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GREENHOUSE GAS CONCENTRATIONS

CANADIAN ENVIRONMENTAL SUSTAINABILITY INDICATORS

Canada

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CANADIAN ENVIRONMENTAL SUSTAINABILITY INDICATORS

GREENHOUSE GAS CONCENTRATIONS

July 2025

Table of contents

List of Figures

List of Tables

Greenhouse gas concentrations

Greenhouse gases (GHGs) absorb energy from the sun and trap heat in the Earth's atmosphere. Without GHGs, Earth's average temperature would be around -18°C, rather than the current average of 15°C. The Earth's natural greenhouse gas effect is one key parameter that makes the planet livable for humans. Human activities, such as the burning of fossil fuels, agriculture practices and industrialization, are changing Earth's natural greenhouse effect. As concentrations of greenhouse gases increase in the atmosphere, more heat is trapped and atmospheric temperatures rise. The indicator presents atmospheric concentrations as measured from sites in Canada and at a global scale for 2 greenhouse gases: carbon dioxide and methane.

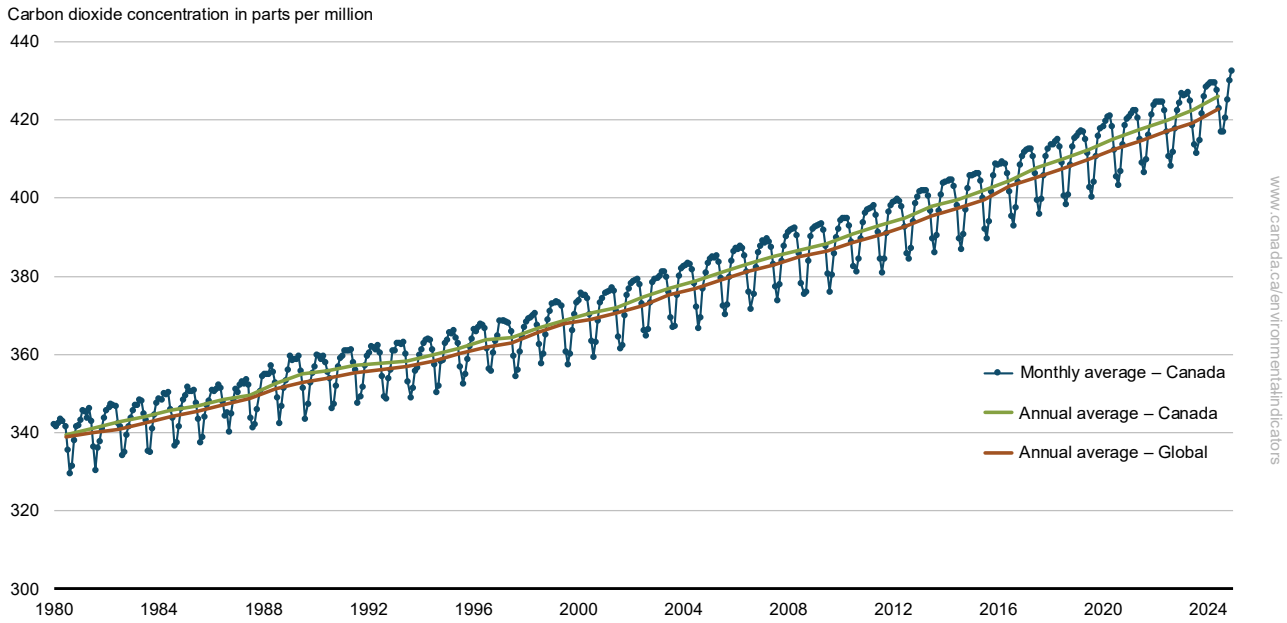
Carbon dioxide concentrations in the atmosphere

Carbon dioxide (CO_2) is the most important greenhouse gas. It is responsible for approximately 66% of the radiative forcing that is currently observed.[1]

Key results

- Globally, annual average carbon dioxide (CO2) concentration increased by 25%, from 338.9 parts per million (ppm) to 422.8 ppm between 1980 to 2024
- In Canada, annual average concentration of CO2 increased by 25%, from 339.6 ppm to 426.0 ppm over the period spanning 1980 to 2024
- In 2024, the average concentration of CO2 in Canada was 426.0 ppm, up from 422.4 ppm in 2023, the largest annual increase since 1980

Figure 1. Carbon dioxide concentrations, Canada and global, 1980 to 2024



Data for Figure 1

[1] Earth's long-term climate is regulated by a balance between energy arriving from the sun and energy leaving the Earth through radiation. The radiative forcing is defined as the difference between incoming and outgoing radiation due to an external factor. If the incoming energy is greater than the outgoing, the radiative forcing is positive and the Earth will warm.

Note: From 1980 to 1999, averages were calculated based on data from 2 to 3 sampling stations. Since 1999, data from 5 sampling stations are used to represent CO_2 concentrations. Due to some site closures during the COVID-19 pandemic, data from Canada between 2020 and 2022 were interpolated based on data from the Alert station, which remained active throughout that period. Additionally, due to access issues, data for the Estevan Point (ESP) site was synthesized between 2023 and 2024. Global annual averages are based on measurements from sampling stations that are part of the Global Greenhouse Gas Reference Network.

Source: Environment and Climate Change Canada (2025) Climate Research Division, Canadian Greenhouse Gas Measurement Program and National Oceanic and Atmospheric Administration (2025) Global Monitoring Laboratory - Trends in Atmospheric Carbon Dioxide.

In 2024, the global average concentration of CO_2 reached a new high of 422.8 ppm, up from 419.4 ppm in 2023. In the pre-industrial era (prior to 1750), the global CO_2 concentration was about 278 ppm.[2]

In Canada, the rate at which CO_2 concentrations are changing has also increased. In the 1990s, the annual increase in CO_2 was around 1.5 ppm. In the last decade, concentrations have increased by about 2.6 ppm per year. Seasonal cycles can also be observed with lower concentrations in summer due to photosynthetic uptake (plants remove CO_2 from the atmosphere) and higher concentrations in winter due to the decay of plant material (breakdown of organic material releases CO_2).

