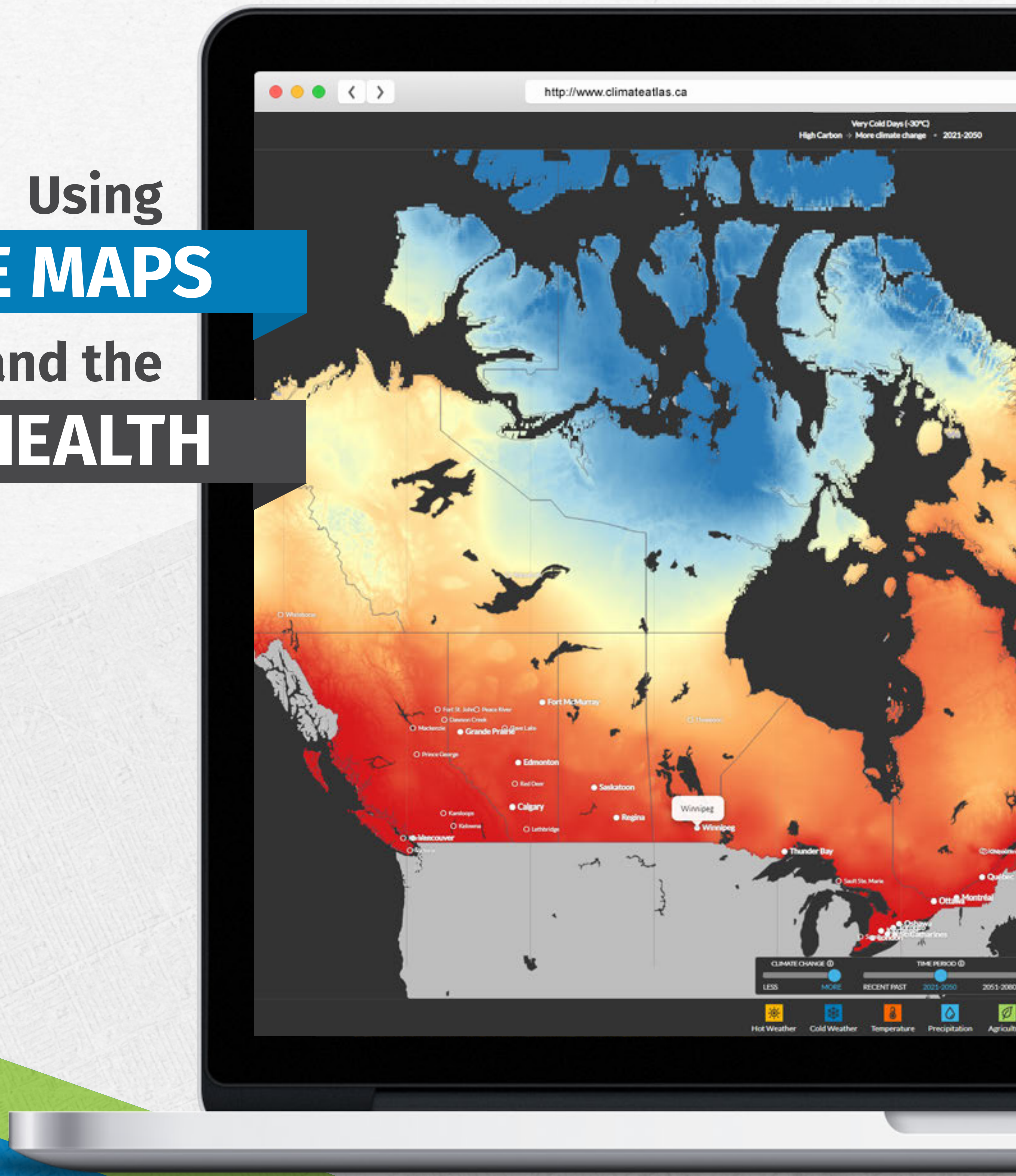
Prairie Climate Centre

# The Climate Atlas and Health

## Using CLIMATE MAPS to understand the FUTURE OF HEALTH

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Prairie
Climate Centre

***The Climate Atlas and Health:***
Using climate maps to understand the future of health



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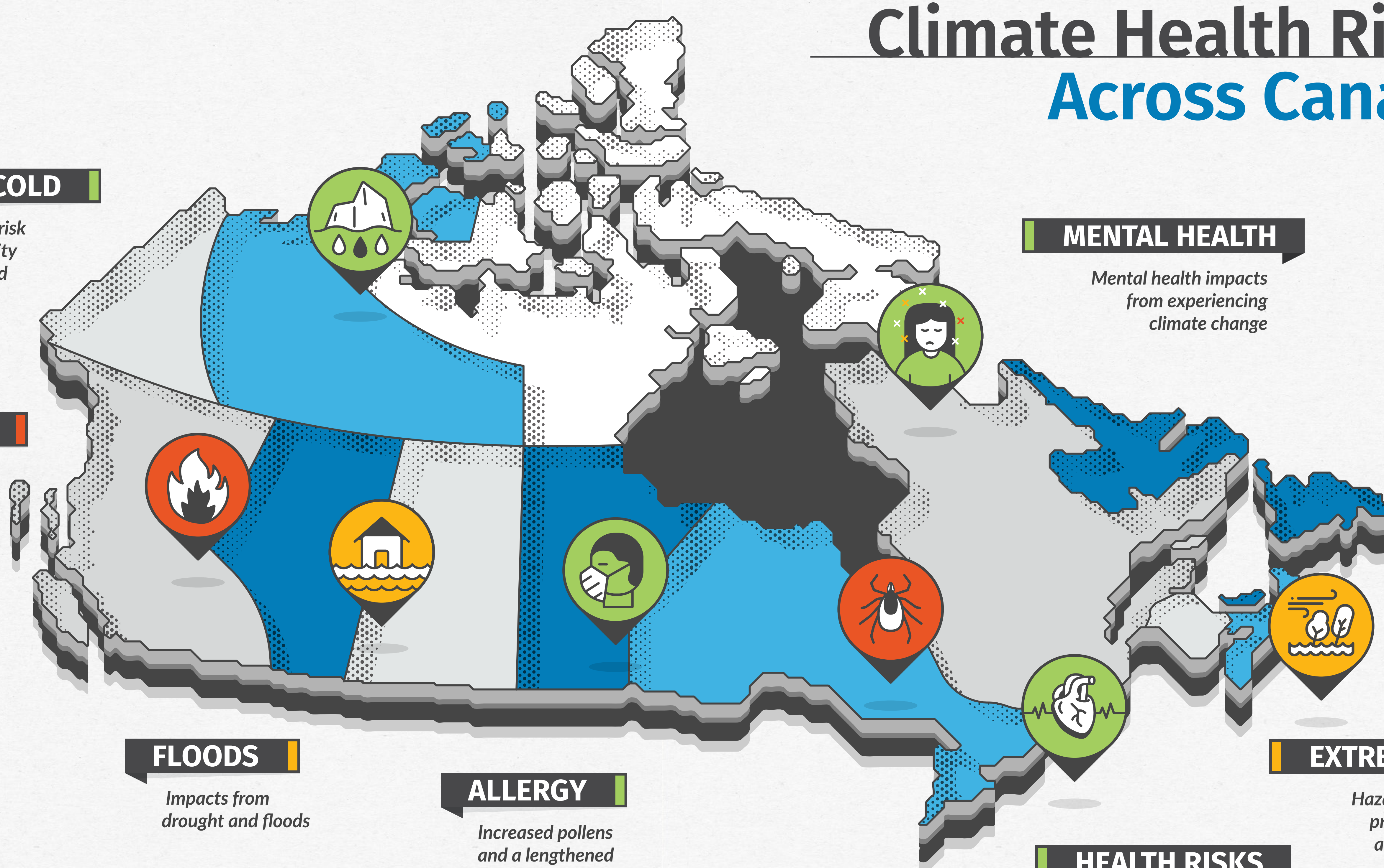
# Introduction

**Climate change is a global issue** affecting the health of communities and individuals. However, the impacts and solutions can be very different depending on what area of Canada you live. Understanding the magnitude of the changes and risks locally and regionally, allows citizens, politicians, and planners to take meaningful action to mitigate and adapt.

