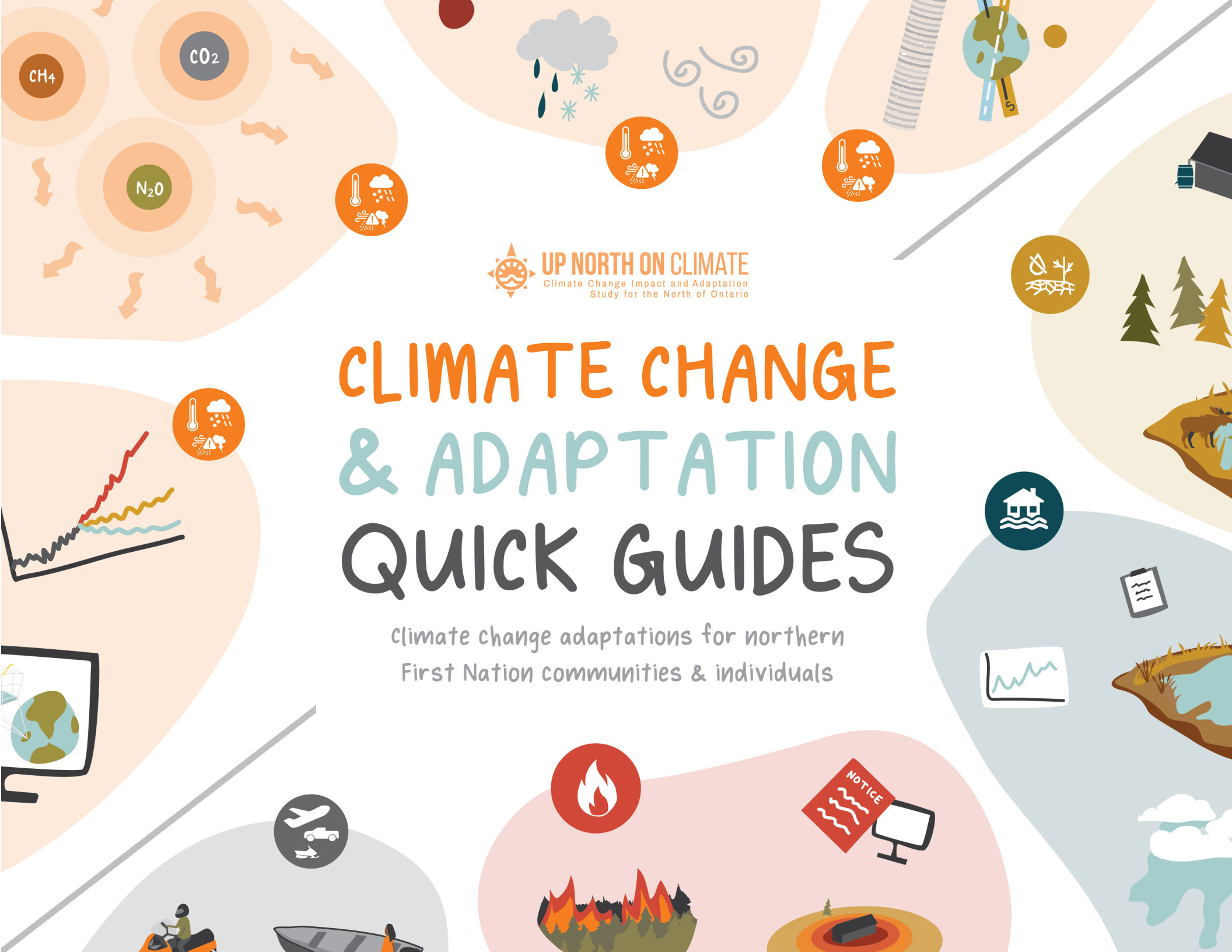
UP NORTH ON CLIMATE
Climate Change Impact and Adaptation Study for the North of Ontario

CLIMATE CHANGE & ADAPTATION QUICK GUIDES

Climate change adaptations for northern First Nation communities & individuals



PICCA Partnership for Indigenous Climate Change Adaptation

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We welcome the use of this document for education or adaptation planning and kindly request it be referenced as follows:

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https://www.upnorthonclimate.ca/adaptation-planning

UP NORTH ON CLIMATE
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Laurentian University
Université Laurentienne

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Building Climate Change Adaptation Capacity of First Nations in Far Northern Ontario Through Knowledge-Exchange and Collaboration

Natural Resources Canada | Ressources naturelles Canada

Canada

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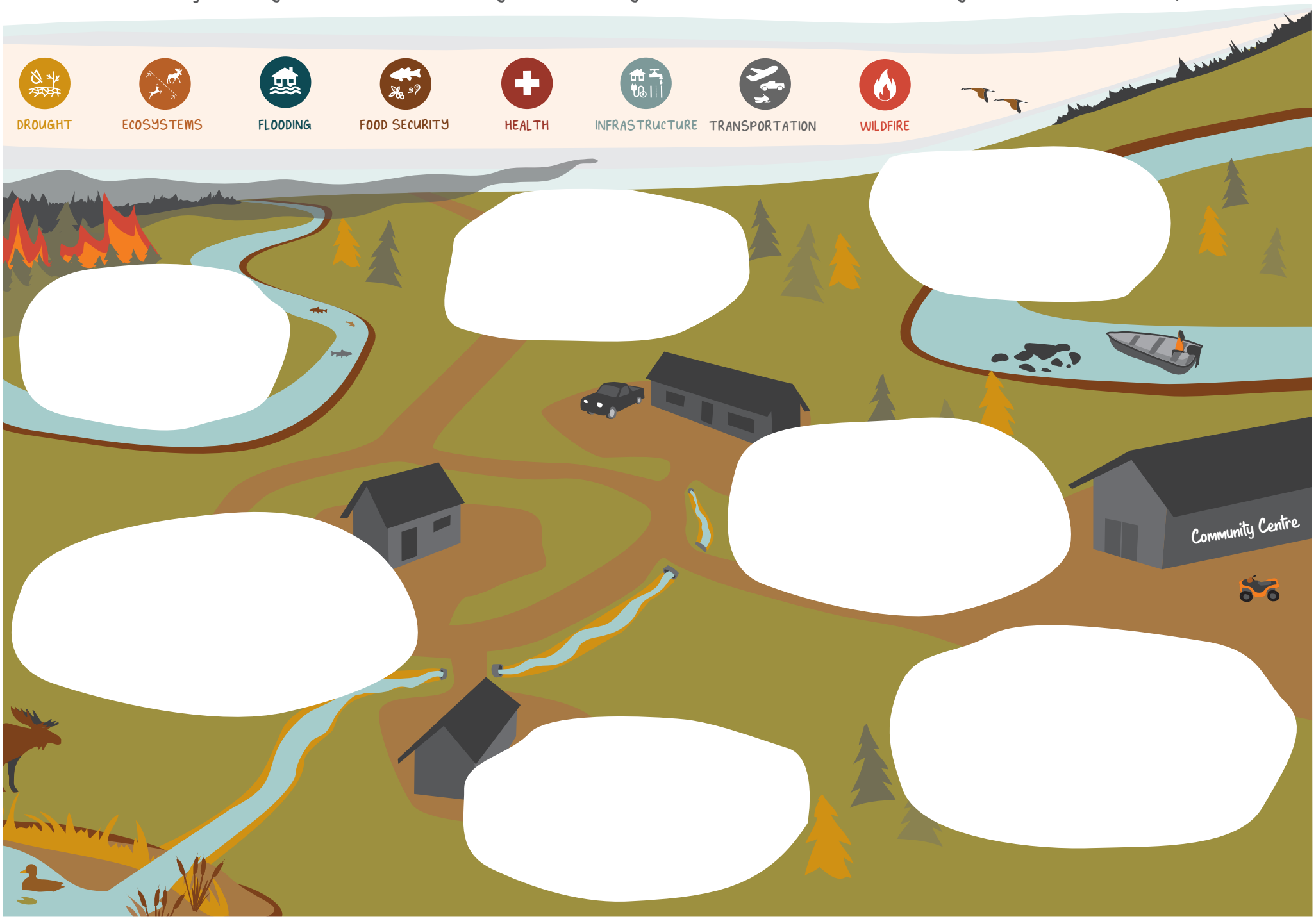
CLIMATE CHANGE IMPACTS EVERYONE

What changes have you seen on the land & in your community? What actions can be taken? Share your ideas in the white spaces below.



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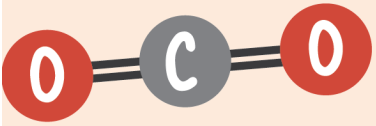
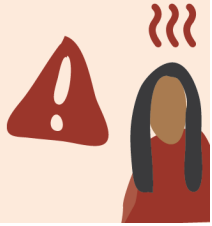
CLIMATE CHANGE QUICK GUIDE





INTRODUCTION

Throughout the world, people are seeing and feeling the effects of human-caused climate change. In northern Ontario, this can mean impacts like warmer winters and shorter winter road seasons, hotter summer heatwaves, drought and wildfires, more frequent flooding, and more intense storms. But understanding how and why climate change is happening can be a challenge. The processes in our atmosphere that drive weather and climate are complex. Adding the effect of human pollution on those processes makes understanding future climate even more difficult.

The Climate Change Quick Guide is a series of graphics designed to present the scientific understanding of human-caused climate change in an approachable and easy-to-understand way. Co-developed by the members of Partnership for Indigenous Climate Change Adaptation (PICCA), the graphics were created with a First Nation audience in mind.

Covering topics like What is Climate Change?, The Greenhouse Effect, Climate Change Then VS Now, and Climate Change Projections, each graphic has a highly-illustrated 'front side' as well as a text-based 'reverse side' to provide additional information. Use them as posters, handouts, or presentation slides when talking with community members, leadership, or youth.

Want to learn more?

Find the Climate Change Quick Guide as well as other climate change and adaptation resources at www.upnorthonclimate.ca including:

- The Climate Change Adaptation Quick Guide
- The Up North on Climate Adaptation Framework
- Climate Change Impact and Adaptation Infosheets
- The Science Climate Story

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WHAT IS CLIMATE CHANGE?

Climate change describes all the changes happening because humans are warming the planet.

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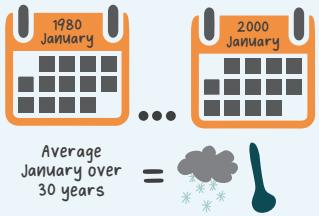
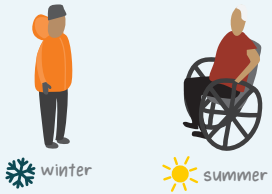
What is climate?

Climate is the average weather a place has over a long period of time. It tells us how much rain or snow or how hot or cold a place usually is.