The COVID-19 pandemic created an economic slowdown in 2020 and 2021 and important reductions in travel by air and land. This resulted in a reduction in anthropogenic CO_2 emissions, in Canada and worldwide. However, there was no recognizable impact on CO_2 concentrations between 2020 and 2022.

[2] World Meteorological Organization (2024) WMO Greenhouse Gases Bulletin 2023. Retrieved on May 27, 2025.

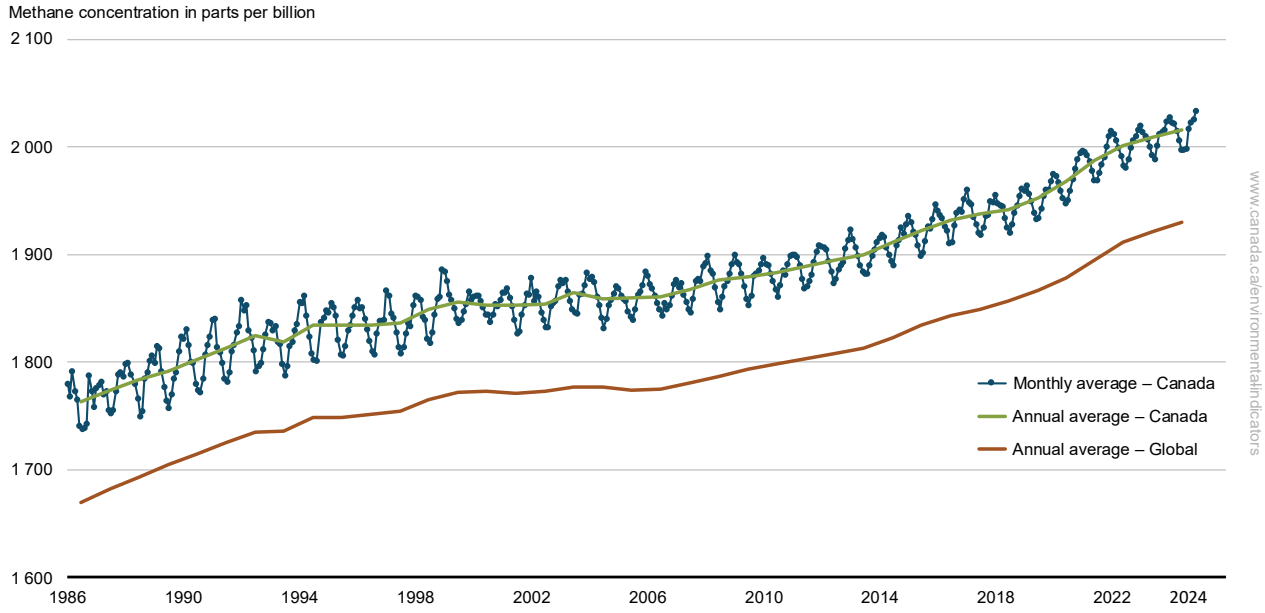
Methane concentrations in the atmosphere

Methane is the second most important greenhouse gas generated by human activity. It is currently responsible for approximately 16% of the radiative forcing.[3]

Key results

- Globally, annual average methane concentration increased by 16%, from 1 670 parts per billion (ppb) to 1 930 ppb between 1986 to 2024
- In Canada, the annual average methane concentration increased by 14%, from 1 764 ppb to 2 016 ppb between 1986 to 2024
- In 2024, the average concentration of methane in Canada was 2 016 ppb, up from 2 009 ppb in 2023

Figure 2. Methane concentrations, Canada and global, 1986 to 2024



Data for Figure 2

Note: From 1986 to 1999, averages in Canada were calculated based on data from 1 to 2 sampling stations. Since 1999, data from 5 sampling stations are used to represent CH_4 concentrations. Due to some site closures during the COVID-19 pandemic, data from Canada between 2020 and 2022 were interpolated based on data from the Alert station, which remained active throughout that period. Additionally, due to access issues, data for the Estevan Point (ESP) site was synthesized between 2023 and 2024. Global annual averages are based on measurements from sampling stations that are part of the Global Greenhouse Gas Reference Network.

Source: Environment and Climate Change Canada (2025) Climate Research Division, Canadian Greenhouse Gas Measurement Program and National Oceanic and Atmospheric Administration (2025) Global Monitoring Laboratory – Trends in Atmospheric Methane.

In 2024, the global average concentration of methane reached a new high of 1 930 ppb, an increase of 8 ppb from 2023. This increase is slightly lower than that observed in 2022 to 2023 and is close to the average annual increase over the past decade. Pre-industrial global methane concentrations were just under 730 ppb.[4]

[3] Earth's long-term climate is regulated by a balance between energy arriving from the sun and energy leaving the Earth through radiation. The radiative forcing is defined as the difference between incoming and outgoing radiation due to an external factor. If the incoming energy is greater than the outgoing, the radiative forcing is positive and the Earth will warm.

[4] World Meteorological Organization (2024) WMO Greenhouse Gases Bulletin 2023. Retrieved on May 27, 2025.

Since 2010, average methane concentrations in Canada and globally have been increasing at a faster rate. In the 2000s, an increase of about 3 ppb/year was observed.

In the 2010s, the increasing rate reached 8.5 ppb/year and the increase has reached 12 ppb/year since 2021. Although no definitive cause has been identified to explain this increase, stable isotope[5] measurements of atmospheric CH_4 strongly suggest that increases in wetland emissions in the tropics may be responsible.[4]

Methane concentrations are higher in the northern hemisphere because both natural and human caused sources of methane are more abundant there.[6] As a result, annual changes in observed methane concentrations in Canada are similar to annual changes observed across the globe, but the magnitude is typically around 85 ppb higher. Globally, approximately 40% of the methane emitted to the atmosphere is from natural sources such as wetlands. The remaining 60% of emissions are due to anthropogenic (human caused) sources such as cattle ranching, agriculture, burning of fossil fuels and landfills.

About the indicator

What the indicator measures

The indicator shows the trends in concentrations for 2 greenhouse gases: carbon dioxide (CO_2) and methane (CH_4). Concentrations are presented on monthly and annual bases for Canada. The indicator also includes the global annual average concentrations.