Maps are great tools to communicate information, this includes information on future climate projections and public health. They help visualize data at national, regional, and local scales. This helps readers connect with locations that are known and loved, making the information more relatable and relevant.

Maps often contain so much information that we can all use a little help to ensure important details are not missed. This guidebook will provide a detailed explanation of maps and how they can be used to describe some of the key climate impacts facing the health of Canadians.

# Climate Health Risks
# Across Canada



**LOSS OF COLD**

*Physical injury risk and food security from loss of cold*

**AIR QUALITY**

*Wildfire damage and poor air quality from smoke*

**FLOODS**

*Impacts from drought and floods*

**ALLERGY**

*Increased pollens and a lengthened allergy season*

**DISEASES**

*Tick- and Mosquito-borne diseases*

**HEALTH RISKS**

*Heat-related health risks*

**EXTREME EVENTS**

*Hazards from extreme precipitation events and coastal erosion*

**MENTAL HEALTH**

*Mental health impacts from experiencing climate change*

## Impacts

Climate is impacting the health of Canadians in many ways. While physical health risks come from increased injury risk, heat illness, air quality issues, and diseases, it is also important to acknowledge the mental health impact climate has on all Canadians.
To read more on the health impacts of climate change visit the *Health topic* or read the *Connecting Climate Change and Health* report on the Climate Atlas of Canada.

# The basics of maps

**Maps are powerful tools** to help visualize data and information. They allow us to see patterns or changes across space. While maps are very useful for a variety of professions, including policy-makers, engineers, planners, geologists, and pilots, to name a few, they are also widely used on a day-to-day basis for common things, like navigating in an unfamiliar place.

There are many different types of maps. Each map aims to communicate different information, and can be used for a variety of purposes. However, most maps will have common features that are key to help understand the information that is being displayed. Below is an overview of these features.

## *Data/Information:*

The type of data that could be represented by a map is vast. An important first step when looking at a map is to identify the type of data and the information it is communicating.

The maps on the Climate Atlas display climate model data of the past and future, however, there are many other types of data that can be presented. For instance demographic data, economic data, indicators of health, geography and elevation, etc. By combining or comparing maps showing different types of data we are able to see patterns or trends which improves our understanding and supports decision-making.

## *Visual components:*

For a map to be effective, it has to contain some key visual elements which will help the reader understand what the map is trying to show. Here are some key elements you can expect to see on any map, including the ones in this guide:[1]

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1 *Making Maps 101 - Layout, elements, and design*

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### *Legend or Key:*

This explains symbols and colours used on the map by identifying a sample of the symbol/ colour along with a short description.

### *Title:*

The title is the subject of the map. Effective titles have the geographic location of the map, what it is indicating and a date or year.

### *Scale:*

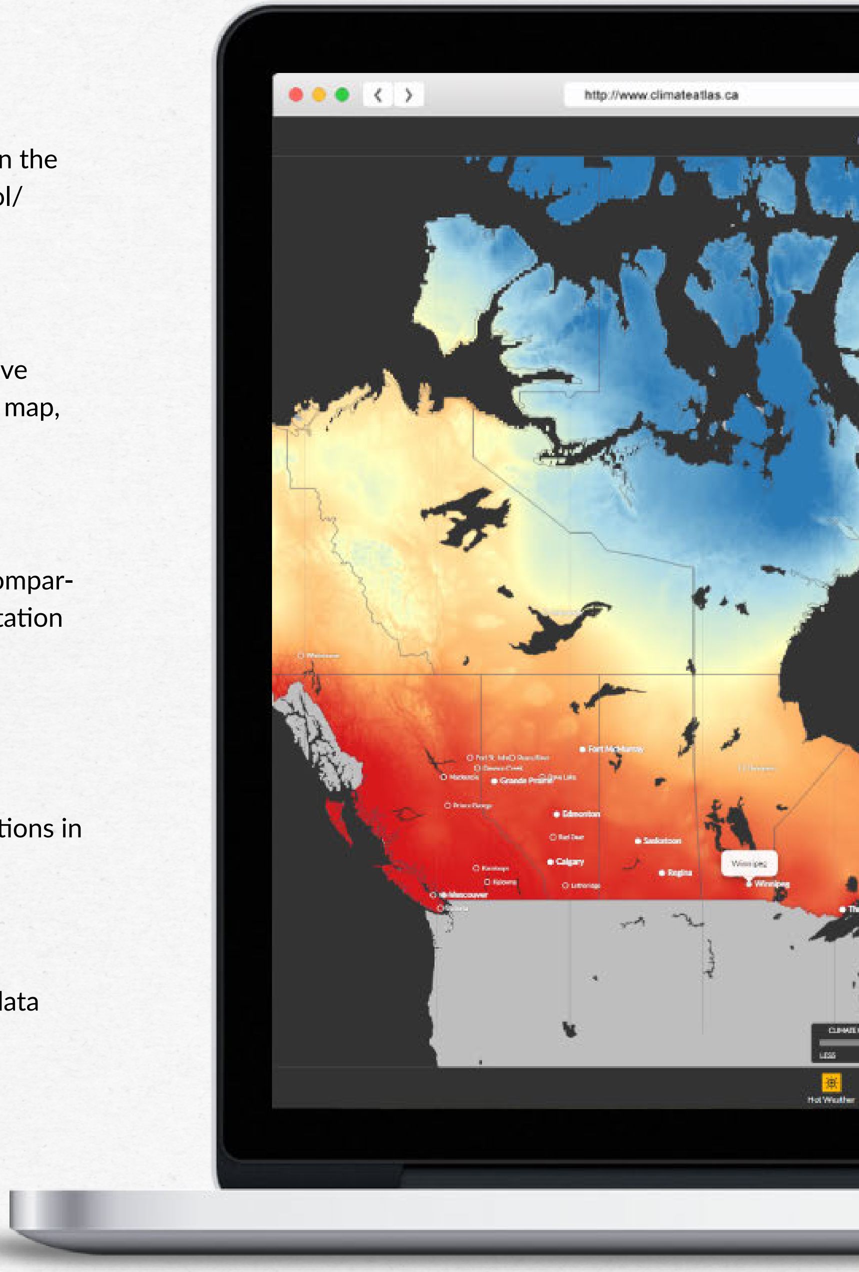
The scale is usually displayed as a ratio comparing one map unit to its distance representation in real world context.

### *Orientation indicator:*

This shows the relationship between the directions on the map and compass directions in real world context.

### *Source:*

This identifies where the information or data about the map came from.




### *Climate Projection Maps:*

- *This guidebook features maps from the **Climate Atlas of Canada**, an online interactive map that displays climate model projections for different time frames and climate change scenarios. The primary source of climate model data presented in this Climate Atlas maps is the **Pacific Climate Impacts Consortium (PCIC)** statistically downscaled data.*

  *Climate projection maps allow you to explore what climate models say about future climate across the country and specifically where you live.*

# Regional changes

**Regions across Canada** are experiencing impacts from climate change differently. Focusing on each region can allow for a more detailed understanding of climate change experiences, and future expectations. The following sections provide an overview of the impacts in each region through maps found on the Climate Atlas. Each section will provide an explanation of the features of the map and an interpretation of the information it communicates. The maps are based on historical data that has been used to create future models of projected trends we are seeing with our climate. They show the change from the recent past to the near future (i.e. a warming of 4.8°C in Winnipeg from 1976-2005 to 2051-2080) rather than expected values to make it easier to compare the differences.

## *North: Yukon, NWT, Nunavut*

The north is warming faster than the rest of Canada, making it a highly vulnerable region for climate change impacts. Loss of winters and ice increases risks of injury/death and mental health impacts. Foodborne illnesses can also increase with climate change in the north as after increased rainfall and snowmelt events there are more visits to health clinics with foodborne illness symptoms in the following weeks.[2] Changing climate has impacted sea-ice, wildlife, and vegetation, making it more challenging for hunting, fishing, and foraging. Water is also impacted by changes in climate as supply and quality become affected. Food and water insecurities can lead to poor nutrition, gastrointestinal issues, diabetes, mental health concerns, and other negative health effects.[3] Climate change is impacting the Inuit way of life as the cold and sea ice are at the center of culture, transportation, safety, health, and education.