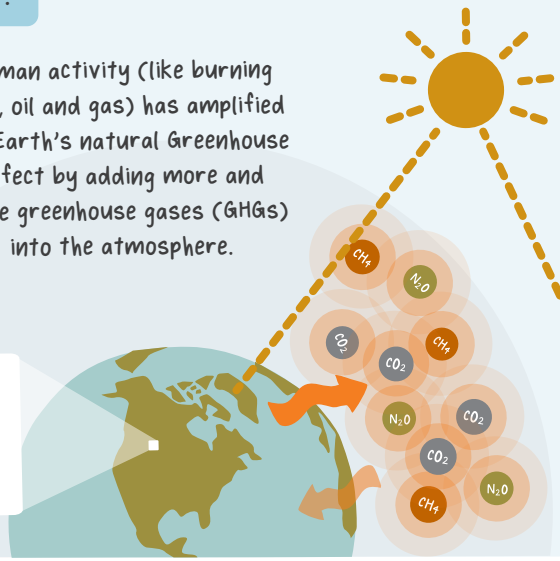
Northern Ontario climate means we expect cold in the winter, and warm in the summer.

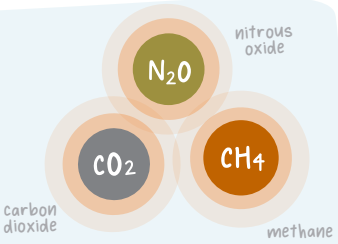


Why is climate changing?

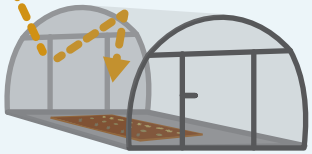
Climate is changing because the Earth is getting warmer.

Human activity (like burning coal, oil and gas) has amplified the Earth's natural Greenhouse Effect by adding more and more greenhouse gases (GHGs) into the atmosphere.





GHGs keep the Earth warm like the glass of a greenhouse traps heat.



How does warming impact climate?

Globally

Climate around the world is driven by large global air patterns and ocean currents.

Making the Earth warmer can change these patterns.

global warming

changes to air patterns

changes to ocean currents

Locally

In our communities, warmer air can mean:

higher temperatures

changes in wind

fewer cold days

Warmer air can also hold more water vapour, leading to:

changes in rain and snow

stronger storms

How can changes in climate impact our land and communities?

DROUGHT

dry land

low water for travel

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shifting habitat for plants & animals

permafrost thaw

FLOODING

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winter flooding from thaw or rain

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HEALTH

heat illness

mental stress

INFRASTRUCTURE

damage & power outages

poor drinking water quality

TRANSPORTATION

shorter winter road season

ice conditions less predictable

WILDFIRE

damage to the community

poor air quality

Preparing for climate change can help us lessen the impacts on people & communities.

Q&A WHAT IS CLIMATE CHANGE?

What's the difference between global warming and climate change?

Global warming is the rapid rise in global temperature that's happening because human activities are adding greenhouse gases (GHGs) to the atmosphere. The added GHGs are amplifying the Earth's natural greenhouse effect, causing the planet to warm 30x faster than it did before the year 1900.

Climate change is the change in climate happening because of global warming. As the Earth gets warmer, the air patterns and ocean currents that drive climate can change, affecting things like how hot or cold places are, how much rain or snow falls, how severe storms are, or how often and where storms happen.

What does climate change mean for extreme weather?

There is a lot of evidence that climate change is causing extreme weather events, like heat waves, storms, and heavy rain, to happen more often and/or be more severe than in the past. This is because the air patterns and ocean currents that drive our weather can change as the Earth heats up.

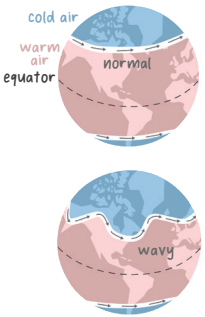
Warmer temperatures and more humid air can lead to heat waves that last longer due to slow moving air masses. A warmer atmosphere can hold more water vapour, which can make heavy rain events or big snow storms more likely. Changing air patterns mean storm systems or weather events can be brought to new/different places.

Yesterday was cold, what happened to global warming?

Just because a given day is cold, it doesn't mean that conditions over the long term (the climate) aren't getting warmer. When you ask "How cold is it today?" or "Is it raining out?", you're asking about the weather. Weather changes day to day, or even hour to hour. Climate, on the other hand, is the average weather a place experiences over a long period of time, like decades or a lifetime. Average global temperature is on the rise, with temperatures in the north rising twice as fast as other regions.

How do air patterns and ocean currents impact climate?

When heat energy from the Sun reaches the Earth, it isn't spread evenly around the globe. The middle of the Earth (the equator) faces the sun more directly so it gets warmer than the poles. This creates temperature and pressure differences that result in the movement of air, creating wind as air rises and falls and moves from areas of higher to lower pressure. These global winds are also bent by the spin of the Earth. As they blow over oceans, they drive ocean currents that are also shaped by the coasts of the continents.



Air patterns and ocean currents influence climate by moving warmth from the equator toward the poles. Air also carries and moves water vapour (water in its gas form) that creates clouds and falls as rain or snow. But global warming can change how air and ocean currents move. Research suggests that warming in the Arctic is causing the jet stream, an important air current in the northern hemisphere, to become wavier, allowing warm air to spread north and cold air south. Melting Arctic ice is also sending more freshwater into the North Atlantic, altering the flow of the Gulf Stream, an important ocean current the takes warm water north from the Gulf of Mexico.

Why does climate change matter?

Our land and communities have been shaped by the climate. The plants and animals we find on the land survive and thrive because the climate provides the conditions they need. Buildings, roads, and other community infrastructure have been designed for the climate expected for the region.

But as climate changes, and extreme events happen more often, plants and animals can find themselves struggling to survive in conditions that no longer give them what they need. Climate is also changing so quickly that they have little chance to adapt. Community infrastructure, like roads, water systems, and power lines, can also be challenged. Preparing now for climate change can help lessen the impacts and risks.

GRAND COUNCIL TREATY #3 · KEEWAYTINOOK OKIMAKANAK · Matawa First Nations Management · Mushkegowuk Council · Nokiiwin Tribal Council · Shibogama First Nations Council · Laurentian University / Université Laurentienne

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The GREENHOUSE EFFECT

Earth's natural greenhouse effect keeps us comfortable, but adding more greenhouse gases heats things up.

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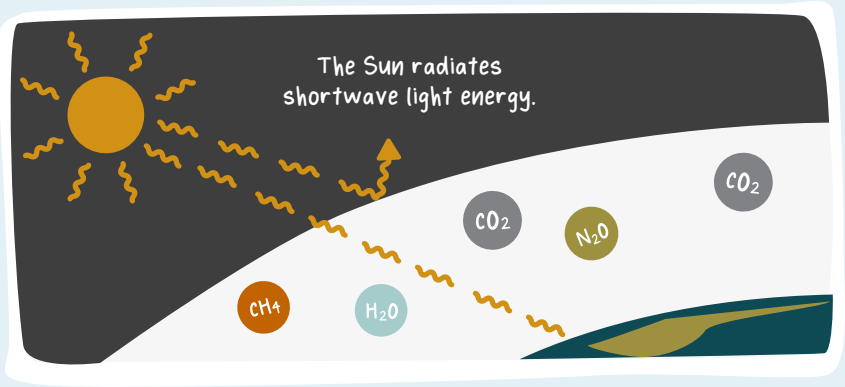
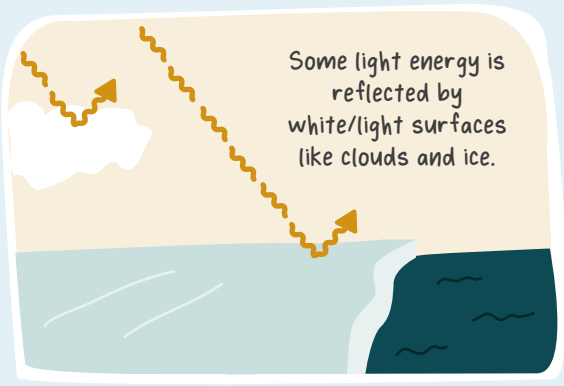
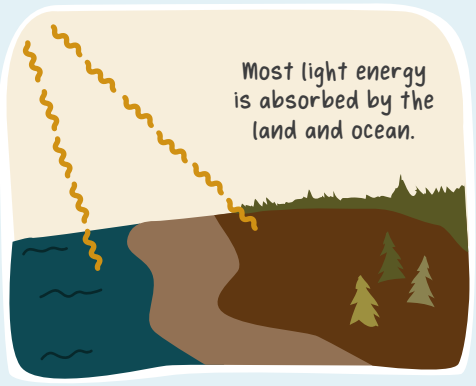
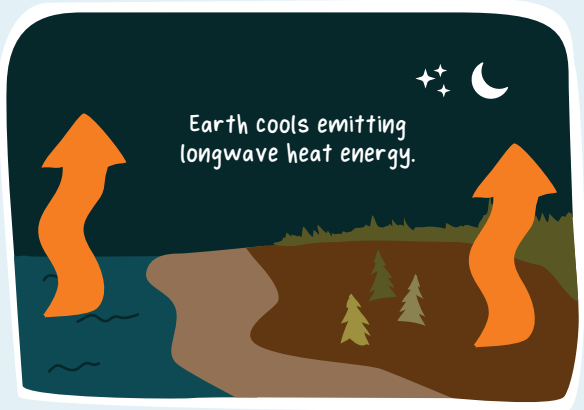
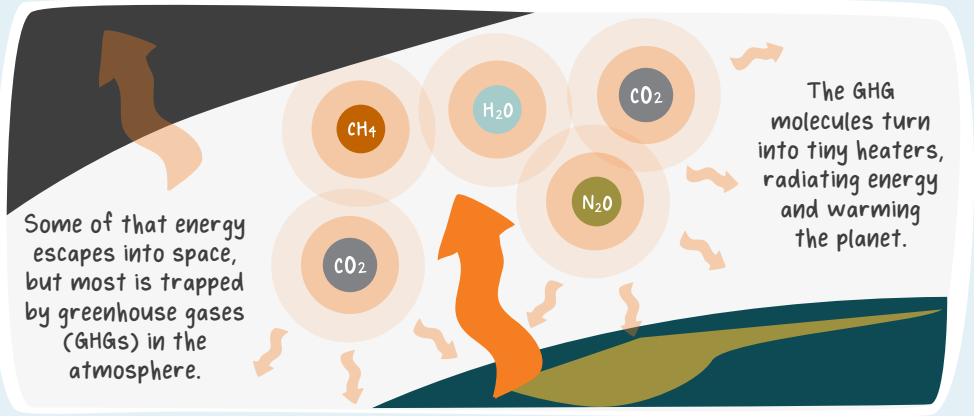
The Natural Greenhouse Effect