Why this indicator is important

Greenhouse gases (GHGs) trap heat in the Earth's atmosphere, just as the glass of a greenhouse keeps warm air inside. Human activity increases the amount of GHGs in the atmosphere, contributing to a warming of the Earth's surface. This is called the enhanced greenhouse effect. The release of GHGs and their increasing concentrations in the atmosphere are having significant impacts on the environment, human health and the economy.

This indicator serves to identify trends and seasonal variability of carbon dioxide and methane concentrations in Canada. It provides a coherent and consistent picture of the current and past states of these 2 greenhouse gases in the atmosphere, as a result of changing atmospheric transport patterns, emissions from natural sources and emissions to the atmosphere due to human activities.

GHG measurements improve our understanding of natural and anthropogenic sources of GHGs, the role of GHGs in warming the atmosphere, as well as the processes that govern the transport and fate of GHGs in the biosphere. GHG measurements in the atmosphere complement other key indicators used to assess progress in mitigating climate change by reducing GHG emissions. Since GHGs are long-lived in the atmosphere, atmospheric measurements are an indicator of the global and domestic efforts to date to address GHG emissions.

Related indicators

The Greenhouse gas emissions indicator reports trends in anthropogenic (human-made) GHG emissions at the national level, per person and per unit gross domestic product, by province and territory and by economic sector.

The Global greenhouse gas emissions indicator provides a global perspective on Canada's share of global GHG emissions.

The Greenhouse gas emissions from a consumption perspective indicator shows the impact of Canada's consumption of goods and services, regardless of where they are produced, on the levels of greenhouse gas released into the atmosphere.

The Greenhouse gas emissions projections indicator provides an overview of Canada's projected GHG emissions for the next several years.

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[5] Chemical molecules are made of elements and each element can have different forms, called isotopes. The isotopes differ in mass and physical properties, but have the same chemical properties. Methane (CH_4) contains 2 elements, carbon and hydrogen, each of which has 2 stable isotopes. The isotope analysis can help determine the origin of the molecules.

[6] National Aeronautics and Space Administration (2016) A Global View of Methane. Retrieved on May 27, 2025.

The Greenhouse gas emissions from large facilities indicator reports GHG emissions from the largest GHG emitters in Canada (industrial and other types of facilities).

The Land-based greenhouse gas emissions and removal indicator provides annual estimates of Canada's GHG emissions and removals from managed lands.

Data sources and methods

Data sources

Concentration data used for these indicators were retrieved from the Canadian Greenhouse Gas Measurement Program of the Climate Research Division of Environment and Climate Change Canada. The indicators are calculated using the greenhouse gas concentrations measured at the Alert (NU), Sable Island (NS), Estevan Point (BC), Fraserdale (ON) and East Trout Lake (SK) monitoring stations. The final ambient concentrations of carbon dioxide (CO_2) and methane (CH_4) are averaged to estimate the annual and monthly indicators values.

Global average annual concentrations were obtained from the National Oceanic and Atmospheric Administration's Global Monitoring Laboratory (NOAA), which developed the Carbon Cycle Greenhouse Gases research program.

More information

Canadian Greenhouse Gas Monitoring Network

Environment and Climate Change Canada has been continually building a long-term observation network for atmospheric measurements of CO_2, CH_4 and carbon monoxide (CO), which currently stands at 16 core continuous observational ground-based sites. These sites are spread across the country in coastal, interior and arctic regions with the aim of providing high quality data to observe and monitor natural sources and sinks, and anthropogenic (human-caused) sources of greenhouse gases in Canada.

The data used for the indicators were measured at 3 coastal sites and 2 mid-continental forest sites that are part of the Canadian Greenhouse Gas Monitoring Network. These 5 stations were selected for the representativeness of their spatial and temporal coverage. Table A5 provides more specific information on each of the stations.

The coastal sites are located at:

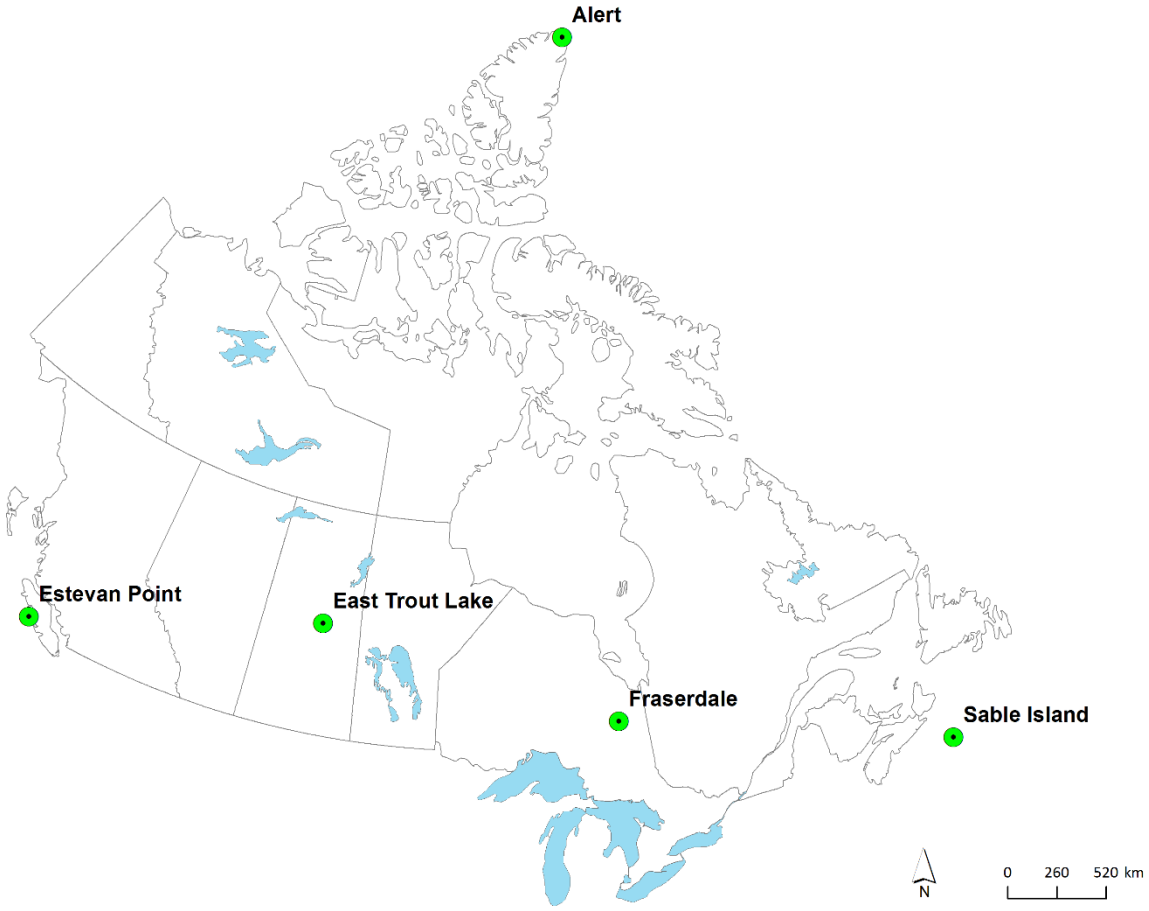
- Alert (NU), on Ellesmere Island in the Canadian high Arctic
- Sable Island (NS), located in the Atlantic Ocean
- Estevan Point (BC), a lighthouse station located on the coastline of Vancouver Island. Estevan Point became the replacement station for Cape St. James in 1992, when the weather station at Cape St. James was automated and no longer required a manned presence on site.