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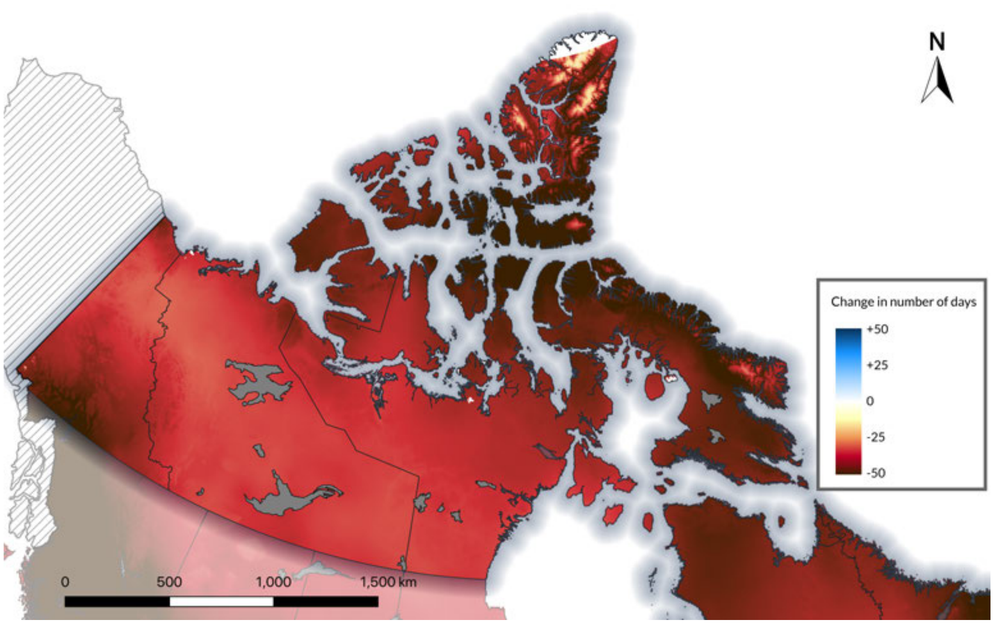
2 *https://nunatsiaq.com/stories/article/northern-communities-face-one-of-biggest-climate-change-risks-study-says/*

3 *At-a-glance – Climate change impacts on health and wellbeing in rural and remote regions across Canada: a synthesis of the literature*

*(2051-2080)*

## Projected Change in Annual Number of Frost Days

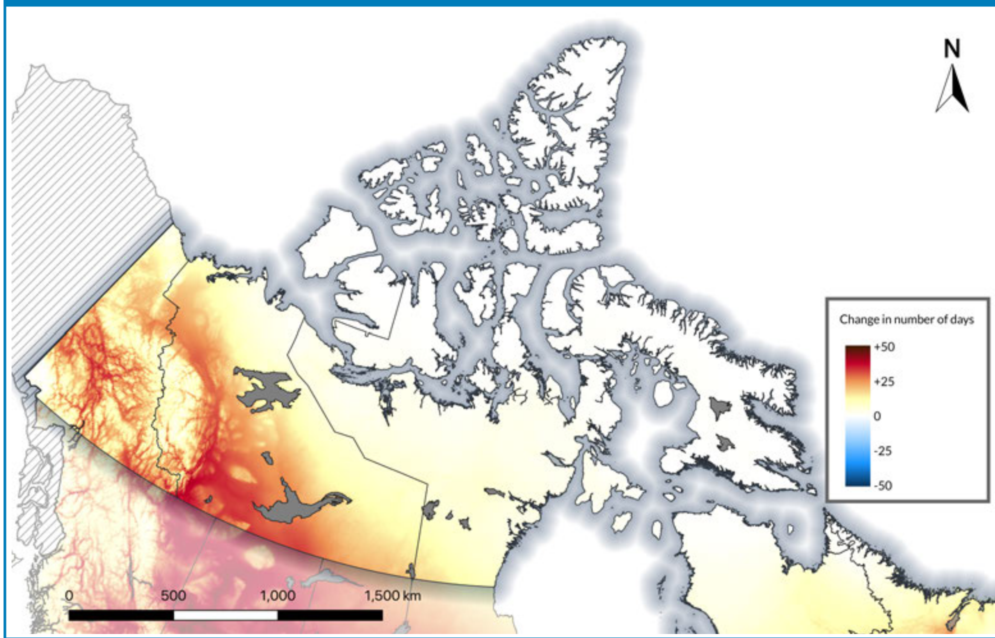



*The legend of this map shows variation in annual number of frost days across the northern region of Canada. A frost day is one on which the coldest temperature of the day is lower than 0°C. The values range from -50 days which is indicated by dark red on the map and increases to +50 days indicated by dark blue (which is not present on the map). Areas on the map shaded in dark red on the map will experience fewer frost days a year than the rest of the region*

View map on the **Climate Atlas** >

*(2051-2080)*

## Projected Changes in Annual Number of Summer Days




*The legend of this map shows variation in annual number of summer days across the northern region of Canada. A Summer Day is a day when the temperature rises to at least 25°C. The values range from -50 days which is indicated by dark blue on the legend and increases to +50 days indicated by dark red. Areas on the map shaded in red on the map will experience more summer days than the rest of the region.*

View map on the **Climate Atlas** >

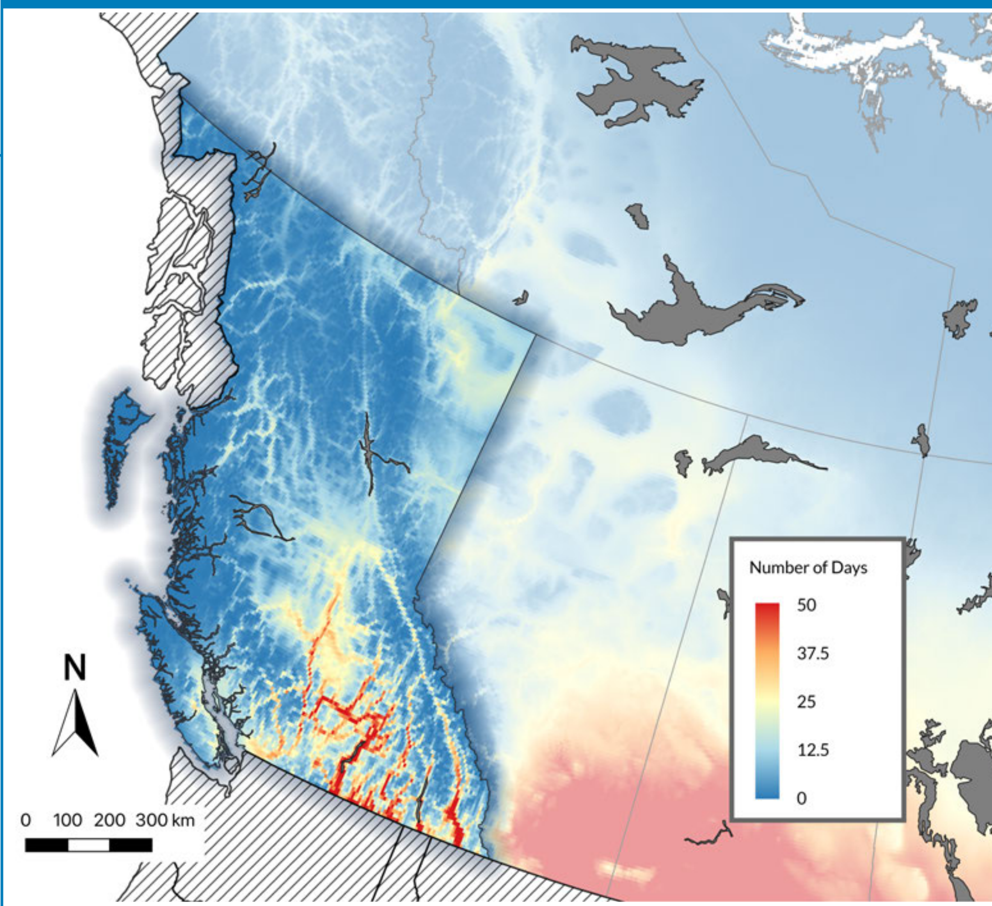
***Feature content:***

- *Visualizing Changing Oceans Through Collaborative Research in Pangnirtung, Nunavut*
- *The Ocean From My Eye*
- *Indigenous Knowledge Science and Climate Change in the North*

