 | -1.4148 | -0.436 | -0.5391 |
| Qmax95 | -0.1573 | -0.147 | -0.0674 | -0.4099 | 0.2884 | 0.2031 |
| B | 61.3643 | 54.8727 | 61.2385 | 73.8895 | 58.0209 | 51.2889 |
| Bmin95 | 64.0265 | 56.2637 | 64.6181 | 77.0146 | 59.258 | 52.8839 |
| Bmax95 | 59 | 52.3818 | 58.0114 | 69.6791 | 56.3379 | 48.9587 |
| Median change | -0.78% | -0.85% | -0.73% | -1.19% | -0.22% | -0.57% |

**Table D.6. Mann-Kendall and Sen's tests results for the national and regional average nitrogen dioxide indicators**

| Statistic | National | Atlantic Canada | Southern Quebec | Southern Ontario | Prairies and northern Ontario | British Columbia |
|---|---|---|---|---|---|---|
| First year | 2006 | 2006 | 2006 | 2006 | 2006 | 2006 |
| Last year | 2020 | 2020 | 2020 | 2020 | 2020 | 2020 |
| n | 15 | 15 | 15 | 15 | 15 | 15 |
| Z-test | -4.85 | -2.67 | -4.45 | -4.65 | -3.86 | -3.66 |
| **Significant** | **Yes[A]** | **Yes[B]** | **Yes[A]** | **Yes[A]** | **Yes[A]** | **Yes[A]** |
| **Q** | **-0.2711** | **-0.0929** | **-0.3895** | **-0.3963** | **-0.1615** | **-0.2359** |
| Qmin95 | -0.3292 | -0.1742 | -0.4723 | -0.4757 | -0.2207 | -0.3245 |
| Qmax95 | -0.2253 | -0.0312 | -0.2996 | -0.2945 | -0.0864 | -0.1302 |
| B | 10.2732 | 4.1643 | 12.1495 | 12.077 | 8.37 | 11.9079 |
| Bmin95 | 10.6856 | 4.8653 | 12.7289 | 12.7124 | 8.6832 | 12.2733 |
| Bmax95 | 9.9068 | 3.6184 | 11.5204 | 11.2095 | 7.8443 | 10.8351 |
| Median change | -2.64% | -2.23% | -3.21% | -3.28% | -1.93% | -1.98% |

**Table D.7. Mann-Kendall and Sen's tests results for the national and regional average peak (98th percentile) 1-hour nitrogen dioxide indicators**

| Statistic | National | Atlantic Canada | Southern Quebec | Southern Ontario | Prairies and northern Ontario | British Columbia |
|---|---|---|---|---|---|---|
| First year | 2006 | 2006 | 2006 | 2006 | 2006 | 2006 |
| Last year | 2020 | 2020 | 2020 | 2020 | 2020 | 2020 |
| n | 15 | 15 | 15 | 15 | 15 | 15 |
| Z-test | -3.86 | -3.27 | -3.17 | -3.46 | -3.27 | -2.18 |
| **Significant** | **Yes[A]** | **Yes[B]** | **Yes[B]** | **Yes[A]** | **Yes[B]** | **Yes[C]** |
| **Q** | **-0.6362** | **-0.6332** | **-0.6303** | **-0.9442** | **-0.466** | **-0.4016** |
| Qmin95 | -0.8039 | -0.8907 | -1.0825 | -1.2553 | -0.7168 | -0.7162 |
| Qmax95 | -0.4601 | -0.3326 | -0.3587 | -0.5324 | -0.2932 | -0.0262 |
| B | 43.5 | 34.32 | 47.8995 | 49.2542 | 41.7088 | 39.2816 |
| Bmin95 | 45.0206 | 36.1227 | 52.5599 | 50.8354 | 43.1651 | 41.266 |
| Bmax95 | 42.4196 | 32.2158 | 45.8964 | 47.1955 | 41.0625 | 36.3058 |
| Median change | -1.46% | -1.85% | -1.32% | -1.92% | -1.12% | -1.02% |