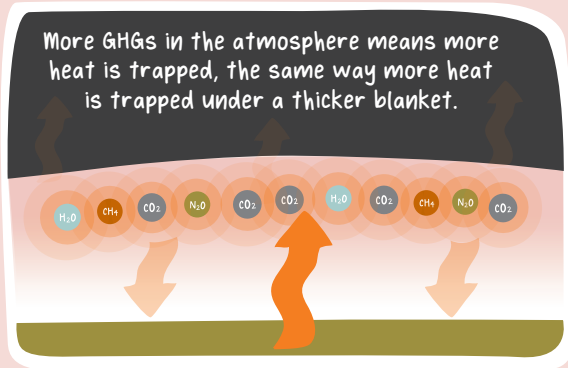


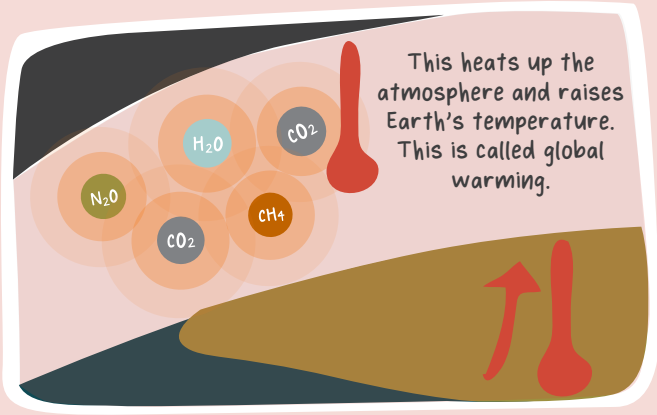


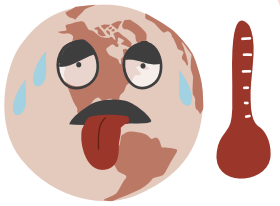
Because of the greenhouse effect the average temperature of the Earth is +15°C allowing life as we know it.

Amplified Greenhouse Effect

Burning fossil fuels (like coal & gas) and other human activities release GHGs.



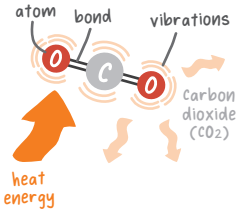




The Earth's average temperature has increased by 1°C in 100 years, 30X faster than in the past.

Q&A THE GREENHOUSE EFFECT

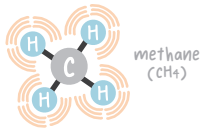
How do GHGs create the greenhouse effect?



Earth's atmosphere is made of invisible gases. Some gases like oxygen (O_2) and nitrogen (N_2) don't trap much heat energy, but others, like carbon dioxide (CO_2) and methane (CH_4), do. Gases that are good at trapping heat are called greenhouse gases (GHGs).

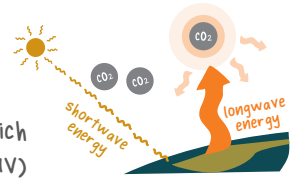
GHGs trap heat because of the way their molecules are put together – they are made of more parts (called atoms) and have more bonds (the force that holds atoms together) than gas molecules that don't trap heat. When heat energy radiated from the Earth hits a GHG molecule it begins to vibrate, as if the bond are little springs. As vibrations slow, the molecules gradually release heat in all directions like tiny heaters. Heat energy moves around the atmosphere, from one GHG molecule to another, or even back down to the surface, like a ball in a pinball machine.

Do some GHGs trap more heat than others?



The number and strength of a molecule's bonds determines how much it vibrates and how much heat energy it can hold. Some greenhouse gases (GHGs) hold more heat than others. But scientists also consider how long a GHG stays in the atmosphere and how much of it there is when looking at its effect on warming.

Why do GHGs only trap outbound energy?



Sunlight enters our atmosphere as shortwave energy, which includes visible light (that we can see) and ultraviolet (UV) light that causes sunburns. This type of energy is not trapped by gas molecules in the atmosphere. When sunlight hits the Earth's surface, that energy is absorbed and re-emitted as longwave energy (called infrared energy) that we can't see but can feel as heat. Longwave energy is a type of energy that can be trapped by greenhouse gases.

Why is the greenhouse effect important?

Earth's atmosphere acts like a blanket holding warmth from the Sun. Without it, the Earth's average temperature would be -18°C. By trapping the heat energy released by the Earth, the natural greenhouse effect warms Earth to an average of 15°C, allowing life as we know it.

How are humans amplifying the greenhouse effect?

Humans are affecting the natural greenhouse effect by adding greenhouse gases (GHGs) to the atmosphere. Carbon dioxide (CO_2), the most abundant GHG, comes from burning fossil fuels like coal and gas. Methane (CH_4) is released by cattle and landfills and is the main component of natural gas. Nitrous oxide (N_2O) comes mainly from fertilizers and agriculture. All these added GHGs have caused Earth's average temperature to rise nearly 1°C in the last 100 years, a rate much faster than the natural warming that has happened in the past.

Is water vapour a GHG?

Water vapour (H_2O) is water in its gas form, like the steam that rises from a pot of boiling water. It's an important part of the atmosphere, forming clouds and falling as rain and snow. It's also a greenhouse gas (GHG), trapping longwave heat energy emitted by the warmed Earth.

Water vapour isn't a human pollutant like other GHGs. Instead, the amount of water in the atmosphere depends on the temperature, with warmer air holding more water than colder air. As the Earth warms, the atmosphere can hold more water vapour, which causes more warming, which leads to more water vapour, and so on.

Which surfaces absorb/reflect the Sun's energy?

White surfaces, like clouds, snow, and ice, reflect the Sun's energy; dark surfaces, like water, rocks, and soil absorb it. When warming temperatures melt reflective ice and snow in the Arctic, more energy is absorbed by the open ocean. This warms the water, impacting weather in the north and even affecting the polar front (an air pattern important to global climate). Less ice also means more dark ocean to absorb energy, leading to more warming and even less ice.

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CLIMATE CHANGE THEN vs NOW

Earth's climate has changed before, how do we know today's climate change is human caused?

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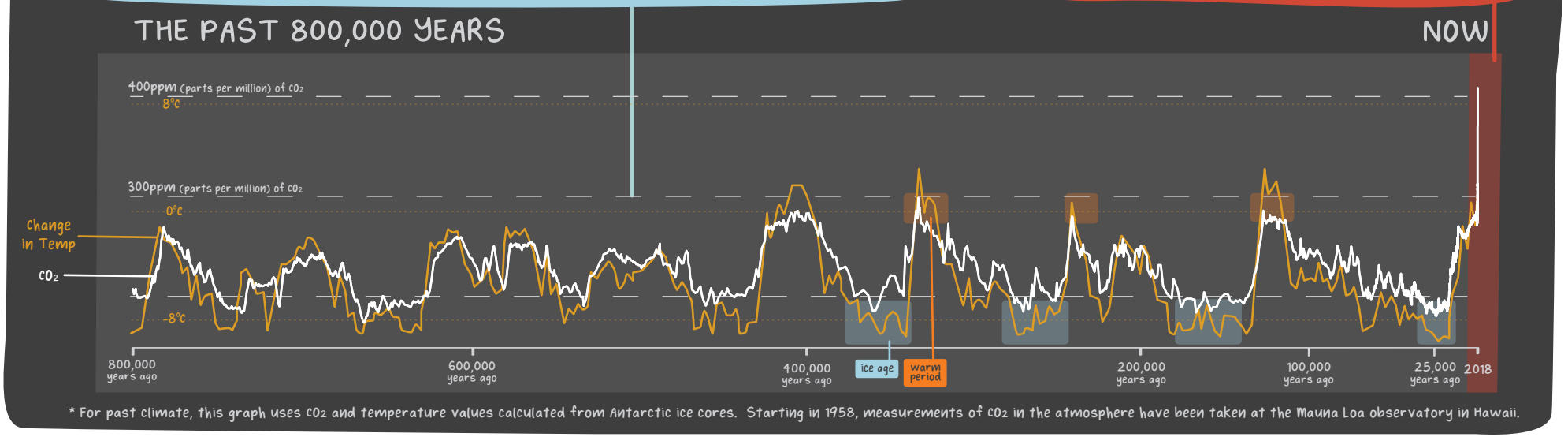
Information from ancient dust and air bubbles trapped in ice cores tells us about Earth's climate over the last 800,000 years. Past changes happened very slowly, with Earth's temperature rising by 1°C every 1,500 years & carbon dioxide (CO_2) never going above this line.

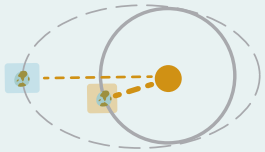
In only 100 years, Earth's temperature has risen by nearly 1°C, a rate that is 30 times faster! No natural event explains this much faster rate of warming.



* For past climate, this graph uses CO_2 and temperature values calculated from Antarctic ice cores. Starting in 1958, measurements of CO_2 in the atmosphere have been taken at the Mauna Loa observatory in Hawaii.

Why did Earth's climate change in the past?

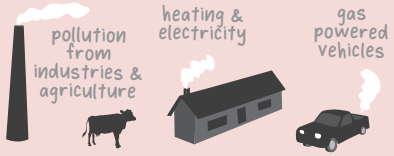
Changes in climate in the last 800,000 years were driven mostly by changes in the Earth's orbit, wobble & tilt, called the Milankovich cycles.



These cycles, which happen very slowly, change how much sunlight (ie. heat energy) reaches the northern part of the Earth.

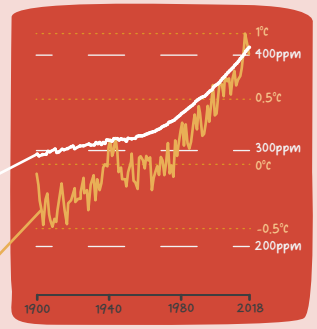
With less heat energy, snow can slowly build up, leading to an ice age. With more heat energy, the snow slowly melts again (warm period).

Why is Earth's climate changing so fast now?



As humans started burning more coal, oil & gas (fossil fuels), the amount of carbon dioxide (CO_2) & other greenhouse gases in the atmosphere got higher & higher.

The rise in CO_2 has been closely followed by a rise in global temperature.



*Temperature difference from 1951-1980 global average

There is still time to act! We can replace fossil fuels with other energy options to lower CO_2 emissions and plan for climate challenges with community adaptations!

Q&A CLIMATE CHANGE THEN vs NOW

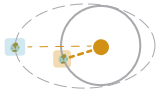
How do ice cores tell us about past climate?