### *West: BC*

Global warming has a direct and obvious effect on wildfire risk by raising temperatures, which will dry out vegetation more quickly and more thoroughly. The presence of all this dry fuel will allow more fires to start and then burn farther and wider. Warmer weather is also causing earlier snowmelt and later fall frosts, which are expanding the fire season. More wildfires mean more wildfire smoke, and more smoke means more smoke-related health problems. And since smoke travels easily, these health problems don't only affect people who live in fire-prone areas. Dense smoke from wildfires can have *fifty times* the amount of these tiny particles than the World Health Organization's guidelines for safe exposure. Emergency room visits spike during wildfires as people experience shortness of breath, coughing and irritation, worsened asthma, and other breathing problems.

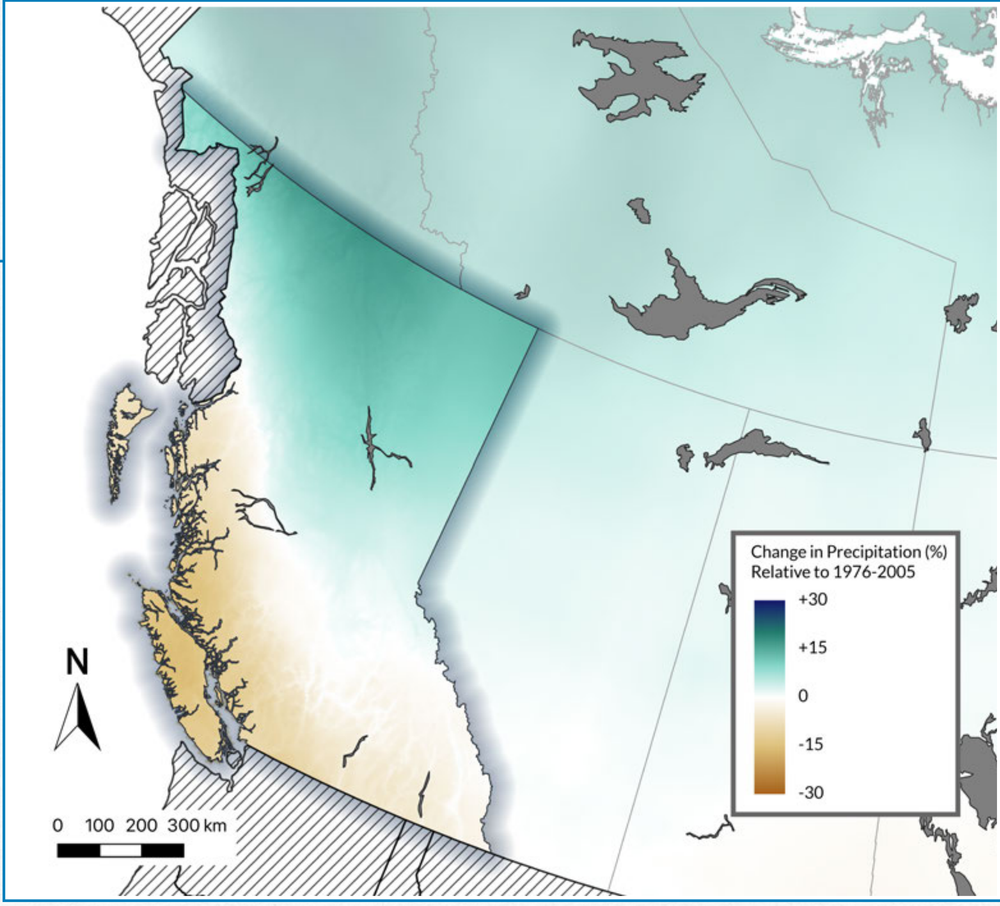
***(2051-2080)***
**Projected Average Number of Very Hot (30°C) Days**




*The legend of this map shows variation in the number of hot days across western Canada. A Very Hot Day is a day when the temperature rises to at least 30°C. The values start at 0 days which is indicated by blue on the map and increase to 50 days indicated by the colour red on the map. Areas on the map shaded in yellow or red on the map will experience 25-50 very hot days compared to the rest of the region.*

View map on the
Climate Atlas ›

*(2051-2080)*
## Projected Change in Summer Total Precipitation




*The legend of this map shows variation in Summer Total Precipitation across western Canada. Summer precipitation is the total amount of rain that will fall between June, July, and August. The values start at -30% change which is indicated by brown on the map and increase to +30% change indicated by blue on the legend. Areas on the map shaded in brown on the map will experience a decrease in summer precipitation compared to the blue shaded areas which will see an increase in summer precipitation.*

View map on the
**Climate Atlas** ›

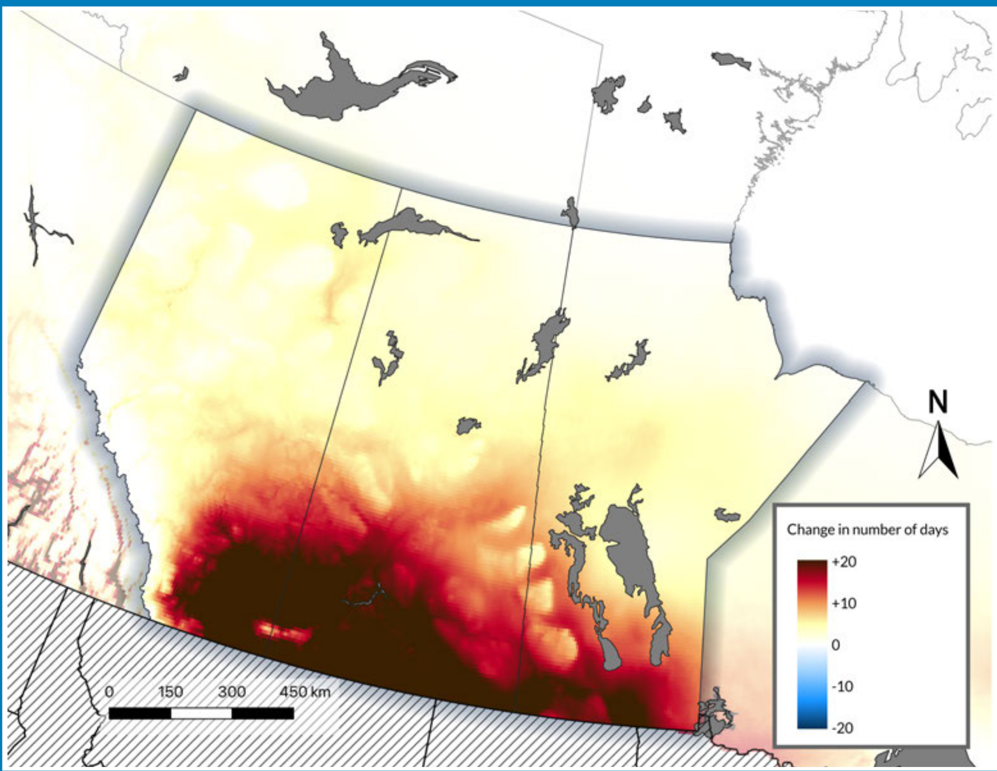
***Feature content:***

- *When Wildfires Strike*
- *Vancouver: "Greenest City in the World by 2020"*
- *Why Hope Matters*

## *Prairies: AB, SK, MB*

The prairies are expected to become a climate change hotspot, seeing some of the most extreme changes in climate which will impact the population in various ways. Infrastructure is falling behind and no longer compatible with changing climate norms as it degrades our roads and buildings including our homes faster, and in turn, negatively impacts our safety and wellbeing if not addressed. The prairies can expect to see an increase in weather extremes such as record temperatures (both high and low), large scale storms, flooding, droughts and forest fires. While the crop season lengthening may seem potentially beneficial for economic purposes, this lengthened season also increases disease carrying vectors (such as tick- and mosquito-borne diseases like west nile and in the prairies as well as an increase in pollens that contribute to seasonal allergies.

