



# THE CANADA COUNTRY STUDY:

*Climate Impacts and Adaptation*

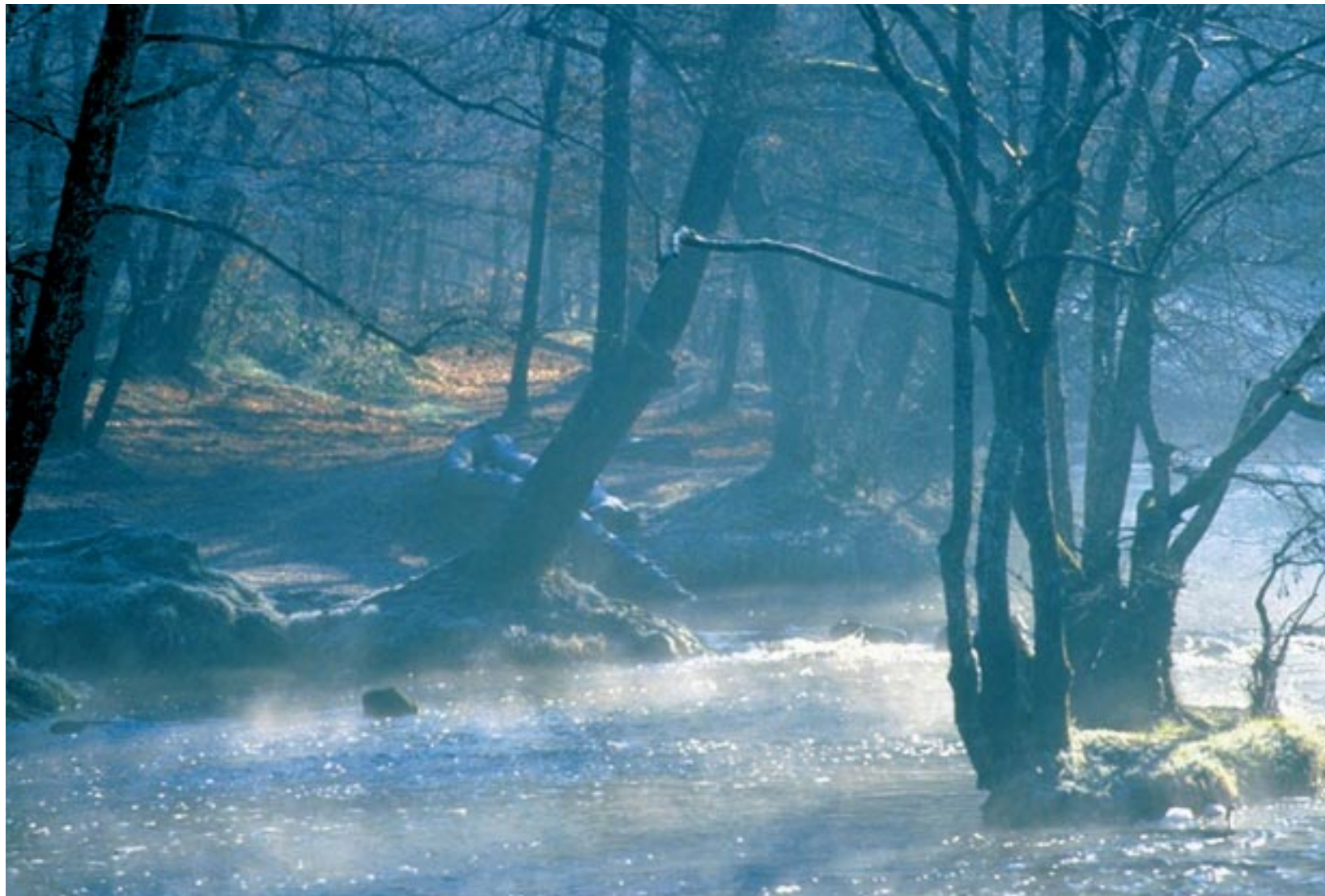


## BRITISH COLUMBIA & YUKON SUMMARY

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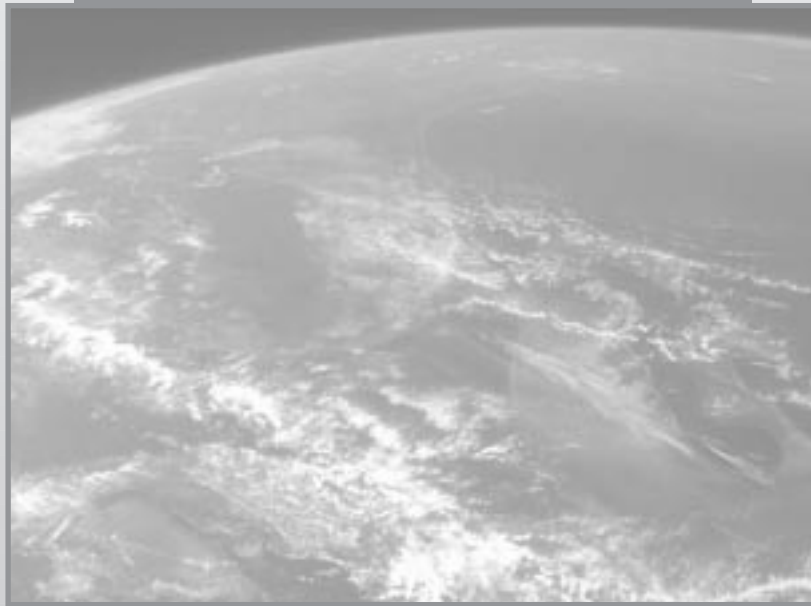
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# **THE CANADA COUNTRY STUDY:**

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## ***BRITISH COLUMBIA & YUKON SUMMARY***



Environment  
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## Report Information

The full report, “Responding to Global Climate Change in British Columbia & Yukon” can be obtained by contracting:

**Environment Canada**  
Commercial Services  
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Vancouver, B.C.  
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This report consists of 26 chapters written by 43 experts in the field of climate, natural resources, the environment and industry.



# THE CANADA COUNTRY STUDY

## Climate Change in British Columbia and Yukon

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### Introduction

The climate of the earth is changing. Unchecked, rising concentrations of greenhouse gases could alter future climates around the world at a rate never before witnessed. Changes in temperature, rainfall and snowfall can have a profound effect on the availability of water, the abundance and distribution of different types of plants and animals, the length of the growing season, and on local and regional economies.

In British Columbia and the Yukon, warmer temperatures are expected to result in milder winters and warmer summers. However, winter storms may be wetter and windier. Summer rainfall may be heavier and thunderstorms may be more intense, increasing the hazards of lightning, wind and hail.