Ice sheets, like those in the Antarctic and Greenland, are made up of snow that has collected over thousands of years. New snow layered on top of old snow and eventually turned into ice under its own weight, creating layers of ice that provide a historical timeline, with the oldest layers at the bottom and the newest on top. Within the layers of the ice core are bubbles of air and particles of dust from the atmosphere that became trapped as the layers formed.

Scientists drill into ice sheets and remove ice cores, cylinders of the ice sheet that let them study the layers in detail. By measuring oxygen, carbon dioxide and other gases in the bubbles, we can get an idea of what past climate was like. Ice cores from Antarctica give us the longest climate record, with layers dating as far back as 800,000 years.

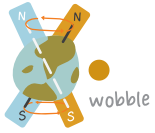
What are the Milankovich cycles and how do they drive climate?

How the Earth moves as it travels around the Sun has a big influence on how much of the Sun's heat energy reaches different parts of the planet.



Earth's orbit (its path around the Sun) stretches and contracts like an elastic band. It changes from being nearly a circle to being a bit of an oval every 100,000 years. When the Earth's orbit is more oval, Earth is closer to the Sun (and warmer) at one end of its orbit compared to the other.

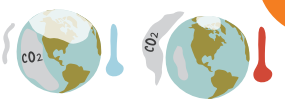
Earth's axis (around which we turn, giving us day and night) is tilted, which points one part of the Earth towards the Sun. Summer in the north happens because the tilt of the axis points us towards the Sun giving us more heat. The degree of this tilt also slowly shifts over about 40,000 years.



As the Earth turns, it wobbles a bit around its axis, like a spinning top. This wobble also changes the tilt of the Earth, pointing it more directly or less directly towards the Sun. One wobble takes about 23,000 years.

Combinations of these movements have led to times where parts of the planet get less of the sun's warmth and become cool enough that snow stays on the ground even in summer. Over hundreds of years, the snow builds up, leading to more cooling and, eventually, an ice age. As the Earth's orbit and axis continue to shift, the Earth warms again and the ice sheet slowly melts.

If ice ages were triggered by Milankovich cycles, why did CO_2 change?



When changes in Earth's orbit and axis make the planet cooler, Earth's oceans absorb more carbon dioxide (CO_2) from the atmosphere. This is because cold water can hold more CO_2 than warm water. With less CO_2 in the atmosphere, the Earth cools even more. As the orbit and axis continue to change, Earth eventually gets enough heat from the sun that a warming period begins. This heats the oceans and leads to a release of CO_2, which causes even more warming. As warming melted the ice sheets over the north, forests grew. This pulled CO_2 from the atmosphere and helped keep it from rising above 300ppm.

What is parts per million (ppm)?

carbon dioxide molecule

1 million molecules in the atmosphere — 300 are CO_2

Parts per million (ppm) is a measurement of the amount of something. Imagine a herd of 1 million caribou. If you replace one caribou with a wolf, the wolf represents 1 part per million. A measurement of 300ppm would mean 300 caribou were replaced by wolves. Similarly, a measurement of 300ppm of carbon dioxide means that if you looked at 1 million molecules in the atmosphere, 300 of them would be carbon dioxide.

Why does going from 300ppm CO_2 to 415ppm CO_2 matter?

Just like adding more wolves to a herd of caribou has an impact, adding more carbon dioxide (CO_2) to the atmosphere impacts Earth's climate. CO_2 levels have changed over the past 800,000 years but have never been above 300 ppm. In the past 100 years, CO_2 levels have risen to 415ppm and the average global temperature has increased by 1°C. 1°C may not seem like much but it has led to the climate impacts we see today, and more warming will mean more severe impacts. For example, a heat wave that only happened once every 50 years could happen every 10 years at 1°C warming, every 3 or 4 years at 2°C warming, or every 1 to 2 years at 4°C warming. If CO_2 keeps rising, we could reach 500ppm in 50 years and see average global temperature increase by 3°C or more, with temperatures in the north rising even higher.

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CLIMATE CHANGE PROJECTIONS

What could future climate look like in northern Ontario?

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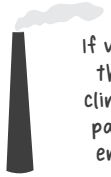
Climate models are complex computer programs that mimic how the Earth behaves.

CH_4 methane

CO_2 carbon dioxide

N_2O nitrous oxide

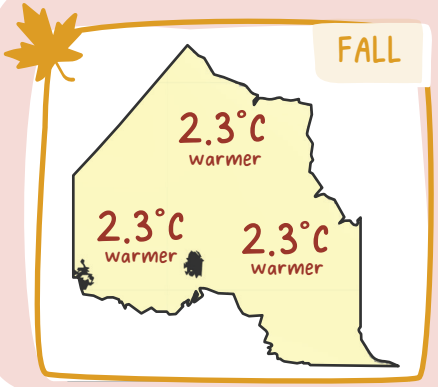
Scientists can use these models to predict what future climate might be like if we emit lots of greenhouse gases (GHGs) or if we emit fewer.

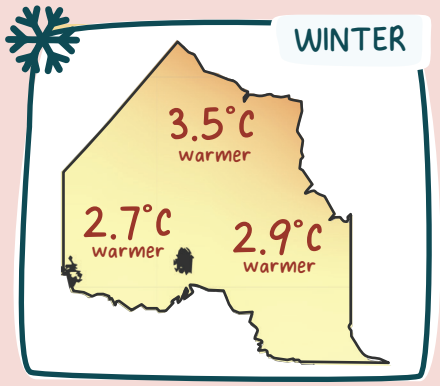


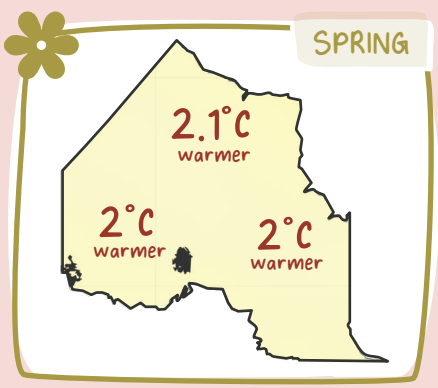
If we keep emitting GHGs at the rate we are now, our climate will likely follow the path predicted in the "high emissions" climate model.

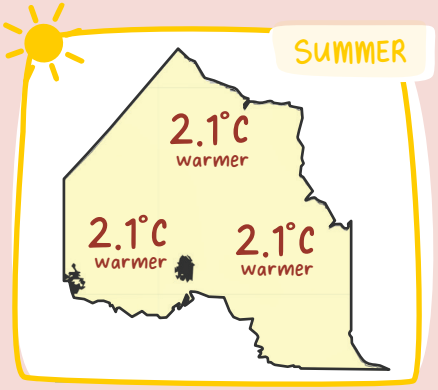
Maps below show temperature & precipitation (rain & snow) for a high emissions future.

How much warmer could the future (2021-2050) be compared to the past (1976-2005) ?

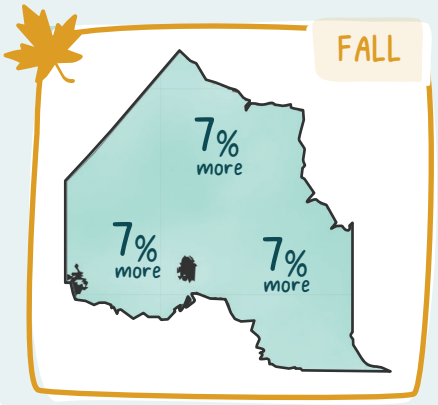


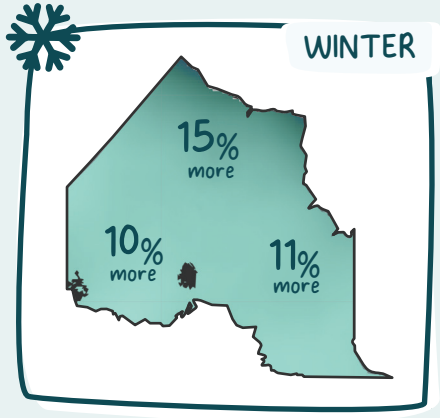


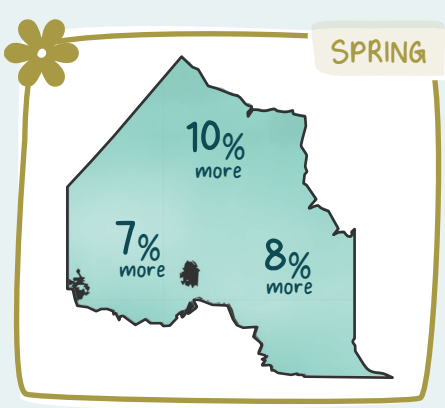


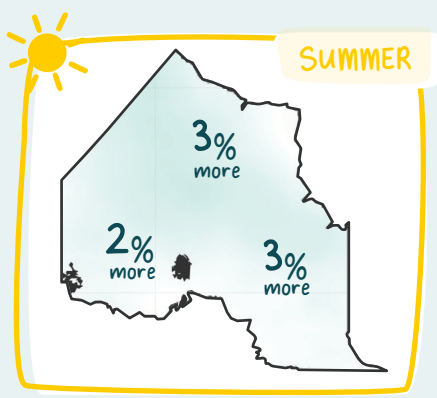


How much more rain & snow could the future (2021-2050) have compared to the past (1976-2005) ?









What could these changes mean?

FALL
- later snowfall
- longer fire season

WINTER
- more winter rain
- thinner ice

SPRING
- faster melt
- more flooding

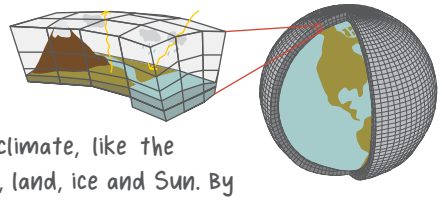
SUMMER
- more drought
- more wildfire

Climate projections can help us plan adaptations. Adaptations that plan for high emissions can help protect people and communities from climate change impacts even if we follow another path.

* Maps & data from: climateatlas.ca

Q&A CLIMATE CHANGE PROJECTIONS

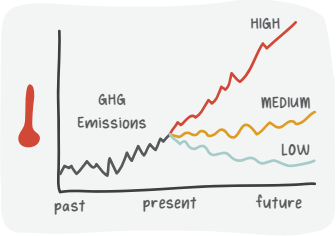
How do climate models work?



Climate models are computer programs that simulate the processes that drive Earth's climate, like the interactions between the atmosphere, oceans, land, ice and Sun. By first dividing the Earth into a grid of thousands of cubes that reach up into the atmosphere and down into the oceans, climate models use mathematical equations and the laws of physics to model processes like wind or the temperature of the air or water in each cube. They also take into account how what's happening in one cube affects neighbouring cubes. Climate models that look decades into the future are so complex they are run on large "super computers".