The mid-continental forest monitoring stations are situated in:

- Fraserdale (ON), located 150 km north of Timmins (ON)
- East Trout Lake (SK), located 150 km north-east of Prince Albert (SK). It became the replacement station for Candle Lake in 2005.

The Alert Station is also an official World Meteorological Organization Global Atmosphere Watch Program (WMO-GAW) station, one of 26 global stations around the world. Alert is the most northerly site in the WMO-GAW Network. The Alert site is also one of 3 sites, along with Mauna Loa and Cape Grim, which have been identified by the WMO-GAW as official greenhouse gas intercomparison sites.

Figure 3. Greenhouse gas concentration monitoring stations in Canada, 2025



Note: The map displays the location of the 5 long-term greenhouse gas concentration monitoring stations of used in the indicator: Alert (NU), Sable Island (NS), Fraserdale (ON) East Trout Lake (SK) and Estevan Point (BC)**.** Only Alert remained continuously active from 2020 to 2022. For more information on the core monitoring stations, please refer to Table A5 in the Annex.

Source: Environment and Climate Change Canada (2025) Climate Research Division, Canadian Greenhouse Gas Measurement Program.

Temporal coverage

The indicator presenting the carbon dioxide (CO_2) concentrations covers the period from 1980 to 2024.

The methane (CH_4) concentrations at the national and global levels were calculated using data for the years 1986 to 2024.

Data availability

Greenhouse gas observations at the 5 monitoring stations are all currently operated continuously and provide hourly, daily and monthly data. Prior to 1988, carbon dioxide (CO_2) observations were monitored using weekly grab (flask) sampling procedures.

Data availability varies by station and by greenhouse gas over time. Table 1 shows the time periods for which data are available for each greenhouse gas at the 5 monitoring stations.

Table 1. Data availability by greenhouse gas and monitoring station

Greenhouse gas	Time period	Monitoring stations
Carbon dioxide	1980 to 2024	Alert
Carbon dioxide	1980 to 2024	Sable Island [A]
Carbon dioxide	1979 to 2024	Estevan Point/Cape St. James [A] [B]
Carbon dioxide	1999 to 2024	Fraserdale [A]
Carbon dioxide	2002 to 2024	East Trout Lake/Candle Lake [A]
Methane	1985 to 2024	Alert
Methane	1999 to 2024	Sable Island [A]
Methane	1999 to 2024	Estevan Point/Cape St. James [A] [B]
Methane	1990 to 2024	Fraserdale [A]
Methane	2002 to 2024	East Trout Lake/Candle Lake [A]

Note: [A] For the years 2020 to 2022, data is incomplete due to site closures as a result of the COVID-19 pandemic.[B] For the years 2023 to 2024, data is incomplete for the Estevan Point (ESP) due to access issues.

Global concentrations from the Carbon Cycle Greenhouse Gases research program

The Carbon Cycle Greenhouse Gases (CCGG) research program from the National Oceanic and Atmospheric Administration's Global Monitoring Laboratory operates the Global Greenhouse Gas Reference Network, measuring the atmospheric distribution and trends of the 3 main long-term drivers of climate change [carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O)] as well as carbon monoxide (CO).

Methods

The monthly and annual concentrations are an average of the daily values over the corresponding period of time.

For the years 2020 to 2022, a large amount of data at the national level are missing as a result of site closures during the COVID-19 pandemic. To calculate the monthly and annual concentrations over Canada for these years, concentrations were interpolated based on long-term trends observed at the Alert site and the average of the mean seasonal cycles observed at all 5 sites.

More information

Carbon dioxide

The continuous measurement of carbon dioxide (CO_2) follows the set of principles and protocols established by the World Meteorological Organization (WMO). The atmospheric CO_2 observational programs at Alert, Fraserdale, East Trout Lake, Sable Island and Estevan Point were all initially based on non-dispersive infrared (NDIR) methodology. A rigorous set of measurement calibrations and data processing are in place to obtain valid ambient 5-minute data measurements. Hourly, daily, monthly and annual data are then estimated from the 5-minute values. Starting in 2009, Cavity Ring-Down Spectrometer (CRDS) analytical setups for CO_2 were beginning to be introduced to the network. The CRDS instruments provide similar measurement precision as NDIR methodology, however, the CRDS systems contain an overall simpler design, are simpler to operate and require much less effort to maintain. Hourly, daily, monthly and annual data are estimated from the 1-minute CRDS values. All CO_2 measurements are directly traceable to the international absolute WMO x2007 mole fraction scale maintained by the WMO Central Calibration Laboratory (CCL) at the National Oceanic and Atmospheric Administration's Earth System Research Laboratories calibration facilities in Boulder, Colorado.

For the earlier parts of the record, CO_2 was also sampled weekly with flasks using NDIR methodology. As for the continuous method, many calibration steps are executed in order to obtain the final measured values. For more information on the flask CO_2 NDIR and continuous CO_2 NDIR and CRDS measurement procedures and data processing please consult the parameter metadata section for the Environment and Climate Change Canada network on the World Data Centre for Greenhouse Gases website.