Accurately predicting how the climate will change due to an enhanced greenhouse effect in specific areas of British Columbia and Yukon over the next 100 years is very difficult. Any forecasts made in this document are based on the best available information. The exact magnitude and timing of climate changes that will result from increases in greenhouse gas concentrations remain uncertain.

The effects of climate change on fish, forests, coastal environments, agriculture, and other sectors of British Columbia and Yukon are documented in detail in Environment Canada's 1997 report, *Responding to Global Climate Change in British Columbia and Yukon, Volume 1, Canada Country Study*. This document is a summary of those findings.

**The Canada Country Study is the first-ever national assessment of how climate change will affect Canadians and their social, biological and economic environment over the next century. It brings together the knowledge and views of climate experts in government, industry and academic institutions, identifies gaps in research and recommends plans of action.**

**This is one of two national and six regional reports summarizing the Canada Country Study findings.**





## Climate Change

Climate is naturally variable. From our own experiences we know that one summer is often warmer than another, or one winter is colder or snowier than another. Such variability is normal, and is related to changes in ocean currents or seasurface temperatures, volcanic eruptions, alterations in the sun's energy output, or other features of the climate system.

Over the past century, however, climates of nations around the globe, in general, have been getting warmer. In the last half a century, most parts of Canada have also experienced warmer temperatures and increased precipitation. These trends may reflect the growing influence of human activities on our planet.