To model how climate might change because of pollution, scientists can run the models with more or less greenhouse gas (GHG) in the atmosphere to predict measures of future climate like temperature and rainfall. These predictions (called climate projections) are calculated for a range of possible GHG futures.

What are the future climate pathways?



Climate models simulate different climate futures (called "pathways") based on how much greenhouse gas (GHG) continues to be added to the atmosphere by human activity. Two systems have been developed:

1. RCP (Representative Concentration Pathway) scenarios look at how GHGs affect radiative forcing, or heat energy trapped in the atmosphere by GHGs. The higher the number, the more energy is trapped and the more the Earth heats up.

2. SSP (Shared Socioeconomic Pathway) scenarios look beyond radiative forcing and try to include how factors like population size, economic growth, and new technologies might influence GHG emissions, and therefore climate warming, into the future. SSP scenarios are numbered 1 to 5.

High Emissions Pathways
(like RCP8.5 and SSP5) assume that we keep using more fossil fuels. They predict the biggest changes in climate.

Medium Emissions Pathways
(like RCP4.5 and SSP2) assume we start to replace fossil fuels with green energy and, in the near future, emit less GHGs than we are now.

Low Emissions Pathways
(like RCP2.6 and SSP1) assume we dramatically cut fossil fuel use now.

Why are northern Ontario projections higher than the global average?

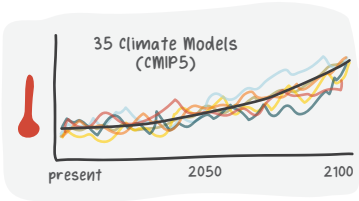

less ice reflecting sunlight


warm air pushing north

Many countries, including Canada, joined the 2015 Paris Agreement to keep average global temperature rise below 2°C by 2100. But high emission projections show warming for northern Ontario of 3.5°C in winter as early as 2050 and as high as 9°C in winter in 2100.

Global warming does not mean the same amount of warming everywhere. Some places are warming more, and more quickly, than others. The Arctic and northern regions are warming more quickly because more warm air is being carried north by large weather systems. The loss of ice reflecting sunlight and more open ocean also means that more of the Sun's heat is being absorbed by the dark water. This faster warming means that when planning adaptations in northern Ontario, we have to look beyond the global averages and use predictions for northern communities.

Why do scientists trust climate models?



To see how well climate models work, scientists test them against climate data from the past. If the model can correctly predict past climate trends, then we expect it to be good at predicting future climate. To get the best results, projections are based on many models developed by scientists all over the world using slightly different calculations for Earth's processes. Canada's climate projection maps come from a group of 35 climate models called CMIP5.

Where can I find climate projections for my community?

The Climate Atlas of Canada (www.climateatlas.ca) is a user-friendly website that provides climate projections for all of Canada. Use the Indigenous button on the interactive map to highlight First Nation, Inuit, and Métis communities and view or download future projections. The numbers on this graphic are from Climate Atlas.

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CLIMATE CHANGE ADAPTATION QUICK GUIDE

Climate change adaptations for northern First Nation communities & individuals

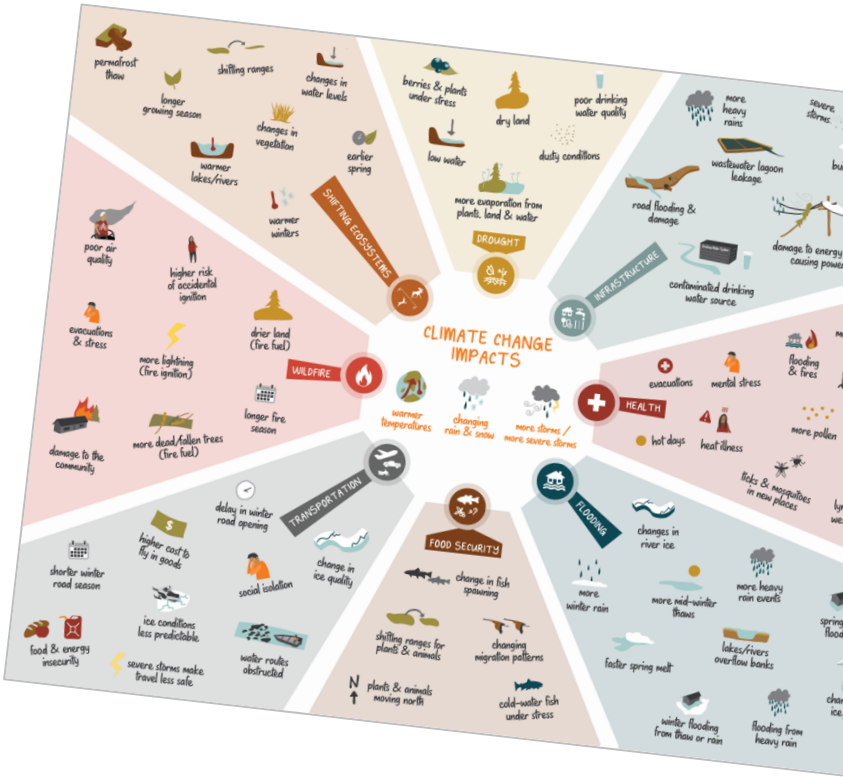
INTRODUCTION

The weather in northern Ontario is changing. Human-caused greenhouse gas emissions are pushing the Earth's climate toward a warmer world at a faster rate than ever before, with temperatures in the north rising at twice the rate of other regions. These changes, coupled with the close ties First Nation communities have with the land, make the need to prepare and adapt to the impacts of climate change increasingly important.

As part of a co-lead Building Regional Adaptation Capacity and Expertise (BRACE) project, Up North on Climate, along with partners from the Tribal Councils of Keewaytinook Okimakanak, Matawa, Mushkegowuk, Nokiiwin and Shibogama, as well as Grand Council Treaty #3, have co-developed resources that can be used by First Nations moving towards climate resilience.

The **Climate Change Adaptation Quick Guide** is a series of illustrations that present climate change impacts and possible adaptation options relevant to northern Ontario First Nation communities.

Climate change impacts are already being noticed and felt by people in communities throughout the north. Some of those impacts, as well as impacts that are expected as climate continues to change, are summarized in the "Climate Change Impacts" illustration (pictured to the right).



To illustrate climate change adaptation actions, impacts are divided into 8 themes:

DROUGHT

ECOSYSTEMS

FLOODING

FOOD SECURITY

HEALTH

INFRASTRUCTURE

TRANSPORTATION

WILDFIRE

Each of the 8 illustrations set adaptation options in a fictional First Nation community in a northern Ontario landscape and includes:

1. **A banner to show how climate change has, will or can impact the land, people and community.**

2. **Bubbles on the front to present possible adaptation options.**

3. **A 'reverse side' that expands on each bubble to give additional detail about the adaptation option.**

The Quick Guide does not aim to present every possible adaptation option for dealing with climate change impacts. Instead, the purpose is to help start conversations about climate change adaptation options in First Nation communities. Whether the illustrations are used as posters, handouts, or slides in a presentation, the aim of the Climate Change Adaptation Quick Guide is to spark ideas and get the ball rolling on discussions around adapting to climate change and creating climate resilient communities.

Want to learn more?

Check out the Up North on Climate Adaptation Framework, a 5-step guide designed to help First Nation communities move toward climate change adaptation projects. Find the Framework and other adaptation planning tools at: https://www.upnorthonclimate.ca/adaptation-planning.

For more information about climate change impacts and adaptations, have a look at the Impact and Adaptation Infosheets or the Adapting to a Changing Climate report available at: https://www.upnorthonclimate.ca/impacts-and-adaptations.

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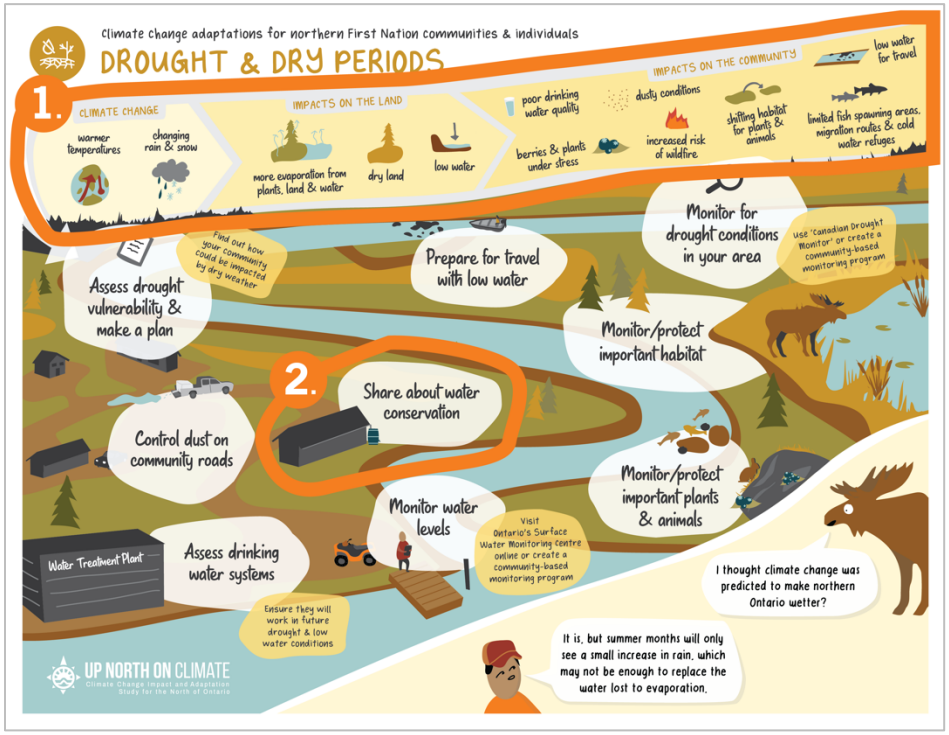

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DROUGHT & DRY PERIODS

CLIMATE CHANGE

warmer temperatures

changing rain & snow

IMPACTS ON THE LAND

more evaporation from plants, land & water

dry land

low water

IMPACTS ON THE COMMUNITY

poor drinking water quality

dusty conditions

low water for travel

berries & plants under stress

increased risk of wildfire

shifting habitat for plants & animals

limited fish spawning areas, migration routes & cold water refuges

Assess drought vulnerability & make a plan

Find out how your community could be impacted by dry weather

Prepare for travel with low water

Monitor for drought conditions in your area

Use 'Canadian Drought Monitor' or create a community-based monitoring program

Monitor/protect important habitat

Share about water conservation

Control dust on community roads

Monitor/protect important plants & animals

Monitor water levels

Visit Ontario's Surface Water Monitoring Centre online or create a community-based monitoring program

Assess drinking water systems

Water Treatment Plant

Ensure they will work in future drought & low water conditions

I thought climate change was predicted to make northern Ontario wetter?