Methane

The atmospheric methane (CH_4) observational measurements at Alert, Fraserdale, East Trout Lake, Sable Island and Estevan Point were all initially made using a gas chromatography technique equipped with a flame ionization detector (FID). In 2009, Cavity Ring-Down Spectrometer (CRDS) analytical setups for CH_4 were being introduced to the network. All CH_4 measurements are reported in 10^{-9} mol CH_4 per mol of dry air [nmol/mol] or parts per billion [ppb] and directly traceable to the international absolute WMO x2004 CH_4 mole fraction scale maintained by the WMO Central Calibration Laboratory (CCL) at the National Oceanic and Atmospheric Administration's Earth System Research Laboratories calibration facilities in Boulder, Colorado.

For more information on the continuous CH_4 measurements procedures and data manipulation please consult the parameter metadata section for the Environment and Climate Change Canada network on the World Data Centre for Greenhouse Gases website.

COVID-19 impact on data availability

For 2020 to 2022, there are extensive data gaps due to the temporary suspension of measurement activities at 4 of the 5 stations during the COVID-19 pandemic. Due to the stationing of a permanent contractor, the Alert station was not impacted. To minimize the potential biases due to missing data, a synthesized mean approach was used to calculate the monthly and annual means of CO_2 and CH_4 in Canada. This approach is based on the long-term trend of observed data at Alert and the average of the mean seasonal cycles of all 5 stations in recent years when the stations were all operational. The synthesized mean was calculated as

$$Synthesized\ mean\ (t) = x(t) + y + z(t)$$

where

x(t) = the long-term trend at Alert station from 2020 to 2022

y = the offset that is a mean difference for 2010 to 2019, between the annual mean at Alert station and the annual mean based on all 5 stations

z(t) = the mean seasonal cycle constructed by averaging the mean seasonal cycles for each of the 5 stations for the 10 years from 2010 to 2019. This constructed mean seasonal cycle is used for each year from 2020 to 2022

The long-term trend and mean annual cycles are derived by applying a curve-fitting procedure to the observational data.

Synthesized data for the Estevan Point site

For 2023 and 2024, there are significant data gaps observed at the Estevan Point (ESP) site due to access issues. To minimize the potential biases due to missing information, synthesized data was calculated for the site during the period when ESP observational data are not available. Synthesized ESP data is based on the relationship between ESP data and Alert (ALT) data and its mean seasonal cycle. This data was calculated using the following equations:

[1.1] $$Fitted\ curve\ of\ ESP = long\text{-}term\ trend\ (ESP) + seasonal\ component\ (ESP)$$

[1.2] $$Fitted\ curve\ of\ ALT = long\text{-}term\ trend\ (ALT) + seasonal\ component\ (ALT)$$

[2] $$Synthesized\ ESP\ mean = Trend + Mean\ difference + Seasonal$$

where

Trend = long-term trend at ALT for 2023 and 2024

Mean difference = mean difference of the trend curves for the 2 sites over a decade, 2010 to 2019

Seasonal = the mean seasonal cycle constructed by averaging the mean seasonal cycles for ESP for the 10 years from 2010 to 2019. This constructed mean seasonal cycle is used for the years 2023 and 2024.

Global annual concentrations

The global annual concentration estimate is based on measurements from a subset of network sites. This estimation only includes data from sites where samples are predominantly made up of well-mixed marine boundary layer (MBL) air representative of a large volume of the atmosphere. Measurements from sites close to anthropogenic and natural sources and sinks are excluded from the global estimate.

Global averages are constructed by first fitting a smoothed curve as a function of time to each site, and then the smoothed value for each site is plotted as a function of latitude for 48 equal time steps per year. A global average is calculated from the latitude plot at each time step. For more details on the methodology used, please consult National Oceanic and Atmospheric Administration's Global Monitoring Laboratory website.

Caveats and limitations

Since greenhouse gases (GHG) are long-lived in the atmosphere and are transported globally from the site of emission, these indicators are an integrated measure of global and domestic GHG emissions to the atmosphere. For more information on Canada's emissions, and to assess Canada's progress in reducing its emissions, please refer to the related indicators which present information on greenhouse gas emissions in Canada.

For both carbon dioxide and methane concentrations, the number of monitoring stations used in the analyses increased in 1999. The change in the number of monitoring sites may have influenced calculations of the average values and make it difficult to compare trends prior and post 1999. In the particular case of methane concentrations, values prior to 1999 were based on data from a single station and may not be representative of the concentrations over Canada.

Due to the COVID-19 pandemic, many monitoring stations were out of operation for much of 2020 to 2022. As such, monthly and annual values were interpolated from the trends observed at Alert and the seasonal variations observed at the 5 monitoring stations. This method may miss inter-annual variations related to sub-regional scale emission changes in Canada.

Resources

References

Environment and Climate change Canada (2025) Canadian Greenhouse Gas Measurement Program. Retrieved on May 27, 2025.

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Related information

Canada's action on climate change

Canada's changing climate report

Climate change

Greenhouse gas emissions indicator

WMO Greenhouse Gases Bulletin

Annex

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

Table A.1. Annual data for Figure 4. Carbon dioxide concentrations, Canada and global, 1980 to 2024

Year	Carbon dioxide concentration – Canada (parts per million)	Carbon dioxide concentration – Global (parts per million)
1980	339.6	338.9
1981	341.2	340.1
1982	342.8	340.9
1983	344.2	342.5
1984	345.8	344.1
1985	346.9	345.5
1986	348.4	347.0
1987	349.5	348.7
1988	352.6	351.2
1989	355.0	352.8
1990	355.8	354.1
1991	357.2	355.4
1992	357.8	356.1
1993	358.3	356.8
1994	359.8	358.3
1995	361.6	360.2
1996	363.8	361.9
1997	364.4	363.1
1998	366.9	365.7
1999	368.6	367.8
2000	370.7	369.0
2001	372.1	370.6
2002	374.7	372.6
2003	376.8	375.2
2004	378.7	377.0
2005	380.8	379.0
2006	383.1	381.1
2007	385.0	382.9
2008	386.8	385.0
2009	388.2	386.5
2010	390.9	388.8
2011	393.0	390.6
2012	395.0	392.7
2013	397.9	395.4
2014	399.5	397.3
2015	401.9	399.7
2016	404.6	403.1
2017	407.8	405.2
2018	409.9	407.6
2019	412.3	410.1
2020	415.1	412.4
2021	417.7	414.7
2022	419.7	417.1
2023	422.4	419.4
2024	426.0	422.8