**Table D.8. Mann-Kendall and Sen's tests results for the national and regional average sulphur dioxide indicators**

| Statistic | National | Atlantic Canada | Southern Quebec | Southern Ontario | Prairies and northern Ontario | British Columbia | Northern territories |
|---|---|---|---|---|---|---|---|
| First year | 2006 | 2006 | 2006 | 2006 | 2006 | 2006 | 2006 |
| Last year | 2020 | 2020 | 2020 | 2020 | 2020 | 2020 | 2020 |
| n | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| Z-test | -4.95 | -2.87 | -4.35 | -3.76 | -3.66 | -4.45 | -2.57 |
| **Significant** | **Yes[A]** | **Yes[B]** | **Yes[A]** | **Yes[A]** | **Yes[A]** | **Yes[A]** | **Yes[C]** |
| **Q** | **-0.0835** | **-0.0694** | **-0.1083** | **-0.1746** | **-0.0368** | **-0.1033** | **-0.0333** |
| Qmin95 | -0.0993 | -0.1196 | -0.1539 | -0.2162 | -0.0668 | -0.1156 | -0.05 |
| Qmax95 | -0.067 | -0.028 | -0.0726 | -0.1183 | -0.0165 | -0.084 | -0.0092 |
| B | 1.7049 | 1.4389 | 2.4278 | 3.4554 | 0.9083 | 2.0239 | 0.6333 |
| Bmin95 | 1.8328 | 1.8041 | 2.7345 | 3.6835 | 1.1399 | 2.0767 | 0.75 |
| Bmax95 | 1.5968 | 1.1586 | 2.142 | 2.9375 | 0.7029 | 1.8157 | 0.4641 |
| Median change | -4.90% | -4.83% | -4.46% | -5.05% | -4.05% | -5.10% | -5.26% |

**Table D.9. Mann-Kendall and Sen's tests results for the national and regional average peak (99th percentile) 1-hour sulphur dioxide indicators**

| Statistic | National | Atlantic Canada | Southern Quebec | Southern Ontario | Prairies and northern Ontario | British Columbia | Northern territories |
|---|---|---|---|---|---|---|---|
| First year | 2006 | 2006 | 2006 | 2006 | 2006 | 2006 | 2006 |
| Last year | 2020 | 2020 | 2020 | 2020 | 2020 | 2020 | 2020 |
| n | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| Z-test | -4.55 | -3.37 | -4.06 | -3.66 | -2.38 | -3.96 | -3.66 |
| **Significant** | **Yes[A]** | **Yes[A]** | **Yes[A]** | **Yes[A]** | **Yes[C]** | **Yes[A]** | **Yes[A]** |
| **Q** | **-2.107** | **-2.618** | **-2.5157** | **-2.4964** | **-2.0212** | **-1.8743** | **-0.1417** |
| Qmin95 | -2.5491 | -4.1499 | -3.3233 | -3.3328 | -2.8775 | -2.2784 | -0.1842 |
| Qmax95 | -1.3817 | -1.0994 | -1.7126 | -1.7092 | -0.2778 | -1.193 | -0.0844 |
| B | 47.1364 | 48.826 | 60.4222 | 65.7964 | 43.8065 | 41.533 | 2.8833 |
| Bmin95 | 49.7776 | 60.9093 | 64.8345 | 73.8053 | 50.884 | 44.2236 | 3.2276 |
| Bmax95 | 39.1585 | 38.1955 | 54.9511 | 59.1017 | 24.7692 | 36.8239 | 2.3719 |
| Median change | -4.47% | -5.36% | -4.16% | -3.79% | -4.61% | -4.51% | -4.91% |

**Table D.10. Mann-Kendall and Sen's tests results for the national and regional average volatile organic compounds indicators**

| Statistic | National | Atlantic Canada | Southern Quebec | Southern Ontario | Prairies and northern Ontario | British Columbia |
|---|---|---|---|---|---|---|
| First year | 2006 | 2006 | 2006 | 2006 | 2006 | 2006 |
| Last year | 2019 | 2019 | 2019 | 2019 | 2019 | 2019 |
| n | 14 | 14 | 14 | 14 | 14 | 14 |
| Z-test | -3.83 | -1.75 | -4.27 | -2.74 | -3.61 | -2.85 |
| **Significant** | **Yes[A]** | **Yes[C]** | **Yes[A]** | **Yes[B]** | **Yes[A]** | **Yes[B]** |
| **Q** | **-3.4837** | **-3.4167** | **-3.1375** | **-1.0877** | **-2.8114** | **-5.2667** |
| Qmin95 | -4.3169 | -7.0755 | -4.6886 | -2.0137 | -4.3776 | -9.5376 |
| Qmax95 | -2.5894 | 0.7948 | -2.0305 | -0.3818 | -1.306 | -2.6289 |
| B | 105.3194 | 129.4167 | 76.6488 | 43.5979 | 126.1886 | 160.65 |
| Bmin95 | 109.6658 | 149.867 | 88.0725 | 52.7153 | 137.4651 | 196.9532 |
| Bmax95 | 99.5594 | 95.5766 | 66.2137 | 39.5616 | 114.4248 | 140.6003 |
| Median change | -3.31% | -2.64% | -4.09% | -2.49% | -2.23% | -3.28% |

Additional information can be obtained at:

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