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TEMPERATURE CHANGE IN CANADA

CANADIAN ENVIRONMENTAL SUSTAINABILITY INDICATORS

Canada

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CANADIAN ENVIRONMENTAL SUSTAINABILITY INDICATORS

TEMPERATURE CHANGE IN CANADA

July 2025

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Temperature change in Canada

Temperature is a key indicator of how the climate is changing in response to greenhouse gas (GHG) emissions from human activities, as increasing GHG concentrations result in warming of the lower atmosphere. Temperature change can influence crops, forests, infrastructure, human health, the spread of disease, the availability of water and the health of ecosystems. Warming temperatures increase the risks of abrupt and/or irreversible impacts on the ecosystems and the climate system.

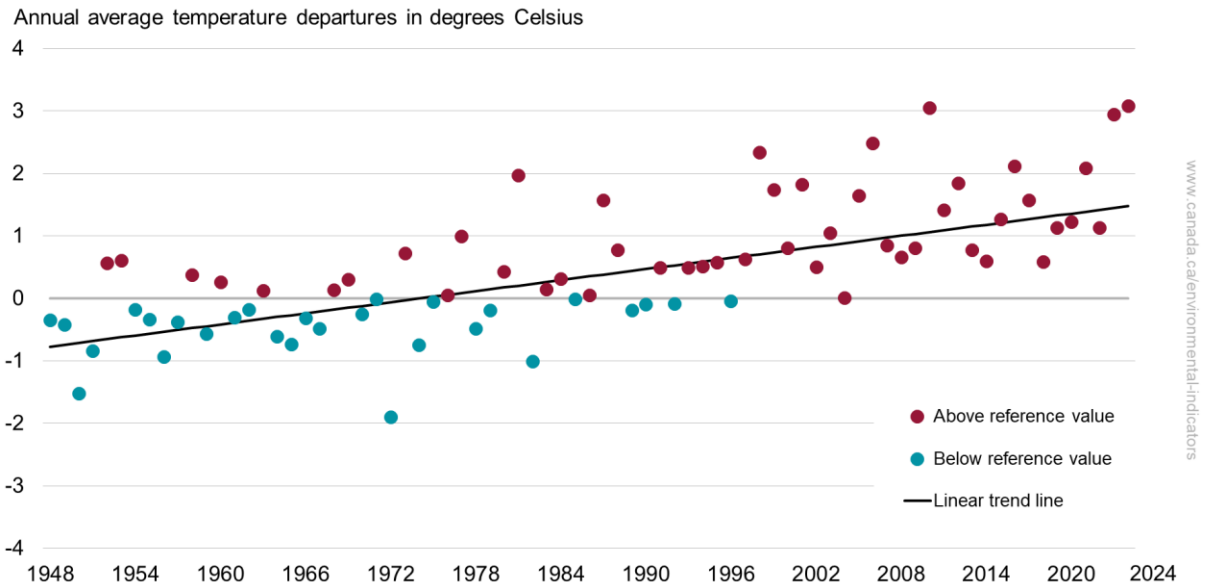
Using the average temperature values from 1961 to 1990 as a baseline, this indicator compares how much the temperature for a given year departs from the "normal". The indicator shows the national annual and seasonal air temperature departures[1] for the years 1948 to 2024. It also represents spatially the temperature departures for 2024 and the change in temperature since 1948.

National annual temperature change

Key results

- In Canada, the national average temperature for the year 2024 was 3.1 degrees Celsius (°C) above the 1961 to 1990 reference value, matching 2010's record as the warmest year since 1948
- The overall trend from 1948 to 2024 has been an increase of 2.4°C
- Annual average temperatures have been consistently above or equal to the reference value since 1997

Figure 1. Annual average temperature departures from the 1961 to 1990 reference value, Canada, 1948 to 2024



Data for Figure 1

[1] The temperature departure corresponds to the difference between the observed temperature values and a temperature reference value, also called the "normal". The average of temperature annual values from 1961 to 1990 is commonly used as a baseline for comparing how temperature for a given year departs from what could be referred to as the "normal" in long-term climate change assessments.

Note: Departures are calculated by subtracting the 1961 to 1990 reference value from the annual average. A positive departure indicates that the observed temperature was warmer than the reference value, while a negative departure indicates the opposite.
Source: Environment and Climate Change Canada (2025) Canadian homogenized monthly surface air temperature.