Note: From 1980 to 1999, averages in Canada were calculated based on data from 2 to 3 sampling stations. Since 1999, data from 5 sampling stations are used to represent CO_2 concentrations. Due to some site closures during the COVID-19 pandemic, data from Canada between 2020 and 2022 were interpolated based on data from the Alert station, which remained active throughout that period. Additionally, due to access issues, data for the Estevan Point (ESP) site were synthesized between 2023 and 2024. Global annual averages are based on measurements from sampling stations that are part of the Global Greenhouse Gas Reference Network.
Source: Environment and Climate Change Canada (2025) Climate Research Division, Canadian Greenhouse Gas Measurement Program and National Oceanic and Atmospheric Administration (2025) Global Monitoring Laboratory - Trends in Atmospheric Carbon Dioxide.

Table A.2. Monthly data for Figure 1. Carbon dioxide concentrations, Canada, 1980 to 2024

Year	January (parts per million)	February (parts per million)	March (parts per million)	April (parts per million)	May (parts per million)	June (parts per million)	July (parts per million)	August (parts per million)	September (parts per million)	October (parts per million)	November (parts per million)	December (parts per million)
1980	342.3	341.9	342.6	343.8	343.2	341.9	335.8	329.7	331.7	338.3	341.7	342.0
1981	343.5	345.8	345.5	344.0	346.4	343.0	336.6	330.6	336.4	337.8	341.1	344.0
1982	346.0	346.8	347.6	347.2	346.8	342.6	341.7	334.4	335.3	339.5	341.8	343.9
1983	346.0	347.2	347.2	348.7	348.3	345.1	343.4	335.5	335.3	341.3	344.8	347.7
1984	348.8	348.6	350.1	350.0	350.5	346.1	343.9	336.8	337.8	341.7	346.3	348.6
1985	349.8	351.9	350.9	350.8	351.1	347.8	343.8	337.6	339.0	344.3	347.1	348.2
1986	351.2	350.8	351.4	352.6	351.7	348.1	344.6	345.4	340.4	345.0	348.5	351.4
1987	350.5	352.4	353.3	352.6	353.7	352.4	344.1	341.6	342.3	346.1	350.7	354.7
1988	355.3	355.2	355.2	357.3	355.7	352.9	349.1	342.6	347.1	351.5	353.5	356.2
1989	359.7	358.6	358.9	359.0	359.8	355.9	351.7	343.7	347.5	352.9	355.3	357.1
1990	360.1	359.7	359.0	359.8	358.2	355.7	354.2	346.5	347.4	352.1	357.2	359.3
1991	359.9	361.3	361.1	361.2	361.5	358.1	356.1	347.9	349.5	352.0	357.5	359.9
1992	360.8	362.4	362.1	361.4	362.5	360.6	354.5	349.4	348.9	354.1	356.2	361.2
1993	361.1	363.0	363.2	362.8	363.2	360.2	353.1	349.1	351.5	355.9	356.9	360.0
1994	361.6	363.2	363.9	364.1	363.8	361.4	357.5	350.5	352.1	358.3	358.6	363.1
1995	363.8	365.9	365.7	366.3	364.5	363.0	357.1	352.7	355.1	358.9	362.3	364.2
1996	366.6	366.0	367.3	367.9	367.7	367.0	361.8	356.5	356.0	360.7	363.6	365.1
1997	368.7	368.9	368.8	368.4	368.3	366.2	359.9	354.7	356.2	360.8	364.6	367.2
1998	368.6	369.3	369.6	370.2	370.8	367.8	362.8	357.9	360.4	365.2	369.1	371.2
1999	373.3	373.4	373.6	373.4	372.6	368.3	361.0	357.6	360.4	366.4	370.5	373.3
2000	373.9	375.9	375.3	375.3	374.5	370.4	363.7	359.6	363.3	368.8	373.5	374.5
2001	376.1	376.2	376.4	377.3	376.3	371.4	364.6	361.8	362.5	370.3	375.3	376.9
2002	378.4	378.9	379.1	379.5	378.1	373.1	366.5	364.9	366.5	373.4	378.6	379.4
2003	379.7	380.3	381.5	381.4	380.0	376.3	369.6	367.1	367.6	375.5	380.4	382.1
2004	382.8	383.1	383.7	383.4	382.0	378.3	372.4	366.9	369.7	377.1	381.1	383.5
2005	384.7	385.2	385.0	385.4	383.7	379.6	372.8	370.7	372.4	379.2	383.9	386.4
2006	387.4	387.0	387.9	387.4	385.6	381.5	376.3	371.9	375.7	382.5	386.2	388.0
2007	389.3	388.8	389.9	389.0	387.7	383.2	377.5	373.9	378.1	384.2	387.9	390.4