*(2051-2080)*
**Projected Change in Annual Number of Extremely Hot Days (+34°C)**

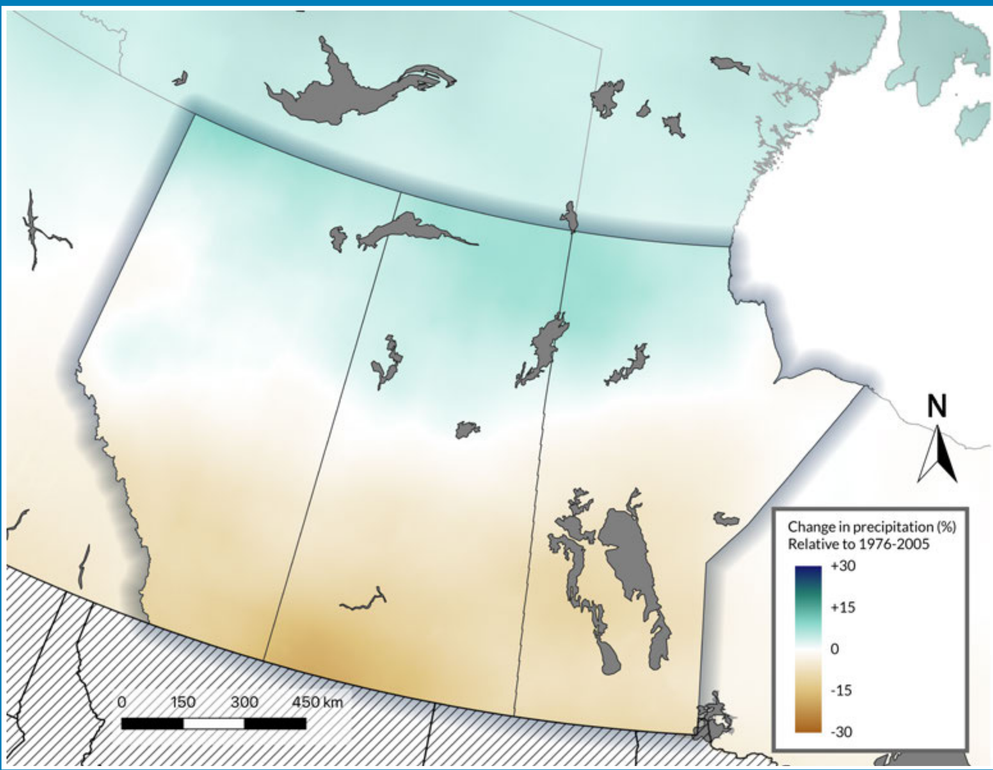



*The legend of this map shows variation in Extremely Hot Days across the prairie provinces. An Extremely Hot Day is when the temperature rises to at least 34°C. The values on this map start at -20 days which is indicated by dark blue on the legend and increases to +20 days indicated by dark red seen on the map. Areas on the map shaded in dark red on the map will experience up to 20 more extremely hot days than the rest of the region.*

View map on the
Climate Atlas ›

*(2051-2080)*

**Projected Change in August Total Precipitation (%)**




*The legend of this map shows change in total precipitation for the month of August across the prairie provinces. August total precipitation is that amount of rain that will fall during the month of August. The values start at -30% change which is indicated by brown on the legend and increase to +30% change indicated by dark blue on the legend. Areas on the map shaded in brown on the map will experience a decrease in August precipitation compared to the rest of the region.*

View map on the
Climate Atlas ›

***Feature content:***

- *Prairie Communities Adapting to Climate Change*
- *Waterborne Disease and Climate Change*
- *Overcoming Climate Anxiety*
- *Toddi Steelman: Learning to Coexist with a Longer, Hotter Fire Season*

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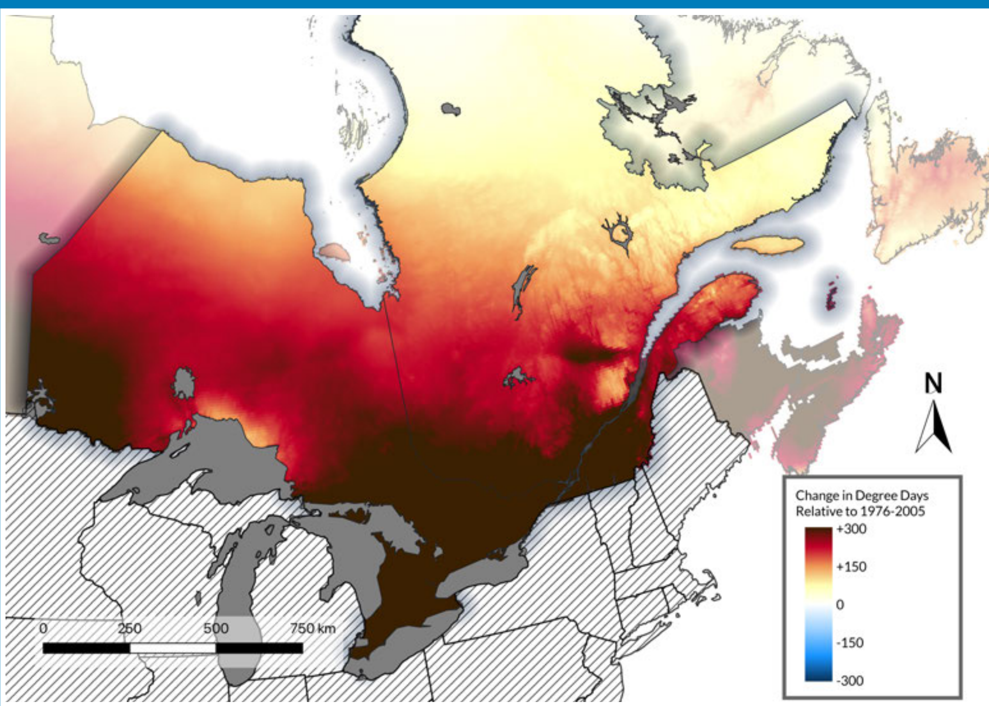
## Central: ON, QC

Communities across Canada know the dangers of heat all too well. In general, a heat wave is an extended period of unusually hot weather. While there isn't a simple commonly accepted scientific definition of a heat wave, we define it as a period of at least three days in a row that reaches 30°C or higher. Heat waves are projected to become longer, hotter, and more frequent. Heat waves and extreme heat warnings have happened frequently in recent summers, including in Winnipeg, Ottawa, Halifax, Toronto, and—most dramatically—Montreal. By choosing to green our cities, promote transportation, and shift towards the use of renewables for our energy needs, we can create healthier communities with fewer air pollutants, which are also more resilient to extreme heat.