The year 2024 joined 2010 as the warmest year on record, both 3.1°C above the 1961 to 1990 reference value. Seven (7) of the 10 warmest years have occurred during the last 20 years. Canada's coldest year since 1948 occurred in 1972 at 1.9°C below the reference value.

Globally, 2024 was the warmest year recorded in 175 years with average temperatures 1.5°C higher than in the pre-industrial era (1850-1990).[2] This record beat the previous heat record set in 2023.

The annual average temperature in Canada has increased at roughly twice the global average rate. However, patterns are different across regions of the country. Temperatures have increased more in northern Canada than in southern Canada. Annual temperatures over northern Canada increased by roughly 3 times the global warming rate on average.

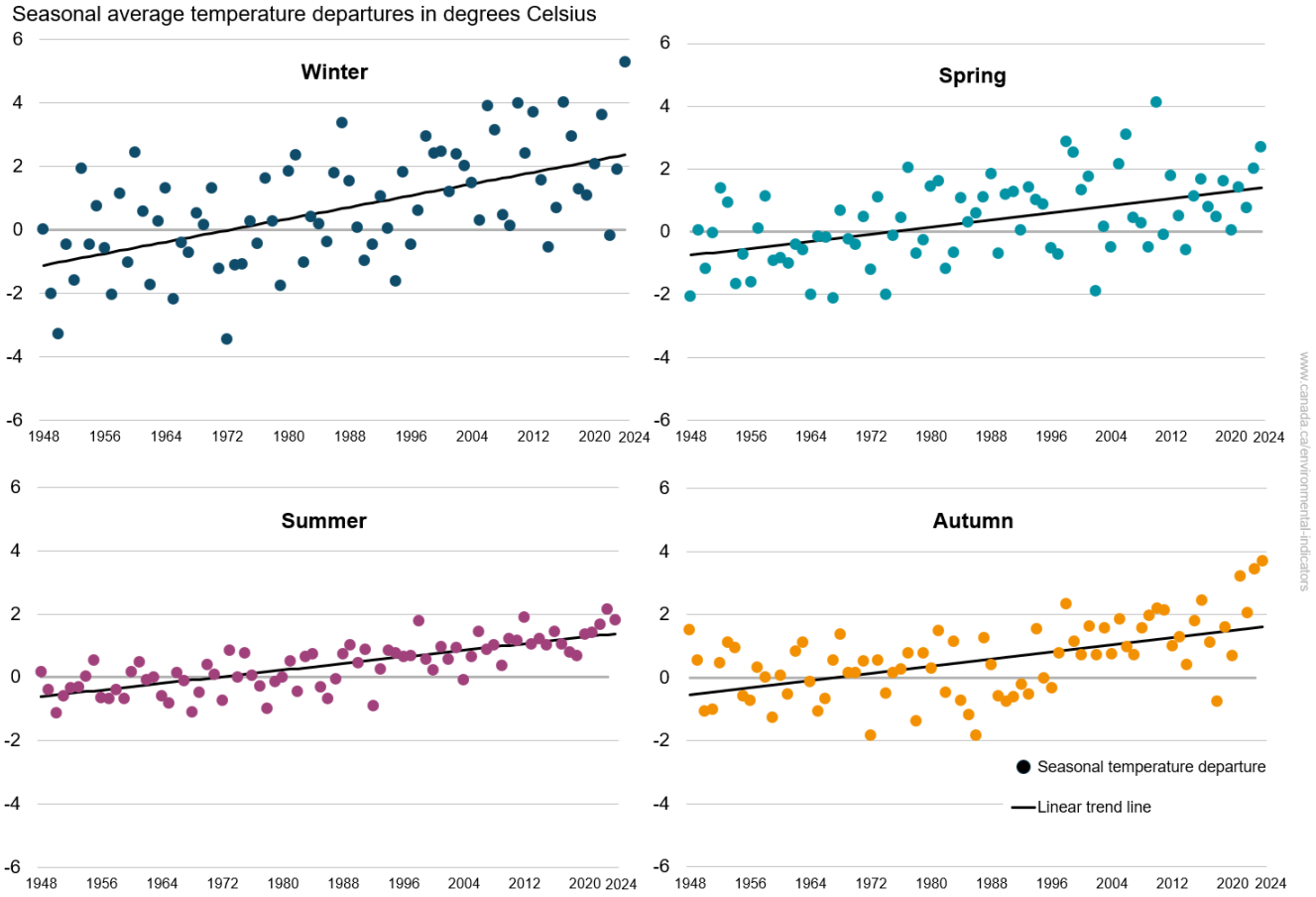
[2] World Meteorological Organization (2025) State of the Global Climate 2024. Retrieved on June 2, 2025.