It is, but summer months will only see a small increase in rain, which may not be enough to replace the water lost to evaporation.

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DROUGHT & DRY PERIODS - ADAPTATION OPTIONS

Travel & low water

- Low water levels can make travel by boat more difficult. Consider changes like:
  - finding new water routes
  - creating a portage around low water areas
  - using motors made for shallow water
  - carrying lighter loads in boats
  - traveling over land instead
- Be mindful of hazards like: newly exposed rocks (sometimes called 'reefs') or logs, soft/muddy shorelines, etc.

Share about water conservation

- Inform the community of drought or low water conditions and encourage water conservation when needed.
- Raise awareness about water conservation and how it can be done in the community (fix leaky taps/toilets, collect rainwater for gardens, etc.).

Monitor water levels

- Set up a program to monitor water levels or use existing programs like the Low Water Conditions Map from Ontario's Surface Water Monitoring Centre.
- In some cases, low water could impact hydro-electric power generation. If this applies in your area, you may want to plan for power outages.

Drought impact assessment

- Find out what areas of the community might be impacted by drought conditions and how community members might be affected.
- Changing drinking water quality, dusty roads leading to breathing problems, lack of water for gardens or harvested foods, are all examples of drought impacts.
- Have a community plan to lessen the impact of drought on people and the community.

Monitor for drought conditions

- Monitor for drought conditions in your area and have a plan in place for dealing with drought conditions (called a drought response plan).
- Drought monitoring can be done with programs like Canadian Drought Monitor.
- Communities may want to create their own drought monitoring program.

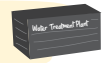
Monitor/protect important habitat

- Monitor and/or put measures in place to protect important habitats that can be impacted by dry conditions and low water.
- This could include wetlands, wild rice beds, fish spawning grounds, fish migration routes, shoreline areas, etc.

Control dust on roads

- Hot, dry weather can cause excessive dust on gravel roads, leading to breathing issues for some in the community.
- To limit dust on community roads: limit traffic, encourage lower speeds, change road building materials, water roads or apply eco-friendly dust suppression products.

Assess drinking water systems



- Low water levels can put drinking water quality at risk.
- Monitor drinking water sources for problems related to low water like algae growth, higher contaminate levels, issues with intake pipes, dry wells, etc.
- Determine if your drinking water system will work well in drought and low water conditions with a vulnerability assessment.
- Have a plan to supply emergency drinking water if needed.

Monitor/protect important plants & animals

- Monitor and/or put measures in place to protect important plant or animal species that could be impacted by drought and dry periods.

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Climate change adaptations for northern First Nation communities & individuals

ECOSYSTEMS

CLIMATE CHANGE

- warmer temperatures
- changing rain & snow
- more extreme weather

IMPACTS ON THE LAND

- more wildfire
- possibly more drought
- possibly more flooding
- permafrost thaw
- warmer lakes/rivers
- changes in vegetation
- earlier spring
- warmer winters

IMPACTS ON ECOSYSTEMS

- plants & animals moving north
- change in temperature-driven events
- berries, trees, plants & animals under stress
- changing ecosystems
- invasive species in new places
- changing migration patterns

Start a land monitoring program

Assist plant migration

Protect permafrost

Keep forests connected & rivers flowing

Keep ecosystems healthy

like lakes, rivers, forests & peatlands

Be guided by Traditional Knowledge

Adjust harvesting

Prevent spread of invasive species

Restore damaged habitat

Protect threatened or culturally important areas, plants & animals

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ECOSYSTEMS - ADAPTATION OPTIONS

Start a monitoring program

- Monitoring can help track changes happening in traditional areas and guide future actions.
- What a community monitors will depend on its needs/goals and could include:
  - Presence of new or invasive species
  - Timing of events like spawning or flowering
  - Migration times and patterns
  - Number and health of culturally significant plants & animals

Traditional Knowledge

- Traditional Ecological Knowledge (TEK) contains valuable information about the land and water and can guide decisions about protection. Intergenerational sharing of TEK is key to continued land and water protection.

Protect permafrost

- Permafrost loss can change the landscape and affect plants and animals (palsa collapse, thaw slumps, shoreline erosion, etc.).
- Protect permafrost by limiting disturbances and properly constructing roads and buildings.
- Limiting global warming by reducing greenhouse gas emissions is the best way to protect permafrost.

Restore damaged habitat

- Help bring damaged habitats back to their natural state by: replanting native vegetation, removing invasive species, cleaning up trash and pollution, etc.
- Restoring habitat supports biodiversity and could provide other benefits like natural flood control and carbon storage.

Keep ecosystems healthy

- Healthy land and water help support all species and may be better able to cope with the impacts of climate change like drought, wildfire, flooding, and invasive species. Healthy peatlands and forests also store carbon which can help limit further climate change.

Keep forests and rivers connected

- Climate change will mean some plants and animals will have to move to new places to survive. Keeping forests continuous or connected and not blocking the paths of rivers can help species that need to move to new areas.

Adjust harvesting

- Change harvesting time and location to match when/where animals and plants are now available. Consider harvesting species new to the area, like deer and bass.

Prevent invasive species

- Climate change could make it possible for invasive species to live in new places.
- Prevention is key. Encourage actions like:
  - Cleaning boats and fishing gear
  - Using local firewood
  - Avoiding invasive plants in gardens
- Monitor for new species and have a control plan for ones that could be damaging.

Protect important areas/plants/animals

- Protect important habitat or culturally significant places from destruction or damage.
- Protect important animals, plants, and medicines by looking after the habitat they need and prevent overharvesting.

Assist plant migration

- Programs where humans help plants move to new areas in response to climate change is called 'assisted migration'.
- This includes helping important plants continue to grow (through seed collection, local transplants, etc.).
- Bringing in new plants could lead to ecosystem disruptions. Weigh risks carefully.

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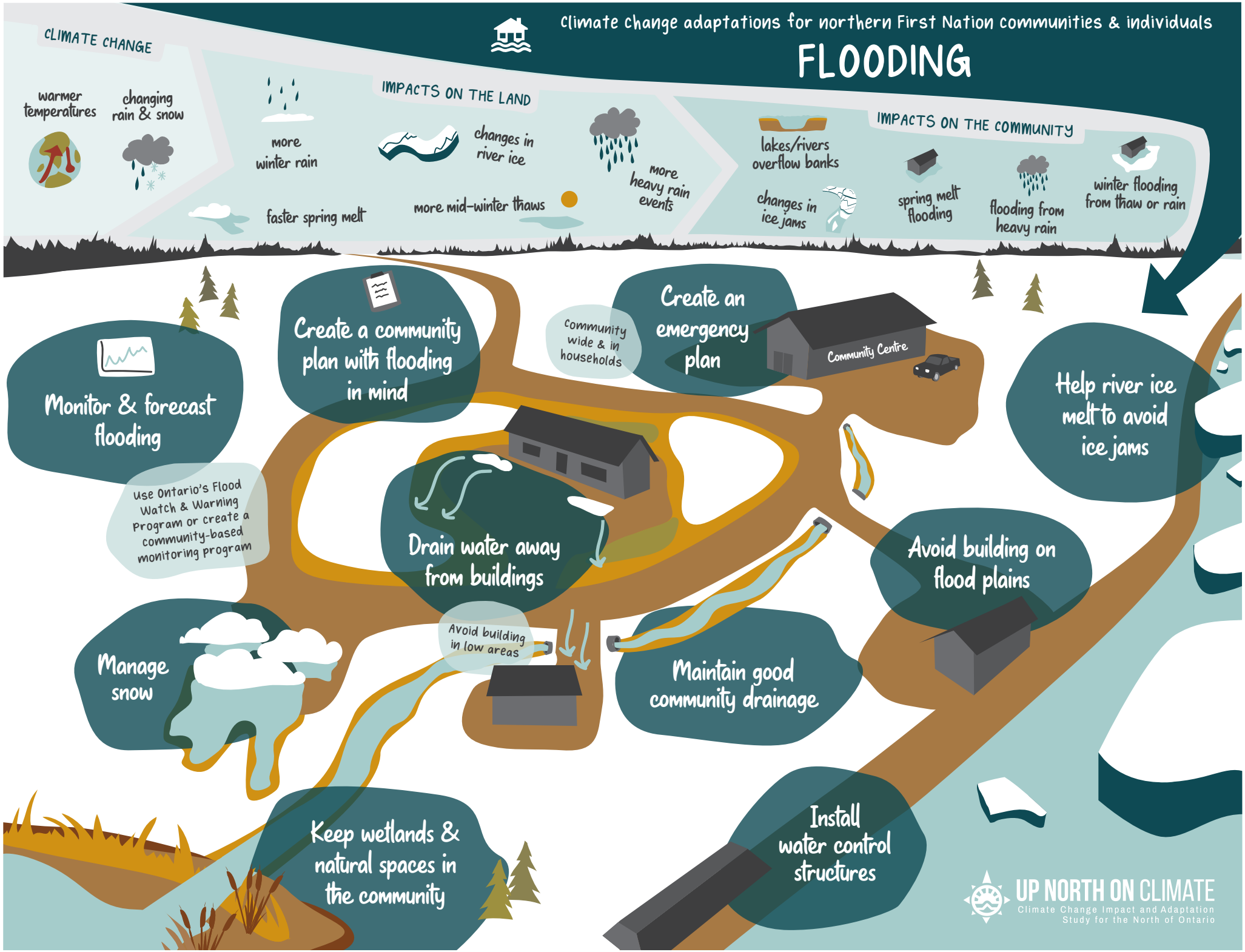
Climate change adaptations for northern First Nation communities & individuals

FLOODING



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FLOODING - ADAPTATION OPTIONS

Flood monitoring & forecasting

- Monitor your area for conditions that could lead to flooding. This could be things like:
  - heavy rains
  - rapid snow melt
  - high water in lakes/river
  - ice jams
- Some flood watch and warning programs already exist (like Ontario's Flood Watch and Warning Program) or communities may want to create their own.
- Flood forecasting models (made specifically for a community or area) look at what conditions have led to flooding in the past to try to predict what conditions will likely cause flooding in the future.

Water control structures

- Structures like dams, dikes and berms are sometimes used for flood control in areas where floods have happened before.
- Structures like ice booms are sometimes used to prevent ice jams from forming.

Wetlands & natural space

- Wetlands and natural forest spaces can help absorb water from rain and spring melt and provide natural flood protection.

Avoid building on flood plains

- A flood plain is an area of low-lying ground next to a lake or river. These areas are more likely to have flooding issues.
- Traditional knowledge about past floods and high water levels can give valuable information about which areas may be at risk of flooding.