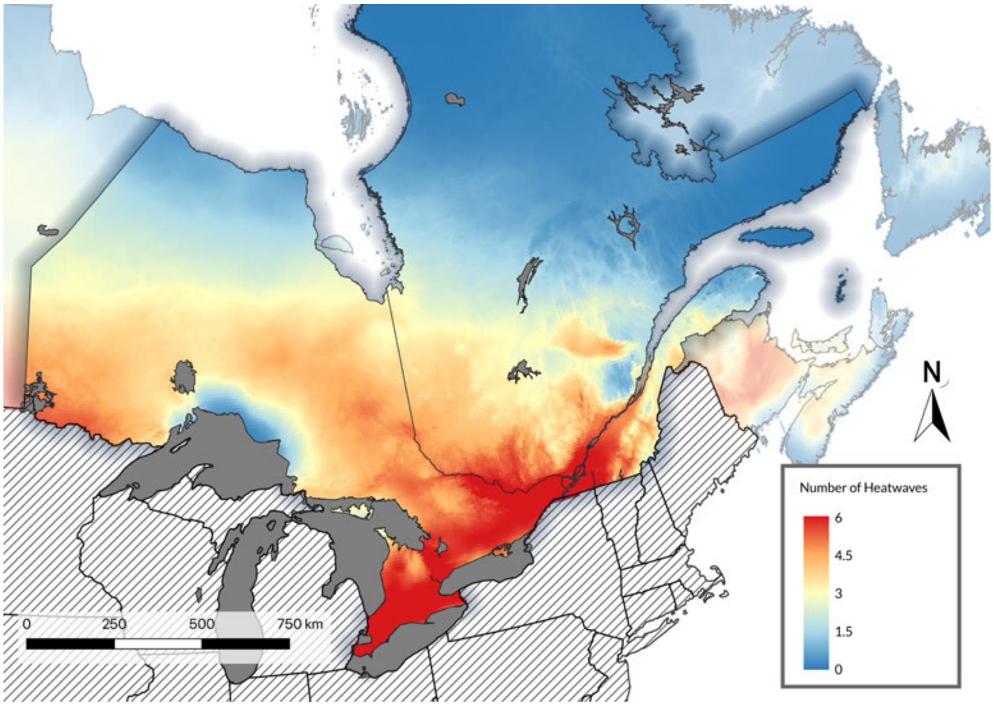
*(2051-2080)*
**Projected Change in Annual Total Cooling Degree Days**




*The legend of this map shows variation in cooling degree days across central Canada. Cooling Degree Days (CDD) are equal to the number of degrees Celsius a given day's mean temperature is above 18°C (For example, if the daily mean temperature is 21°C, the CDD value for that day is equal to 3°C.) We use 18°C as the base because this is the temperature which air conditioning is required to cool buildings. The values start at -300 degree days which is indicated by dark blue on the legend and increase to +300 degree days indicated by dark red on the map. Areas on the map shaded in dark red on the map will experience up to 300 more cooling degree days.*

View map on the Climate Atlas ›

*(2051-2080)*
## Projected Average Annual Number of Heatwaves




*The legend of this map shows the expected future number of heatwaves expected across central Canada. A heatwave is considered to be a span of at least 3 consecutive days that are at or above 30°C. The values start at 0 which is indicated by blue on the map and increase to 6 indicated by red on the map. Areas on the map shaded in red on the map could experience up to 6 heatwaves a year.*

View map on the
**Climate Atlas** >

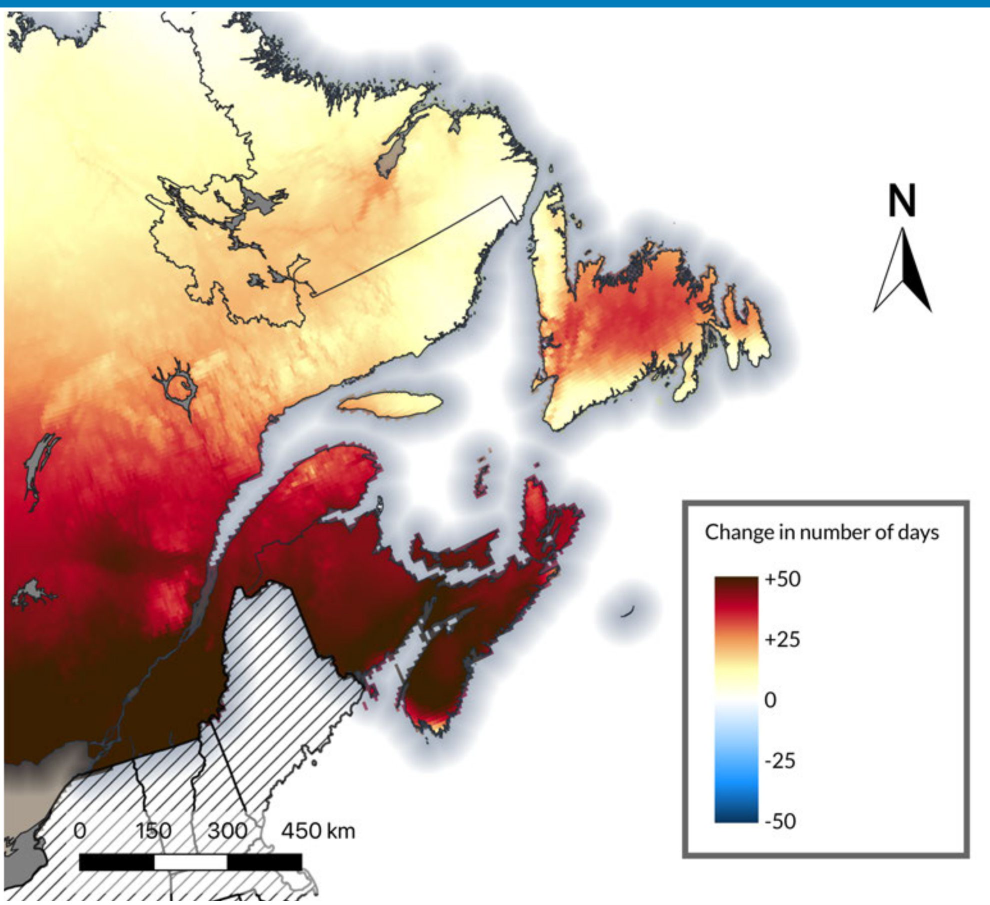
***Feature content:***

- *Lyme Disease Under Climate Change*
- *Health Impacts of Extreme Heat*
- *Aggravated allergies*
- *Quality Control: Wildfires, Water, and our Health*

## *Atlantic: NB, NS, PEI, NL*

Increased precipitation and storm surges are causing an increase in coastal erosion and flooding across the region. Climate change is also bringing higher tides and stronger winds leaving more and more people shouldering the costs and risks. Places like Prince Edward Island are slowly disappearing into the ocean, in large part due to climate-change-related sea level rise and powerful storm surges which are increasing erosion of the island's soft sandstone base. Tides have become noticeably different and have destroyed infrastructure including lighthouses, bridges, wharfs, streets, boardwalks, water wells, and sewer lines. Heavy investments are needed for shoreline protection for those with homes close to the sea in order to minimize the need to evacuate. Experiences with and witnessing climate change both dramatically or gradually, such as experiencing flooding events and observing coastal erosion, can lead to significant mental health impacts.