National seasonal temperature change

Key results

- Like the national annual average temperature, seasonal average temperatures increased over the 1948 to 2024 period
- Warming trends were detected for all 4 seasons:
  - winter[3] average temperatures increased by 3.7°C
  - spring average temperatures increased by 2.1°C
  - summer average temperatures increased by 2.1°C
  - autumn average temperatures increased by 2.4°C
- The year 2024 saw the warmest winter and autumn since 1948. The warmest summer was in 2023, and the warmest spring was in 2010

Figure 2. Seasonal average temperature departures compared with the 1961 to 1990 reference value, Canada, 1948 to 2024



Data for Figure 2

Note: Departures are calculated by subtracting the 1961 to 1990 reference value from the seasonal average. A positive departure indicates that the observed temperature was warmer than the reference value, while a negative departure indicates the opposite. Seasons are defined as winter (December, January and February), spring (March, April and May), summer (June, July and August), and autumn (September,

[3] Winter 2024 includes the months of December 2023, January 2024, and February 2024.

October and November).
Source: Environment and Climate Change Canada (2025) Canadian homogenized monthly surface air temperature.

Regional temperature change

Regional temperature departures

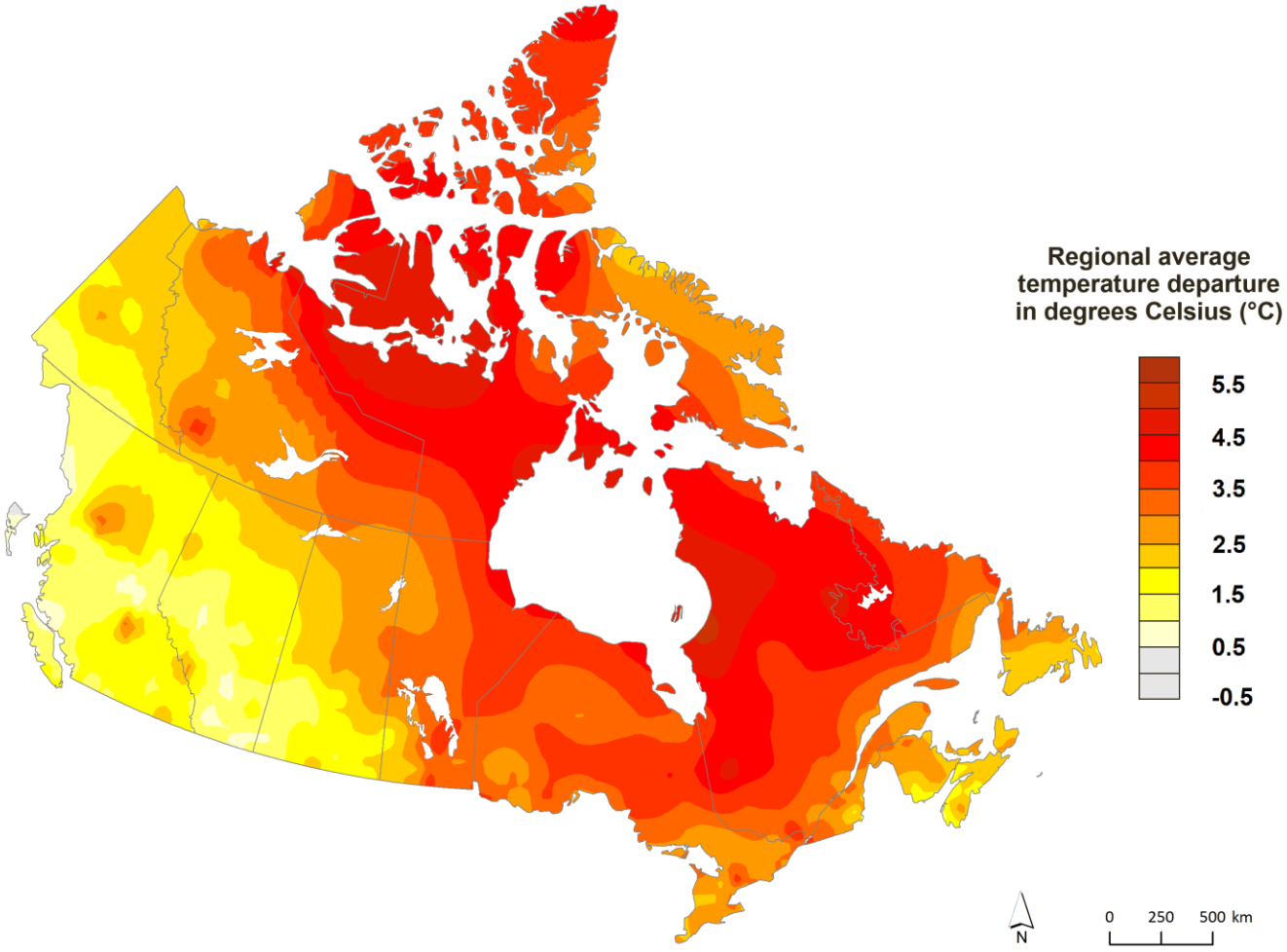
This section presents the difference between temperatures recorded in 2024 and the normal (departures from the 1961 to 1990 reference value) at the regional level.