Year	January (parts per million)	February (parts per million)	March (parts per million)	April (parts per million)	May (parts per million)	June (parts per million)	July (parts per million)	August (parts per million)	September (parts per million)	October (parts per million)	November (parts per million)	December (parts per million)
2008	391.5	392.0	392.3	392.7	390.6	385.9	378.4	375.6	376.2	384.2	390.4	392.2
2009	392.8	393.1	393.5	393.9	392.0	387.5	380.3	375.7	380.4	385.7	390.6	392.3
2010	394.4	395.1	394.9	395.0	393.1	389.1	382.7	381.4	384.8	389.9	394.0	396.4
2011	397.3	397.6	397.9	398.3	395.9	391.6	384.7	381.2	384.7	391.2	396.7	398.4
2012	399.2	399.5	399.9	399.5	397.9	392.9	386.0	384.8	387.4	394.1	398.9	400.5
2013	401.8	402.1	402.1	402.3	400.7	397.0	389.8	386.2	390.8	396.9	401.2	404.0
2014	404.3	404.7	404.9	404.9	403.3	398.3	390.0	387.2	391.0	397.3	402.7	406.0
2015	405.9	406.2	406.5	406.4	404.7	400.2	392.3	390.0	394.3	401.8	406.0	408.9
2016	408.6	409.0	409.4	409.0	406.5	401.9	395.7	393.1	397.8	404.3	408.6	410.8
2017	412.0	412.5	412.8	412.8	410.8	406.6	399.8	396.2	400.0	406.0	410.9	412.8
2018	413.9	413.9	414.7	415.3	413.4	409.4	400.8	398.7	401.1	408.6	413.3	415.5
2019	416.1	416.9	417.3	417.1	415.3	411.6	403.0	400.6	404.2	410.9	416.2	418.1
2020	418.5	419.8	421.1	421.2	418.5	412.4	405.8	403.4	407.1	413.8	418.7	420.6
2021	421.1	421.7	422.6	422.8	420.6	415.3	409.2	406.8	410.1	416.4	421.6	424.1
2022	424.8	424.8	425.0	424.9	422.8	417.3	410.9	408.5	412.0	418.1	422.7	424.7
2023	427.1	426.5	426.8	427.3	425.0	418.8	413.9	411.8	415.1	421.8	426.3	428.8
2024	429.1	429.6	429.7	429.7	427.8	423.2	417.2	417.1	420.6	425.3	430.3	432.8

Note: From 1980 to 1999, averages in Canada were calculated based on data from 2 to 3 sampling stations. Since 1999, data from 5 sampling stations are used to represent CO_2 concentrations. Due to some site closures during the COVID-19 pandemic, data from Canada between 2020 and 2022 were interpolated based on data from the Alert station, which remained active throughout that period. Additionally, due to access issues, data for the Estevan Point (ESP) site was synthesized between 2023 and 2024. Global annual averages are based on measurements from sampling stations that are part of the Global Greenhouse Gas Reference Network.
Source: Environment and Climate Change Canada (2025) Climate Research Division, Canadian Greenhouse Gas Measurement Program and National Oceanic and Atmospheric Administration (2025) Global Monitoring Laboratory - Trends in Atmospheric Carbon Dioxide.

Table A.3. Annual data for Figure 2. Methane concentrations, Canada and global, 1986 to 2024

Year	Methane concentration – Canada (parts per billion)	Methane concentration – Global (parts per billion)
1986	1 764	1 670
1987	1 774	1 683
1988	1 784	1 693
1989	1 792	1 705
1990	1 803	1 714
1991	1 813	1 725
1992	1 824	1 735
1993	1 819	1 736
1994	1 835	1 742
1995	1 834	1 749
1996	1 835	1 751
1997	1 836	1 755
1998	1 849	1 766
1999	1 856	1 772
2000	1 853	1 773
2001	1 853	1 771
2002	1 855	1 773
2003	1 864	1 777
2004	1 859	1 777
2005	1 863	1 774
2006	1 861	1 775
2007	1 868	1 781
2008	1 877	1 787
2009	1 878	1 794
2010	1 883	1 799
2011	1 889	1 803
2012	1 895	1 808
2013	1 900	1 813
2014	1 912	1 823
2015	1 922	1 834
2016	1 932	1 843
2017	1 938	1 850
2018	1 942	1 857
2019	1 952	1 867
2020	1 969	1 879
2021	1 988	1 895
2022	2 001	1 912
2023	2 009	1 922
2024	2 016	1 930

Note: From 1986 to 1999, averages in Canada were calculated based on data from 1 to 2 sampling stations. Since 1999, data from 5 sampling stations are used to represent CH_4 concentrations. Due to some site closures during the COVID-19 pandemic, data from Canada between 2020 and 2022 were interpolated based on data from the Alert station, which remained active throughout that period. Additionally, due to access issues, data for the Estevan Point (ESP) site was synthesized between 2023 and 2024. Global annual averages are based on measurements from sampling stations that are part of the Global Greenhouse Gas Reference Network.
Source: Environment and Climate Change Canada (2025) Climate Research Division, Canadian Greenhouse Gas Measurement Program and National Oceanic and Atmospheric Administration (2025) Global Monitoring Laboratory - Trends in 1 930Atmospheric Methane.

Table A.4. Monthly data for Figure 2. Methane concentrations, Canada and global, 1986 to 2024

Year	January (parts per billion)	February (parts per billion)	March (parts per billion)	April (parts per billion)	May (parts per billion)	June (parts per billion)	July (parts per billion)	August (parts per billion)	September (parts per billion)	October (parts per billion)	November (parts per billion)	December (parts per billion)
1986	1 780	1 769	1 792	1 773	1 766	1 741	1 738	1 740	1 744	1 788	1 774	1 759
1987	1 776	1 779	1 782	1 771	1 774	1 756	1 753	1 756	1 774	1 789	1 791	1 788
1988	1 799	1 800	1 789	n/a	1 781	1 767	1 750	1 755	1 785	1 791	1 802	1 806
1989	1 800	1 815	1 813	1 792	1 777	1 764	1 758	1 771	1 785	1 791	1 811	1 825
1990	1 822	1 831	1 817	1 801	1 800	1 780	1 775	1 773	1 785	1 808	1 817	1 825
1991	1 840	1 841	1 815	1 809	1 800	1 785	1 782	1 791	1 810	1 817	1 829	1 834
1992	1 858	1 849	1 854	1 830	1 823	1 812	1 792	1 797	1 800	1 813	1 826	1 838
1993	1 837	1 830	1 834	1 819	1 818	1 799	1 788	1 797	1 815	1 820	1 831	1 836
1994	1 857	1 855	1 862	1 844	1 824	1 808	1 803	1 802	n/a	1 838	1 842	1 849
1995	1 846	1 856	1 852	1 844	1 821	1 808	1 807	1 816	1 830	1 835	1 844	1 852
1996	1 858	1 851	1 851	1 841	1 831	1 821	1 811	1 808	1 827	1 839	1 839	1 840
1997	1 867	1 862	1 846	1 842	1 829	1 815	1 809	1 815	1 827	1 837	1 834	1 854
1998	1 863	1 861	1 859	1 843	1 840	1 823	1 819	1 829	1 844	1 859	1 862	1 887
1999	1 885	1 876	1 863	1 859	1 851	1 841	1 837	1 840	1 848	1 855	1 866	1 858
2000	1 861	1 862	1 862	1 858	1 851	1 845	1 845	1 838	1 845	1 854	1 852	1 859
2001	1 865	1 865	1 869	1 861	1 852	1 840	1 828	1 829	1 845	1 853	1 864	1 863
2002	1 879	1 858	1 866	1 862	1 847	1 840	1 833	1 833	1 853	1 855	1 858	1 871
2003	1 877	1 874	1 877	1 866	1 857	1 850	1 843	1 845	1 857	1 864	1 872	1 883
2004	1 878	1 880	1 875	1 862	1 853	1 842	1 832	1 841	1 854	1 858	1 865	1 872
2005	1 877	1 874	1 863	1 860	1 850	1 847	1 846	1 854	1 863	1 866	1 872	1 885
2006	1 881	1 873	1 869	1 862	1 856	1 849	1 844	1 855	1 850	1 854	1 862	1 873
2007	1 878	1 870	1 874	1 864	1 857	1 850	1 846	1 859	1 876	1 878	1 876	1 890
2008	1 892	1 900	1 885	1 883	1 870	1 856	1 849	1 861	1 871	1 876	1 883	1 892
2009	1 893	1 889	1 890	1 883	1 871	1 859	1 852	1 865	1 879	1 883	1 883	1 891
2010	1 897	1 892	1 891	1 883	1 876	1 868	1 862	1 872	1 886	1 882	1 891	1 900
2011	1 901	1 901	1 899	1 891	1 878	1 869	1 871	1 876	1 882	1 894	1 903	1 909
2012	1 909	1 907	1 905	1 895	1 885	1 874	1 878	1 887	1 891	1 894	1 906	1 914
2013	1 924	1 915	1 907	1 899	1 891	1 885	1 883	1 882	1 891	1 900	1 906	1 912