***(2051-2080)***
**Projected Change in Annual Number of Summer Days**

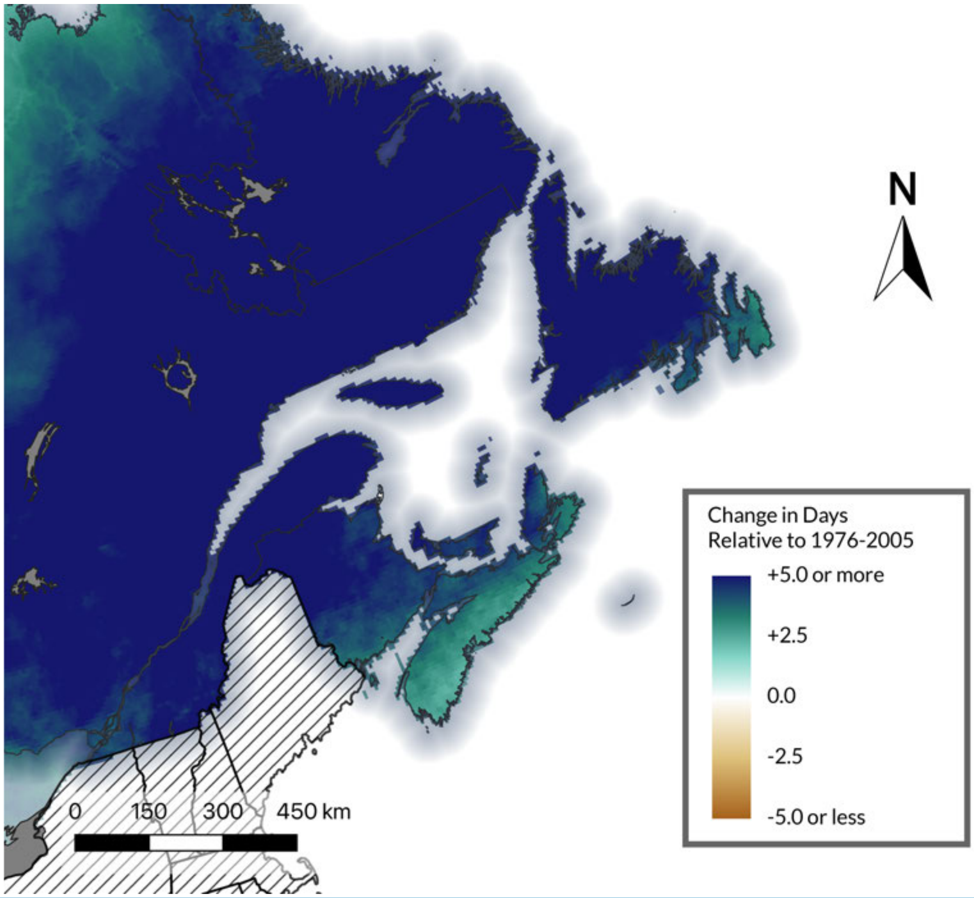



*The legend of this map shows variation in annual number of summer days across the eastern region of Canada. A Summer Day is a day when the temperature rises to at least 25°C. The values range from -50 days which is indicated by dark blue on the legend and increases to +50 days indicated by dark red. Areas on the map shaded in red on the map will experience more summer days than the rest of the region.*

View map on the
Climate Atlas ›

*(2051-2080)*

**Projected Change in Annual Number of Heavy Precipitation Days (10mm)**




*The legend of this map shows variation in precipitation across eastern Canada. Annual Heavy Precipitation Days (HPD) is the total annual days on which at least 10 mm of rain or frozen precipitation falls. The values start at -5 days which is indicated by brown on the legend and increases to +5 days indicated by dark blue seen on the map. Areas on the map shaded in dark blue on the map can expect to experience an increase of 5 or more heavy precipitation days.*

View map on the
Climate Atlas >

***Feature content:***

- *Storms of the future*
- *Prince Edward Island: Life on a Shrinking Island*
- *Ferryland, Newfoundland: Small Towns vs Sea Level Rise*
- *Indian Island, New Brunswick: Adapting to Sea Level Rise*

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# Urban heat island effect

**So far only maps from the Climate Atlas have been presented,** however, there are many different types of maps that are used to present different types of information. For more localized information, you can find maps with even more details.

These types of maps can inform community-based planning by identifying high risk areas for climate health impacts (such as heat illness). This information is important for community planning and policy development to protect populations against climate change. In this section, the Urban Heat Island effect will be explained featuring maps from Vancouver, Toronto, Montreal, and Winnipeg to highlight some maps using historical climate information.

**Note:** the maps in this section are showing data values from a particular place and time, compared to the above maps which have shown future climate projection of data. While all the maps show the urban heat island effect effectively, the maps for each city are not comparable to each other as their legends are not compatible and are displaying the urban heat island effect using different variables.

*Urban heat island effect*

## Urban Heat Island

*Urban Heat Island (UHI) effect describes the temperature difference between urban (or city) areas and nearby rural areas. Our cities are often filled with buildings and paved surfaces that trap heat far more effectively than natural ecosystems and rural areas. Heat from the sun, known as solar radiation, is absorbed by these man-made surfaces (e.g., concrete, brick, asphalt etc.) which later contribute to an increased air temperature in urban areas.*

*UHI effect is more pronounced in large cities where surfaces can absorb large quantities of solar radiation during the day and release the heat at night. Large cities can be as much as 12 °C warmer than their surrounding environments in the evening (Health Canada, 2020).*

## UHI Health Impacts

*The health risks of extreme heat events are intensified by the UHI effect. Vulnerable populations including children, seniors, and people with chronic illness, are at particular risk of respiratory difficulties, heat cramps, exhaustion, heat stroke, and heat-related mortality (Health Canada, 2020).*

*Marginalized people such as socially isolated, homeless or low-income people are also vulnerable to extreme heat particularly in regions where air conditioners and mechanical ventilation systems are not available in apartment buildings and homes.*

## UHI in Canadian regions

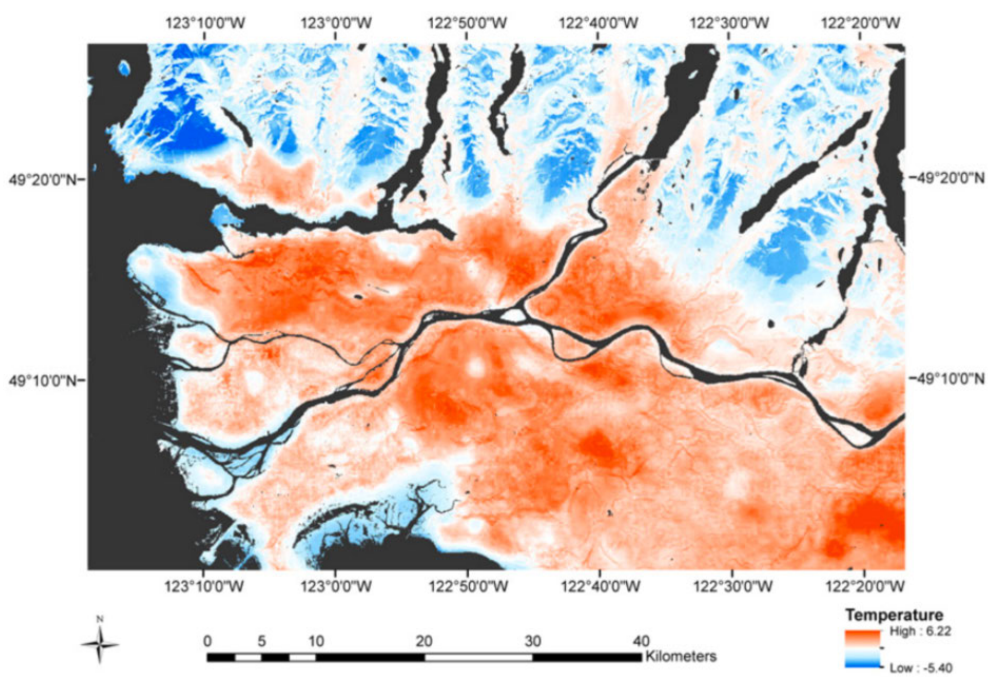
*UHIs are more pronounced in the southern parts of Canada. If greenhouse gas emissions are not reduced, projections for 2051-2080 show that many Canadian cities will see at least four times as many +30°C days per year on average as they have in the recent past (Climate Atlas of Canada).*

### *Vancouver*

In Metropolitan areas of Vancouver, residential, commercial and industrial land uses have been replacing natural vegetation covers. As a result, the surface temperature is rising. Dense urban areas like Metro Vancouver tend to be hotter than surrounding areas due to the UHI effect.