Key results

In 2024,

- All of Canada experienced annual temperatures above the 1961 to 1990 reference value
- Most of northern Canada and the northern parts of Quebec and Ontario, experienced temperatures significantly above the baseline average
- Annual temperatures were closest to the baseline average in southern Nova Scotia, southern Saskatchewan, Alberta, British Columbia and southern Yukon

Figure 3. Regional average temperature departures from the 1961 to 1990 reference value, Canada, 2024



Navigate data using the interactive map

Note: 2024 annual average temperature departures were computed for 651 active sites across Canada. Departures are calculated by subtracting the 1961 to 1990 reference value from the annual average. A positive departure indicates that the observed temperature was warmer than the reference value, while a negative departure indicates the opposite.
Source: Environment and Climate Change Canada (2025) Canadian gridded homogenized monthly surface air temperature.

Regional temperature change trends

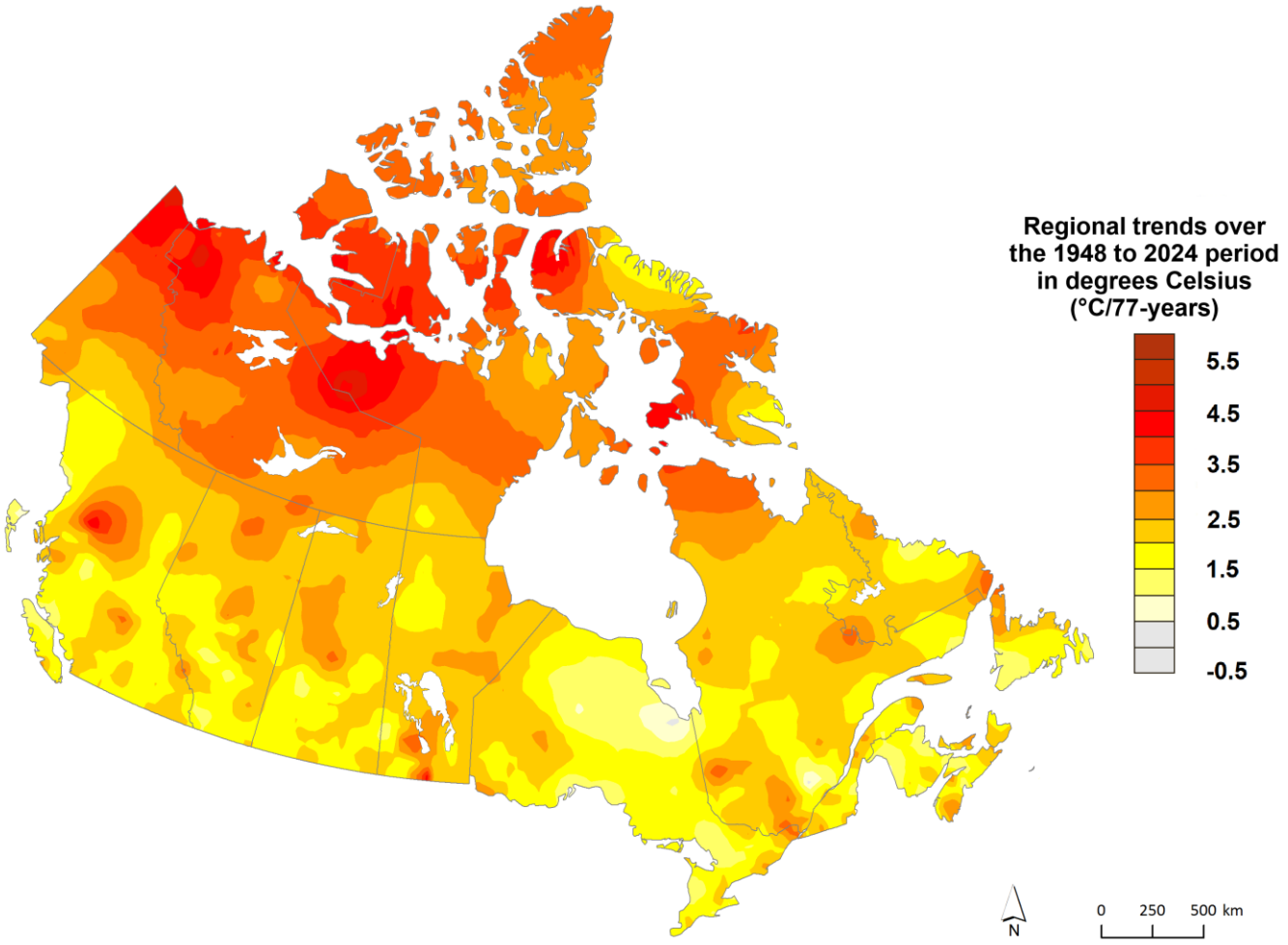
This section presents the long-term trends in temperature change over the period from 1948 to 2024 at the regional level.