Drain water away from buildings

- Keep water from entering homes and buildings with:
  - eavestroughs, drain pipes, weeping tile
  - trenches to direct water away
  - sloping the ground away from foundations
- Consider the slope of the land and how water will drain when choosing where to build homes/buildings.

Community drainage

- A good community drainage system (ditches, culverts, water storage areas, etc.) can help prevent flooding from heavy rain or during spring melt.
- Regular maintenance (clearing blockages, replacing damaged culverts, etc.) can help keep drainage systems working well.

Community planning

- Consider flooding in community planning, like when deciding where to build homes/buildings, where/how roads should be constructed, plans for drainage, etc.

Help river ice melt

- In areas where ice jams are common, weakening the ice to melt it faster can help prevent a jam or make it less severe.

Emergency planning

- Emergency planning can help keep people safe.
- Community emergency plans could include: evacuation plans, refuge centres, plans to protect infrastructure, etc.
- Households can prepare by: having emergency supplies, knowing what to pack for evacuations, knowing the community emergency plan, etc.

Manage snow

- Pile snow in a places where melt water can drain away safely from buildings and other infrastructure.

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FOOD SECURITY

CLIMATE CHANGE

warmer temperatures

changing rain & snow

IMPACTS ON THE LAND

changes in water levels

permafrost thaw

warmer lakes/rivers

earlier spring

warmer winters

changes in vegetation

IMPACTS ON FOOD

changing migration patterns

shifting ranges for plants & animals

changes in fish spawning

cold-water fish under stress

N plants & animals moving north

Monitor commonly harvested plants, animals & fish

Assist plant migration

Adjust where, when & how you harvest

Protect/restore important habitat

Share harvested food

Community Centre

Start a community food storage program

Use community coolers/freezers or traditional food storage

Grow food in the community

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FOOD SECURITY - ADAPTATION OPTIONS

Community-based monitoring

- Monitoring activities can help us understand what's happening with plants and animals in our area.
- What a community chooses to monitor will depend on its needs and goals.
- The information gathered from monitoring can help guide future actions and decisions.
- Things to monitor could include:
  - population counts (how many?)
  - fish spawning times & locations
  - migration times & patterns
  - animal health & diseases
  - locations where important plants grow
  - when plants are ready for harvest
  - water levels & temperature

Protect/restore habitat

- Protect the habitat that is important to harvested plants and animals and/or restore habitat areas that have been damaged.
- Important habitat areas might include:
  - migration routes
  - staging & nesting areas
  - calving grounds
  - spawning grounds
  - cold water refuges
  - wild rice stands

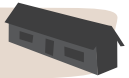
Adjust how you harvest

- Change when and where you harvest to match when/where animals and plants are now available.
- Change how/when you travel and wait until weather conditions are safe.
- Harvest species that are new to the area and shift away from harvesting vulnerable populations.

Community food storage

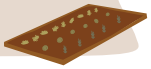
- Warmer fall weather can make it harder to keep harvested meat cool.
- Community coolers can provide a cool space for community members to hang and butcher their game. Community freezers can be used for long-term storage of food by members.
- Encourage traditional food storage methods, like smoking/salting meat, fish houses or storing food underground (if climate conditions still allow).

Food sharing



- Sharing harvested foods within the community can help ensure that everyone has access to healthy traditional foods.

Community food production



- Growing food in the community can help more people have access to healthy foods. Examples of local or community food production include:
  - household gardens
  - community gardens
  - forest gardens
  - greenhouses
  - raising animals
  - indoor growing methods
  - other methods of culturally appropriate food production

Assisted migration

- Programs where humans help species move to new areas in response to climate change is called 'assisted migration'.
- For food security this may mean planting berries or other plants that will grow well in future climate, or helping important plants in the area continue to grow.
- Moving plants and animals can lead to invasive species and disruptions of ecosystems. Weigh all risks carefully before using assisted migration.

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HEALTH

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HEALTH - ADAPTATION OPTIONS

Health support

- Make sure that health professionals serving the community know the health risks of climate change.
- Information about climate change and health should be shared with the community.
- Advocate for health services for climate change challenges (mental health support, medications for asthma, respiratory conditions, Lyme disease prevention, etc.).

Community plan for weather events

- Communities can make a plan/plans for events like heat, storms, flood, wildfire, etc.
- Consider things like community alerts, refuge centres, emergency supplies, planning for power outages, evacuation plans, etc.
- Identify vulnerable groups in the community (children, Elders, those with health issues, etc.) and include their needs.

Monitor air quality

- Air quality could be affected by wildfire smoke or increases in pollen/allergens.
- Monitor air quality in the community with existing programs (like firesmoke.ca) or with a community air-monitoring station.

Protection from sun & heat

- Avoid sunburns and heat illness by:
  - finding shade
  - covering skin with clothing or sunscreen
  - wearing hats & sunglasses
  - limiting activity in the hottest part of the day

Monitor for hot weather

30°C

- Create a monitoring program for heat events. Warn community members of hot weather days and share steps for avoiding heat illness.

Monitor & prevent bites from ticks and mosquitoes

- Climate change will allow species to live in areas where they couldn't live before, like blacklegged ticks that can carry Lyme disease or mosquitoes that can carry West Nile virus.
- Monitoring activities, like tick dragging and mosquito traps, can help alert communities to new species in their area.
- Help prevent infection by preventing bites. Take actions like covering skin, using 'bug spray' and checking for ticks after being outdoors.

Recognize & prevent mold growth in homes

- Mold can grow when there is extra moisture in your home from condensation, leaking pipes, flooded basements, etc.
- Share information about recognizing, preventing, and dealing with mold in community homes.

Cultural activities

- Cultural activities support community health and well-being.
- Consider weather and the changing climate when planning traditional or outdoor activities; provide shade, water and shelter to participants.

Refuge centres

- Refuge centres provide safe spaces for people during emergencies or extreme events.
- Cooling centres for hot weather, clean air spaces for poor air quality, and evacuation centres or emergency housing for people who have to leave their homes, are types of refuge centres.

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INFRASTRUCTURE

Climate change impacts on energy

more rain
severe storms
heavy wet snow
freezing rain & ice storms
damage
power outages

Impacts on drinking water systems & wastewater lagoons

warmer waters
changes to rain & snow
Drinking Water Systems
poor drinking water quality
wastewater lagoon leakage
contaminated drinking water source
changing water levels

Impacts on homes & buildings

severe storms
heavy wet snow loads
heavy rain flooding
building damage

Impacts on roads

more freeze-thaw cycles
more heavy rains
road damage
road flooding

Assess vulnerability & make a plan

Make sure infrastructure is ready for climate change

Plan for snow load

Monitor wastewater lagoons

Create a plan for power outages

Community Centre

community-wide & in households

Produce renewable energy

Rely less on diesel generators, provide back-up power

Monitor drinking water quality

Drinking Water Treatment Plant

Have an emergency plan to supply water if needed

Build/retrofit for climate change

Homes, community buildings, energy infrastructure & treatment plants

Maintain good community drainage

Design roads to let water run off

Include ditches & culverts and keep them maintained

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INFRASTRUCTURE - ADAPTATION OPTIONS

Produce renewable energy

- Communities can use renewable sources, like wind, solar or micro hydro, to produce energy.
- Renewable energy can reduce dependence on diesel generators or the provincial grid.
- Renewable energy can also provide backup power if the larger electrical grid goes down.

Good community drainage

- Good drainage can help keep water from settling on roads and keep it out of basements and crawlspaces.
- Drainage systems should have:
  - an appropriate slope
  - water holding areas (like wetlands)
  - culverts that are the right size and not damaged
  - clear ditches

Snow load

- Snow load is the weight of snow and ice on the roof of a home or building.
- Know the warning signs of snow load problems for homes/buildings.
- Measure snow amounts and have a plan for snow removal.

Vulnerability assessment

- Climate change will bring many challenges to energy infrastructure, community roads, water systems, homes and buildings. A vulnerability assessment can help identify how these parts of the community are at risk.
- Make a plan to get vulnerable infrastructure ready for climate change.

Build or retrofit for climate change

- Keep climate change (extreme heat, severe storms, flooding, etc.) in mind when planning new projects or repairing/upgrading existing homes, buildings and services.
- Improve community homes with things like insulation, drainage, sump pumps, energy efficient windows, etc.
- Structural changes or improvements might also be needed.

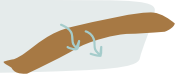
Monitor drinking water quality

- Monitor drinking water sources for potential climate change impacts (lower water levels, water quality changes, problems with intake pipes, etc.).
- Have a community plan if tap water is not safe to drink.

Plan for power outages

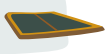
- A community plan for power outages could include: an emergency centre (warming in winter, cooling in summer), support for community members, community alerts, etc.
- Having a source of emergency power will be an important part of community planning.
- Households can prepare by: having emergency supplies, knowing how to keep refrigerated foods from spoiling, knowing how to keep pipes from freezing, etc.

Building roads



- Shape roads to help water drain off (water on roads can create potholes & washouts).
- Include ditches and culverts and keep them maintained.
- Limit erosion on roadside slopes by keeping the grade gentle and letting plants grow.

Monitor wastewater lagoons



- Climate change could bring challenges like more heavy rain events. Monitor lagoons for signs of problems, like leakage, that can contaminate surrounding land.