Year	January (parts per billion)	February (parts per billion)	March (parts per billion)	April (parts per billion)	May (parts per billion)	June (parts per billion)	July (parts per billion)	August (parts per billion)	September (parts per billion)	October (parts per billion)	November (parts per billion)	December (parts per billion)
2014	1 916	1 919	1 918	1 907	1 900	1 895	1 891	1 909	1 914	1 926	1 920	1 929
2015	1 937	1 931	1 922	1 919	1 909	1 900	1 902	1 913	1 927	1 924	1 934	1 947
2016	1 941	1 938	1 934	1 926	1 923	1 911	1 912	1 927	1 939	1 943	1 940	1 952
2017	1 961	1 950	1 947	1 936	1 928	1 921	1 919	1 926	1 936	1 938	1 950	1 949
2018	1 956	1 948	1 946	1 945	1 934	1 926	1 921	1 928	1 940	1 946	1 955	1 962
2019	1 960	1 965	1 958	1 951	1 939	1 934	1 935	1 943	1 955	1 961	1 961	1 969
2020	1 975	1 974	1 968	1 960	1 953	1 949	1 951	1 960	1 970	1 980	1 989	1 995
2021	1 997	1 996	1 993	1 988	1 978	1 970	1 970	1 976	1 984	1 991	2 001	2 011
2022	2 016	2 013	2 007	2 000	1 992	1 983	1 982	1 989	2 000	2 007	2 011	2 016
2023	2 021	2 015	2 011	2 007	2 001	1 993	1 989	2 002	2 013	2 015	2 016	2 024
2024	2 028	2 024	2 022	2 015	2 007	1 998	1 998	1 999	2 017	2 024	2 027	2 035

Note: n/a = not available. From 1986 to 1999, averages in Canada were calculated based on data from 1 to 2 sampling stations. Since 1999, data from 5 sampling stations are used to represent CH_4 concentrations. Due to some site closures during the COVID-19 pandemic, data from Canada between 2020 and 2022 were interpolated based on data from the Alert station, which remained active throughout that period. Additionally, due to access issues, data for the Estevan Point (ESP) site was synthesized between 2023 and 2024. Global annual averages are based on measurements from sampling stations that are part of the Global Greenhouse Gas Reference Network.
Source: Environment and Climate Change Canada (2025) Climate Research Division, Canadian Greenhouse Gas Measurement Program and National Oceanic and Atmospheric Administration (2025) Global Monitoring Laboratory - Trends in 1 930 Atmospheric Methane.

Table A.5. Data for Figure 3. Greenhouse gas concentration monitoring stations in Canada, 2025

Start Date	Site Name (3 letter station code)	Coordinates	Elevation (Above Sea Level)	Intake height	In-situ parameters	In-situ instrumentation	Flask sampling frequency (CO_2, CH_4, CO, N_2O, SF_6)
March, 1975	Sable Island, Nova Scotia (WSA)	43.932237N, 60.009275W	5 m	25 m	CO_2, CH_4, CO	NDIR[A], GC[B], CRDS[C]	Single flask every 3 days
July, 1975	Alert, Nunavut (ALT)	82.450833N, 62.507222W	200 m	10 m	CO_2, CH_4, CO, N_2O	NDIR[A], GC[B], CRDS[C], OA-ICOS[D]	One pair of flasks each week
January, 1990	Fraserdale, Ontario (FSD)	49.875222N, 81.570083W	210 m	40 m	CO_2, CH_4, CO, N_2O, SF_6	NDIR[A], GC[B], CRDS[C]	Single flask once per week (in the afternoon)
June, 1992	Estevan Point, British Columbia (ESP)	49.382954N, 126.544101W	7 m	40 m	CO_2, CH_4, CO	NDIR[A], GC[B], CRDS[C]	One pair of flasks once per week
August, 2005	East Trout Lake, Saskatchewan (ETL)	54.354130N, 104.986835W	493 m	105 m	CO_2, CH_4, CO, N_2O, SF_6	NDIR[A], GC[B], CRDS[C]	Single flask once per week (in the afternoon

Note: [A]Non-Dispersive Infrared, [B]Gas Chromatography, [C]Cavity Ring-Down Spectrometer, [D]Off-Axis Integrated Cavity Output Spectroscopy.

Source: Environment and Climate Change Canada (2025) Climate Research Division, Canadian Greenhouse Gas Measurement Program.

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