Key results

Over the period from 1948 to 2024,

- All of Canada experienced an increase in annual average temperature
- Increases of at least 1°C were observed almost everywhere across the country
- Most of northern Canada and northern parts of British Columbia, the Prairies and Quebec saw increases of more than 2°C

Figure 4. Regional temperature change trend, Canada, 1948 to 2024



Navigate data using the interactive map

Note: Annual average temperature trends were computed for 651 active sites across Canada. The change in temperature was obtained through a linear trend analysis.
Source: Environment and Climate Change Canada (2025) Canadian gridded homogenized monthly surface air temperature.

About the indicator

What the indicator measures

The Temperature change in Canada indicator helps show how Canada's surface air temperature has changed since nationwide recording of consistent and comparable climate observations began in 1948. The indicator shows the yearly and seasonal surface air temperature departures for the years 1948 to 2024. As well, it presents the geographic distributions of surface air temperature departures for the year 2024 and trends in temperature over the period from 1948 to 2024.

An annual departure is the difference between the value for a given year and a baseline value. The baseline values used in this indicator are the annual and seasonal temperature averages for the reference period of 1961 to 1990 (often referred to as the "1961 to 1990 normal"). This reference period is consistent with the approach used to compare anomalies in the Intergovernmental Panel on Climate Change Sixth Assessment Report and the World Meteorological Organization Annual Statements on the Status of the Global Climate. The temperature departures are measured in degrees Celsius (°C) and calculated using data from weather stations across Canada with long enough data records for a meaningful trend calculation.

Why this indicator is important

The heat-trapping effect of atmospheric greenhouse gases is well established. It is extremely likely that human activities, especially emissions of greenhouse gases, are the main cause of observed warming since the mid-20th century. Natural factors cannot explain this observed warming. Evidence of a human influence on many other changes in climate is widespread.[4]

The effects of widespread warming are evident in many parts of Canada and are projected to intensify in the future. These effects include more extreme heat, less extreme cold, longer growing seasons, shorter snow and ice cover seasons, earlier spring peak streamflow, thinning glaciers, thawing permafrost, and rising sea levels.[5]

Much of Canadian economic and social activity, as well as individual health, is climate dependent. Studies have shown that extreme heat (over 30°C) increases deaths in Canadian cities. Those with underlying conditions such as cardiovascular disease, schizophrenia and pregnancy may experience more severe effects of extreme heat. In addition, sociological factors such as income, housing status, age and social isolation may impact the degree to which individuals can manage extreme temperatures.[6] Understanding how Canada's climate is changing is important for developing adaptive responses to these effects.

The Intergovernmental Panel on Climate Change and the United Nations Framework Convention on Climate Change use surface air temperature, among other variables, to assess long-term changes in climate. Surface air temperature is considered by the World Meteorological Organization - Global Climate Observing System as an Essential Climate Variable.

Related initiatives

This indicator supports the measurement of progress towards Goal 13 of the 2022 to 2026 Federal Sustainable Development Strategy: Take action on climate change and its impacts.