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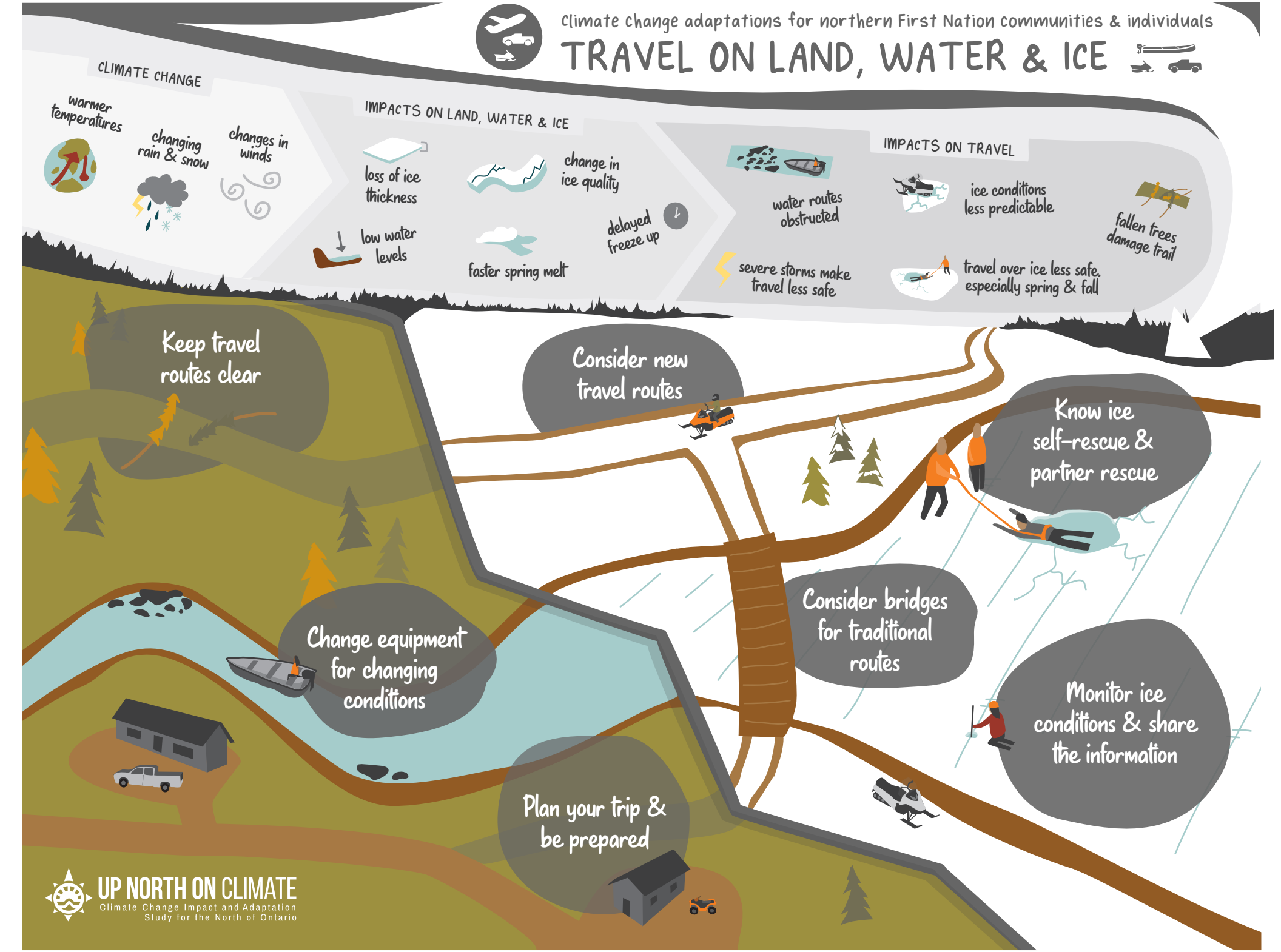
TRAVEL ON LAND, WATER & ICE



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TRAVEL ON LAND, WATER & ICE - ADAPTATION OPTIONS

Change equipment

- People in the north are already changing the way they travel on land, water & ice by doing things like:
  - using ATVs instead of snowmobiles
  - using boats and motors for shallow water
  - taking lighter loads in boats
  - using lighter equipment on thinner ice

Keep routes clear

- Making sure trails and routes stay accessible may mean putting more time and effort into keeping trails clear (removing fallen trees, keeping brush down, etc.).

New or different routes

- Taking a different route or creating a new trail might be needed if low water levels, thin ice, or changes to the land make traditional routes unsafe or obstructed.

Plan trip & prepare

- Trip planning and carrying emergency supplies can help keep people safe in the face of changing and unpredictable weather.
- Actions can include:
  - checking the weather forecast
  - sharing your travel plans with someone you trust
- Supplies can include:
  - food and water
  - first aid kit
  - extra medication
  - satellite phone or SPOT device

Bridge crossing

- Climate change is making the ice-on season shorter and affecting the thickness and quality of ice.
- Permanent bridge crossings over water on popular routes and trails could make crossing ice safer and extend the length of time people can travel.

Monitor ice conditions

- Monitor ice conditions in the area and share that information with the community.
- Ice thickness can be measured with an axe or auger, or with ice-monitoring sensors like ground penetrating radar, like the ones used in the SmartICE program.

Ice rescue

- Ice self-rescue is knowing how to get yourself out of the water. Partner-rescue is knowing how to help someone else out of the water.
- Consider arranging ice rescue training in the community.
- Having safety equipment (floater suits, ice picks, throw ropes, etc.) and knowing how to use it can make a difference.
- Communities may want to consider making safety equipment available for people to use.

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WINTER ROAD TRAVEL

CLIMATE CHANGE

warmer temperatures

changing rain & snow

especially winter, spring & fall

more winter rain

IMPACTS ON LAND, ICE & WINTER ROAD

later freeze up

earlier break-up

more mid-winter thaws

unexpected road closures

delay in road opening

shorter winter road season

permafrost thaw

weaker, thinner ice

worse road conditions

IMPACTS ON THE COMMUNITY

energy insecurity

higher cost to fly in goods

food insecurity

unable to attend events/ appointments

social isolation

Share daily road information in the community

Consider an all-season road feasibility study

Reduce dependence on shipped goods

Harvest from the land when you can

Realign the route

Reduce the need for fuel tankers

Produce energy in the community

Seek funding for equipment

Install permanent bridge crossings

Add bridges at increasingly risky water crossings

Gather winter road information

Improve winter road flooding methods

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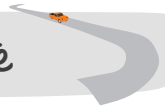
WINTER ROAD TRAVEL - ADAPTATION OPTIONS

Permanent bridge crossings

- Bridges over river and creek crossings can make winter roads less dependent on ice conditions allowing roads to open sooner and stay open longer.
- This option is likely to be expensive.

Realign the route



- Winter road builders, guided by local knowledge or their own experiences, may be able to make small-scale changes to the winter road routes like: avoiding steep slopes, limiting south-facing exposures, finding better creek-crossing locations, etc.
- Large-scale changes to the route involving big stretches of road (and likely more than one community) would be a big project involving consultants, engineers, government, etc.

Reduce need for fuel tankers

- Fuel for diesel generators is a big part of the goods shipped over winter roads.
- Energy from renewable sources, like wind or solar projects, reduce the need for diesel in communities.
- Wataynikaneyap Power is also connecting some remote communities to the provincial electricity grid.

Share information

- Climate change is making winter road conditions less predictable.
- Share daily winter road information in the community. Many communities and community members already do this using social media.
- Conditions can vary over different sections of winter roads. Information about road conditions over long distances, like the entire route from major centres in the south to communities in the north, could be very useful.

Better equipment

- Equipment upgrades could allow some road construction to start earlier. Graders, for example, could allow land sections to be built quickly without needing to wait for plentiful snow to create a smooth road bed.
- Seek funding for new equipment.

Reduce need for shipped goods

- It may be possible to harvest some goods, like logs or food, from the land.
- Consider foods that can be grown in your community with gardens, greenhouses, etc.
- Traditional ways of building may better incorporate materials from the land and strengthen cultural connection.

All-season road feasibility

- As the winter road season gets shorter, Tribal Councils, regions, etc. might explore the option of an all-season road.
- Communities may want to support an all-season road feasibility study for their region.
- Planning and building an all-season road is a long, multi-million dollar process that will require engineers/consultants, impact assessments, a coordinated plan, etc.

Winter road flooding

- It may be possible to change or improve road flooding methods to get better results.
- Newer water pumps, more water pumps, or other types of equipment could be helpful. Seek funding if equipment could be updated or improved.
- Ice-penetrating radar machines (like used in SmartIce) could be helpful for determining safe ice thickness for flooding and travel.

Gather information

- Gathering information about the winter road (road condition, road usage, opening/closing dates, etc.) can be important for future decisions.

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WILDFIRE

CLIMATE CHANGE

- warmer temperatures
- changing rain & snow
- more/intense storms & winds

IMPACTS ON THE LAND

- more evaporation, drier land — summer
- warmer = possible insect outbreaks — fall
- later snow fall — winter
- earlier melt — spring

IMPACTS ON WILDFIRE

- longer fire season
- more dead/fallen trees (fire fuel)
- more lightning (fire ignition)
- drier land (fire fuel)
- higher risk of accidental ignition

IMPACTS ON PEOPLE

- poor air quality
- evacuations & stress
- damage to the community

Use fire resistant materials for homes & buildings

Monitor for smoke & air quality

Monitor for wildfire risk in your area

Use 'Ontario's Forest Fire Info Map' or create a community-based monitoring program

Monitor water quality after a fire in the area

Keep people informed with community alerts

Share info about fire hazard risk, smoke & air quality with the community

Manage trees & plants in and around the community

Raise awareness about human-caused fires

Create an emergency plan

community wide & in households

Become a FireSmart community

Community Centre

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WILDFIRE - ADAPTATION OPTIONS

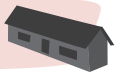
Emergency planning

- Emergency planning can help keep people safe in the event of a wildfire.
- Community emergency plans could include: evacuation plans, the roles and responsibilities of community members, plans to protect infrastructure, etc.
- Households can prepare for emergencies by: having emergency supplies, knowing what to pack for evacuation, knowing the community emergency plan, etc.
- Communities can also inventory any fire equipment they have and keep it in working order.

Monitor water quality

- Wildfires can impact water when ash, sediment, or other debris is washed into lakes and rivers.
- When fires happen near or upstream of a community, drinking water could be affected.
- Monitor lakes/rivers that supply drinking water after wildfire events and have a plan if water is not safe to drink.

Fire-resistant materials

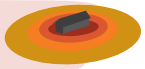


- Some materials are more fire resistant than others. Use more fire-resistant materials when building new homes or updating existing ones.

Community alerts

- Share information about fire hazard risk, smoke and air quality with the community. Social media, community websites, local television and radio, and posted notices can all be good ways to do this.
- Communities may want to have a special alert or warning alarm to tell residents when there is a wildfire emergency.

FireSmart community



- FireSmart Canada offers programs and information to help households and communities be better prepared for wildfire.
- Managing trees and plants, priority zones around homes and communities, fire-resistant materials, community fireguards, and more, are all part of FireSmart.

Monitor wildfire risk

- Hot, dry conditions can make it easier for fires to start and spread.
- Communities can monitor the fire hazard risk in their area with online tools like Ontario's Forest Fire Info Map or the Canadian Wildland Fire Information System, or create their own program.

Monitor for smoke & air quality

- Knowing when smoke is predicted to reach your community (smoke forecasting) can allow time to put health actions in place.
- Track wildfire smoke with online tools like FireSmoke Canada or Canada's Wildfire Smoke Prediction System (FireWork).
- Identify those in the community most vulnerable to poor air quality (Elders, those with asthma, etc.).
- When air quality is poor or predicted to become poor, communities can: inform community members, set up clean air spaces, evacuate vulnerable people, etc.

Prevent human-caused fires

- Raise awareness of human-caused fires and how they can be prevented on the land and in the community.

Manage trees & plants

- Managing trees and plants can help keep wildfires out of your community. This could include: fireguards, thinning trees, encouraging growth of deciduous trees, clearing dead material and controlled burning.

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