In June of 2021, Metro Vancouver went through a deathly hot heat event that is usually temperate in the summer. This record-breaking temperature was caused by a “Heat Dome” where hot air was “trapped” over Western Canada which led to the prolonged period of heat. Temperatures in the downtown area exceeded 40°C. The BC government reported that the Heat Dome resulted in 619 deaths which is far greater than the typical year. Many of the victims were without adequate cooling and from vulnerable populations such as senior citizens, low-income people, people with pre-existing health issues. (Gov BC, 2022)

**Maximum apparent temperature relative to Vancouver airport**



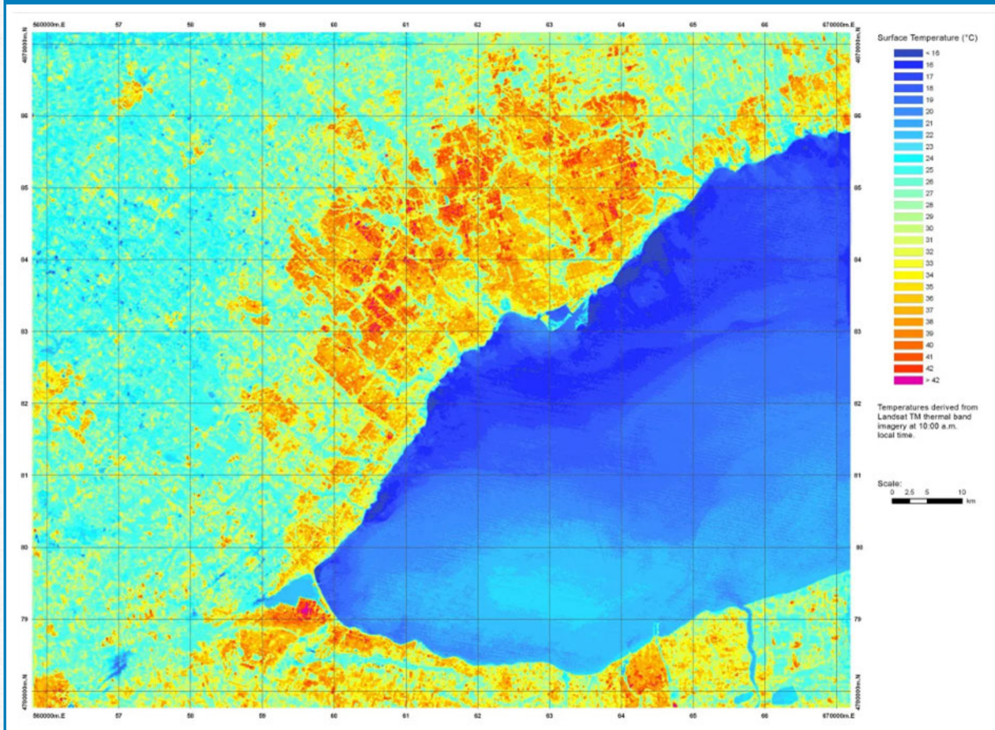

*This is a Map of the Metropolitan Area of Vancouver. The map depicts the temperature difference between the Vancouver Airport and Vancouver and the surrounding area. The map shows relatively high temperatures observed in the urban areas as opposed to temperatures found in the mountainous areas of West and North of Vancouver. Due to the sea breeze cooling and “wall effect”, downtown Vancouver is relatively cooler (shown as dark blue) than other major urban areas. The major urban areas in the Vancouver Metropolitan area are the most densely populated and developed which contributed to higher apparent temperatures (shown as dark red) than the surrounding area.*

Source: Ho, Chak et. al. 2016

## Toronto

Toronto is one of the fastest growing urban areas in North America. Toronto's urban atmosphere is strongly affected by the design and density of buildings and by man-made changes to the urban environment. The paved surfaces within the City of Toronto have been constructed using materials that absorb heat from the sun (City of Toronto, 2009). In Toronto, average temperatures are significantly higher for commercial and resource/industrial land uses, and lower for parks and recreational areas, as well as water bodies in Toronto (Rinner et. al. 2011).

***(July 7, 2010)***
**Land Surface Temperature for the Greater Toronto Area**



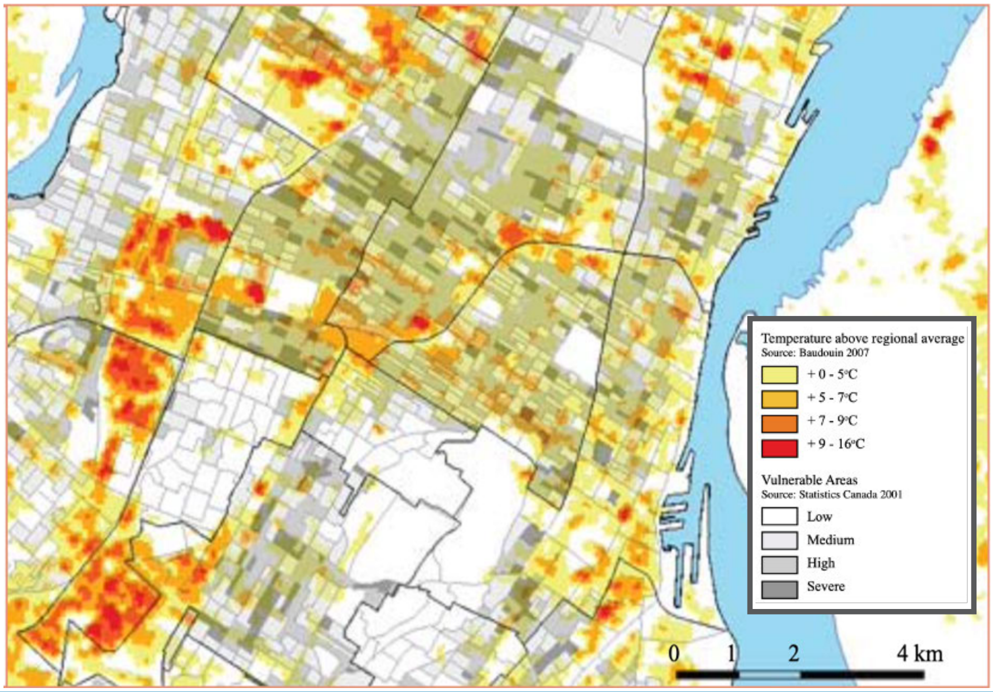

*This is a Map of the Greater Toronto Area. The map shows the land surface temperatures of the different locations in the GTA on July 7, 2010. The map reveals that the southern parts of GTA have relatively cooler temperatures than other urban areas due to the Lake Ontario effect. While the average temperatures are significantly higher for commercial and resource/industrial land uses (shown as dark red), they are lower for parks, recreational land uses and water bodies (shown as orange, yellow and blue). High proportion of built-up surface has contributed to higher temperatures observed in the commercial and resource/industrial land uses of GTA.*

Source: Natural Resources Canada, 2010

## Montreal

Montreal is the second most populated city in Canada. It has a humid climate - the summers are long and warm; the winters are freezing, snowy, and windy; and it is partly cloudy year-round. It is predicted that climate change will make heat waves in Montreal more frequent and more intense. The impact of UHI is not equally observed across Montreal metropolitan areas. Areas that are characterized by large-scale industrial and commercial uses, where dark-surfaced buildings and parking lots predominate in Montreal are more likely to experience severe UHIs (Chan et. al. 2007). Due to lower population density and a lot of tree cover, the western end of the island in Montreal is less vulnerable to urban heat than the central portion of the island.

**An overlay of temperature and UHI vulnerability in central Montreal**




*This is a Map of Central Montreal. The map shows there are two different types of data being displayed. One: the temperature difference between a specific location on the map and the regional average; this is indicated by the yellow to red coloured legend. Two: the Level of Vulnerability of an Area, determined by socio-demographic variables (dependent population, income and people living alone); this is indicated by the white to dark grey legend. Most parts of central Montreal have higher temperatures than the regional average. As expected, the most severe UHIs in central Montreal were located over industrial and commercial developments (shown as dark red) where a higher proportion of the vulnerable populations reside. The purpose of overlaying the two types of data is to help policy makers determine which UHI adaptation strategies make sense for different parts of Montreal.*

Source: Chan et. al. 2007

# General conclusion

**Not all areas of a city,** region, or country will be impacted by changes in climate equally. Additionally, individuals living in certain areas of a city may be less able to cope with changes due to environmental, infrastructural, social and economic reasons.

Maps such as those presented above help create awareness around the most impacted areas and in some cases the most vulnerable areas of a city or region. This supports our collective ability to adopt adaptive health behaviors on an individual level, and encourage policy and infrastructure changes to protect citizens on a regional and community scale.

In the case of Urban Heat Islands, maps like those presented above can support initiatives to combat UHI effects on citizens. Sustainable Montreal, Vancouver's Street Cooling Network, Winnipeg Urban Forest Strategy are great examples of local governments using weather and climate information for on the ground action. Redeveloping traditional infrastructures to implement more green spaces and increase shaded areas to minimize temperature increases in urban areas.

***Reference:***

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