In addition, the indicator contributes to the Sustainable Development Goals of the 2030 Agenda for Sustainable Development. It is linked to Goal 13, Take urgent action to combat climate change and its impacts.

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[4] Bush E, Gillett N, Watson E, Fyfe J, Vogel F and Swart N (2019) Understanding Observed Global Climate Change; Chapter 2 in Canada's Changing Climate Report, (ed.) E. Bush and D.S. Lemmen; Government of Canada, Ottawa, Ontario, p. 24–72.

[5] Bush E and Lemmen DS, editors (2019) Canada's Changing Climate Report; Government of Canada, Ottawa, ON. 444 p.

[6] Bush E, Gillett N, Watson E, Fyfe J, Vogel F and Swart N (2019) Understanding Observed Global Climate Change; Chapter 2 in Canada's Changing Climate Report, (ed.) E. Bush and D.S. Lemmen; Government of Canada, Ottawa, Ontario, p. 24–72.

Related indicators

The Extreme heat events indicator reports trends in the cumulative number of days per year and in the average number of degrees Celsius per year of extreme heat conditions across Canada.

The Greenhouse gas concentration indicator presents atmospheric concentrations as measured from sites in Canada and at a global scale for 2 greenhouse gases: carbon dioxide and methane.

The Precipitation change in Canada indicator presents annual, seasonal and regional precipitation departures (or anomalies).

The Sea ice in Canada indicator provides information on variability and trends in sea ice in Canada during the summer season.

The Snow cover indicator provides information on spring snow cover extent and annual snow cover duration in Canada.

Data sources and methods

Data sources

The Temperature change in Canada indicator is based on Environment and Climate Change Canada's gridded temperature departures, or anomalies, data (Canadian gridded homogenized monthly surface air temperature), which in turn is based on the Canadian homogenized monthly surface air temperature dataset for historical climate observations and on near real-time data in the national climate archives for the current year.

More information

The indicator is calculated using surface air temperature data collected in weather stations across Canada for the period 1948 to 2024.

The dataset contains daily data from 651 active sites. Each site reflects data from either single weather station or combined data from multiple stations. Data from closely located stations were joined into single records to ensure observations for long periods.

The Fourth Generation of Homogenized Temperature datasets replaced the third generation datasets that were used in the previous versions of the Temperature change in Canada indicator.

This dataset was prepared for use in climate trend analysis in Canada. The list of stations was revised to include observations from a larger number of surface monitoring stations, particularly those collected at Reference Climate Stations and at some Canadian Aviation Weather Services stations. The procedures used to produce the Fourth Generation are described in the publication Canada's fourth generation of homogenized surface air temperature and its trends for 1948-2023.

Methods

The seasonal and annual average temperature departures are computed at each observing station and for each season and year by subtracting the reference value (defined as the average over the 1961 to 1990 reference period) from the relevant seasonal and annual values.

More information

The annual departure is the average of all monthly departures, and the seasonal departure is the average of the monthly departures in the corresponding season. Seasons are defined as winter (December of the previous year, January and February of the current year), spring (March, April and May), summer (June, July and August) and autumn (September, October and November).

Temperature departures were computed for the 651 sites across Canada. A Kriging method was used to interpolate the daily and monthly temperature anomalies onto 10 km grids. Temperature departures were assumed to be uniform and equal for a given cell. Values for each grid cell were averaged together to produce the annual and seasonal time series of temperature departures representing the entire country. Values for grid boxes over large bodies of water are excluded. More information about the calculation

method for annual average temperature departures can be found in the Climate Trends and Variations Bulletin documentation.

Non-parametric statistical tests were carried out on annual and seasonal average temperature departures 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. A trend was reported when the Mann-Kendall test indicated the presence of a trend at the 95% confidence level.

For the regional temperature change trend, statistical tests were carried out on the temperature departure time series for each individual grid cell. From the obtained slope, the change in temperature was calculated over the period from 1948 to 2024: slope value (°C/year) x 77 years. For 99% of the cells, the Mann-Kendall test indicated the presence of a trend at the 95% confidence level. However, the trend results from all cells were displayed on the map.

Recent changes

The annual mean temperature trend over Canada has increased from 2.0°C for the 76-year period from 1948 to 2023, as reported in last year's indicator, to 2.4°C for the 77-year period from 1948 to 2024. This increase in the warming rate is due to 2024 being the warmest year on record in Canada and globally, and to the use of an updated (fourth generation) temperature dataset. Compared to the third generation dataset used in last year's indicator, the fourth generation dataset provides improved spatial and temporal data coverage. This includes double the number of stations in northern Canada resulting from a new process for filling missing values. The increased number of stations in northern Canada (where observed warming is generally higher than in southern Canada) contributes the increased warming trend. The new dataset also corrects the cold bias in daily minimum temperatures for all 505 stations, compared to 96 corrected stations in the third generation dataset, also contributing to the increased trend. For more information, please consult Canada's fourth generation of homogenized surface air temperature and its trends for 1948-2023.

Caveats and limitations

Breaks in the data can be a concern. To mitigate this, the Temperature change in Canada indicator uses homogenized and adjusted station data for temperature. Adjustments for data variations caused by changes in site exposure, location, instrumentation, observer, and observing procedures over the 77-year reporting period were performed on the dataset. Observations from nearby co-located stations are sometimes merged to produce longer time series.

Resources

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Related information

Canada's 10 most impactful weather stories of 2024

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Annex

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

Table A.1. Data for Figure 1. Annual average temperature departures from the 1961 to 1990 reference value, Canada, 1948 to 2024

Year	Temperature departure (degree Celsius)	Warmest year ranking
1948	-0.4	64
1949	-0.4	66
1950	-1.5	76
1951	-0.8	73
1952	0.6	34
1953	0.6	30
1954	-0.2	56
1955	-0.3	63
1956	-0.9	74
1957	-0.4	65
1958	0.4	40
1959	-0.6	69
1960	0.3	43
1961	-0.3	61
1962	-0.2	57
1963	0.1	46
1964	-0.6	70
1965	-0.7	71
1966	-0.3	62
1967	-0.5	67
1968	0.1	45
1969	0.3	42
1970	-0.3	60
1971	0.0	50
1972	-1.9	77
1973	0.7	27
1974	-0.7	72
1975	-0.1	53
1976	0.1	48
1977	1.0	21
1978	-0.5	68
1979	-0.2	58
1980	0.4	39
1981	2.0	8
1982	-1.0	75
1983	0.1	44
1984	0.3	41
1985	0.0	51
1986	0.1	47
1987	1.6	14
1988	0.8	26
1989	-0.2	59
1990	-0.1	55
1991	0.5	37
1992	-0.1	54
1993	0.5	38
1994	0.5	35
1995	0.6	33
1996	0.0	52
1997	0.6	29
1998	2.3	5
1999	1.7	11
2000	0.8	23
2001	1.8	10
2002	0.5	36
2003	1.1	20
2004	0.0	49
2005	1.6	12
2006	2.5	4
2007	0.9	22
2008	0.7	28
2009	0.8	24
2010	3.1	2
2011	1.4	15

Year	Temperature departure (degree Celsius)	Warmest year ranking
2012	1.8	9
2013	0.8	25
2014	0.6	31
2015	1.3	16
2016	2.1	6
2017	1.6	13
2018	0.6	32

Year	Temperature departure (degree Celsius)	Warmest year ranking
2019	1.1	18
2020	1.2	17
2021	2.1	7
2022	1.1	19
2023	2.9	3
2024	3.1	1

Note: Annual average temperature departures were computed for weather stations across Canada with sufficiently long data records to allow for trend calculation and were then interpolated to a 10-kilometre spaced grid. Annual grid point values were averaged together to produce an annual time series of temperature departures representing the entire country. Departures are calculated by subtracting the 1961 to 1990 reference value from the annual average. A positive departure indicates that the observed temperature was warmer than the reference value, while a negative departure indicates the opposite.
Source: Environment and Climate Change Canada (2025) Canadian homogenized monthly surface air temperature.

Table A.2. Data for Figure 2. Seasonal average temperature departures compared with the 1961 to 1990 reference value, Canada, 1948 to 2024

Year	Temperature departure in winter (degree Celsius)	Temperature departure in spring (degree Celsius)	Temperature departure in summer (degree Celsius)	Temperature departure in autumn (degree Celsius)
1948	0.0	-2.1	0.2	1.5
1949	-2.0	0.1	-0.4	0.5
1950	-3.3	-1.2	-1.1	-1.1
1951	-0.5	0.0	-0.6	-1.0
1952	-1.6	1.4	-0.3	0.5
1953	1.9	0.9	-0.3	1.1
1954	-0.5	-1.6	0.0	0.9
1955	0.7	-0.7	0.5	-0.6
1956	-0.6	-1.6	-0.7	-0.7
1957	-2.1	0.1	-0.7	0.3
1958	1.1	1.1	-0.4	0.0
1959	-1.0	-0.9	-0.7	-1.3
1960	2.4	-0.8	0.2	0.1
1961	0.6	-1.0	0.5	-0.5
1962	-1.7	-0.4	-0.1	0.8
1963	0.3	-0.6	0.0	1.1
1964	1.3	-2.0	-0.6	-0.1
1965	-2.2	-0.1	-0.8	-1.1
1966	-0.4	-0.2	0.1	-0.7
1967	-0.7	-2.1	-0.1	0.6
1968	0.5	0.7	-1.1	1.4

Year	Temperature departure in winter (degree Celsius)	Temperature departure in spring (degree Celsius)	Temperature departure in summer (degree Celsius)	Temperature departure in autumn (degree Celsius)
1969	0.2	-0.2	-0.5	0.2
1970	1.3	-0.4	0.4	0.2
1971	-1.2	0.5	0.1	0.5
1972	-3.5	-1.2	-0.7	-1.8
1973	-1.1	1.1	0.8	0.6
1974	-1.1	-2.0	0.0	-0.5
1975	0.3	-0.1	0.8	0.1
1976	-0.4	0.4	0.1	0.2
1977	1.6	2.1	-0.3	0.8
1978	0.3	-0.7	-1.0	-1.4
1979	-1.8	-0.3	-0.1	0.8
1980	1.9	1.4	0.0	0.3
1981	2.4	1.6	0.5	1.5
1982	-1.0	-1.2	-0.4	-0.5
1983	0.4	-0.7	0.6	1.1
1984	0.2	1.1	0.7	-0.7
1985	-0.4	0.3	-0.3	-1.2
1986	1.8	0.6	-0.7	-1.8
1987	3.4	1.1	0.0	1.3
1988	1.5	1.9	0.7	0.4
1989	0.1	-0.7	1.0	-0.6
1990	-1.0	1.2	0.5	-0.8
1991	-0.5	1.3	0.9	-0.6
1992	1.1	0.1	-0.9	-0.2
1993	0.1	1.4	0.3	-0.5
1994	-1.6	1.0	0.8	1.5
1995	1.8	0.9	0.8	0.0
1996	-0.5	-0.5	0.6	-0.3
1997	0.6	-0.7	0.7	0.8
1998	3.0	2.9	1.8	2.3
1999	2.4	2.5	0.6	1.1
2000	2.5	1.3	0.2	0.7
2001	1.2	1.8	1.0	1.6
2002	2.4	-1.9	0.6	0.7
2003	2.0	0.2	0.9	1.6
2004	1.5	-0.5	-0.1	0.7
2005	0.3	2.2	0.6	1.9
2006	3.9	3.1	1.4	1.0

Year	Temperature departure in winter (degree Celsius)	Temperature departure in spring (degree Celsius)	Temperature departure in summer (degree Celsius)	Temperature departure in autumn (degree Celsius)
2007	3.1	0.5	0.9	0.7
2008	0.5	0.3	1.0	1.6
2009	0.1	-0.5	0.4	2.0
2010	4.0	4.1	1.2	2.2
2011	2.4	-0.1	1.2	2.1
2012	3.7	1.8	1.9	1.0
2013	1.6	0.5	1.0	1.3
2014	-0.6	-0.6	1.2	0.4
2015	0.7	1.1	1.0	1.8
2016	4.0	1.7	1.5	2.4
2017	3.0	0.8	1.1	1.1
2018	1.3	0.5	0.8	-0.8
2019	1.1	1.6	0.7	1.6
2020	2.1	0.1	1.4	0.7
2021	3.6	1.4	1.4	3.2
2022	-0.2	0.8	1.7	2.0
2023	1.9	2.0	2.2	3.4
2024	5.3	2.7	1.8	3.7

Note: Seasonal average temperature departures were computed for weather stations across Canada with sufficiently long data records to allow for trend calculation and were then interpolated to a 10-kilometre spaced grid. Seasonal grid point values were averaged together to produce a seasonal time series of temperature departures representing the entire country. Seasons are defined as winter (December, January, and February), spring (March, April, and May), summer (June, July, and August), and autumn (September, October, and November). Departures are calculated by subtracting the 1961 to 1990 reference value from the annual average. A positive departure indicates that the observed temperature was warmer than the reference value, while a negative departure indicates the opposite.
Source: Environment and Climate Change Canada (2025) Canadian homogenized monthly surface air temperature.

Additional information can be obtained at:

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