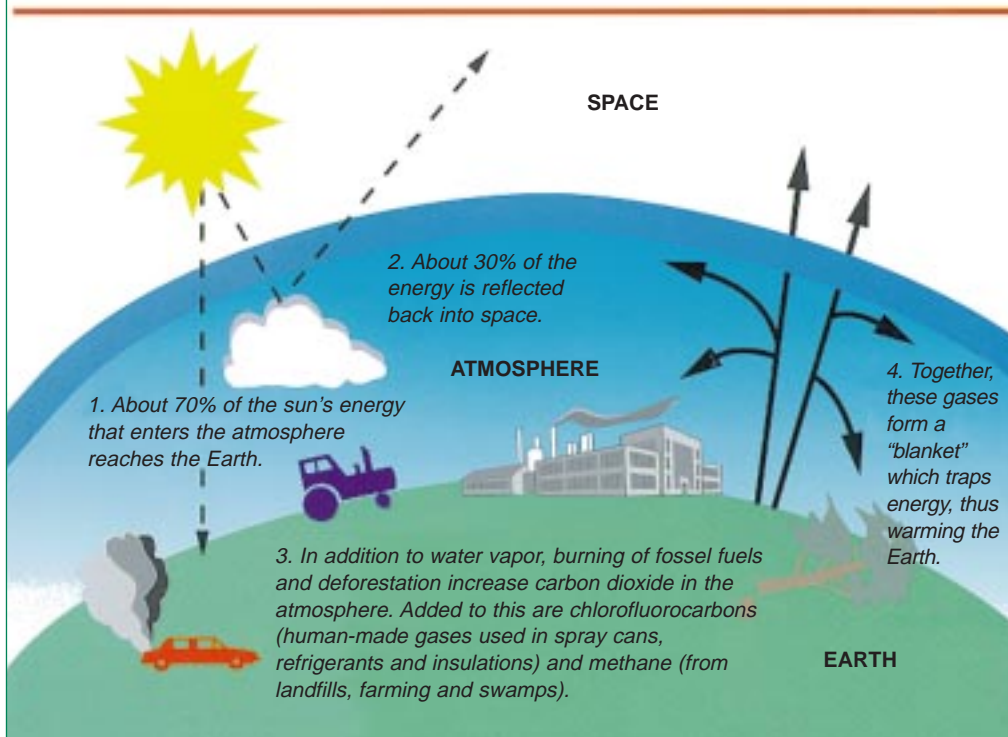
The concentrations of greenhouse gases, mainly carbon dioxide, methane and water vapour, which occur naturally in the atmosphere, are being altered through the burning of fossil fuels (coal, oil, natural gas), deforestation, and

industrial and agricultural processes. These gases warm the atmosphere, and the climate and environment respond. Each climatic response triggers others, and we are still learning about some of these responses. So, it is difficult for scientists to accurately predict how much climate will change, or how those changes will affect us, especially at a regional or local level.

Greenhouse gas emissions will continue to increase over the next century. If the world continues along its present course, the concentration of greenhouse gases in the atmosphere will double before the end of the 21st century. In response, the average global temperature is expected to rise by one to four degrees Celsius. To get an idea of how significant this change could be, consider that the global temperature during the last Ice Age was only four to six degrees cooler than today.

While climate changes and impacts in Canada will mirror global ones, significant regional variations are anticipated, owing to the large size of the country. Here are some of the changes we're already experiencing:

### How the Greenhouse Effect Works



☁️ warming across most of Canada this century, with largest changes occurring in the northern prairies and Mackenzie Basin;

☁️ increased precipitation in almost all regions of the country over the last half a century;

🌊 sea level rises along portions of the coast;

🌪️ increases in insured losses caused by extreme weather events.

Source: World Resources Institute, *Changing Climate: A Guide to the Greenhouse Effect* (World Resources Institute, Washington, D.C., 1989).



## How Climate Change Will Affect Canada's Pacific Region

Climate change in British Columbia and the Yukon will be characterized by warmer and wetter winters and somewhat warmer and drier summers. Up to a 40% increase in winter precipitation should occur in southern areas of British Columbia. Higher winter temperatures will result in more rain and relatively less snow. With winter temperatures expected to increase by up to four degrees Celsius along the coast of British Columbia and up to six degrees Celsius in the interior regions, winters will be shorter and summers will be longer. Yukon winter temperatures are projected to increase by two to five degrees Celsius in the south and by as much as eight degrees Celsius along the north coast.

Summer temperatures may rise by as much as six degrees Celsius in British Columbia and southern Yukon and up to four degrees Celsius in northern Yukon.

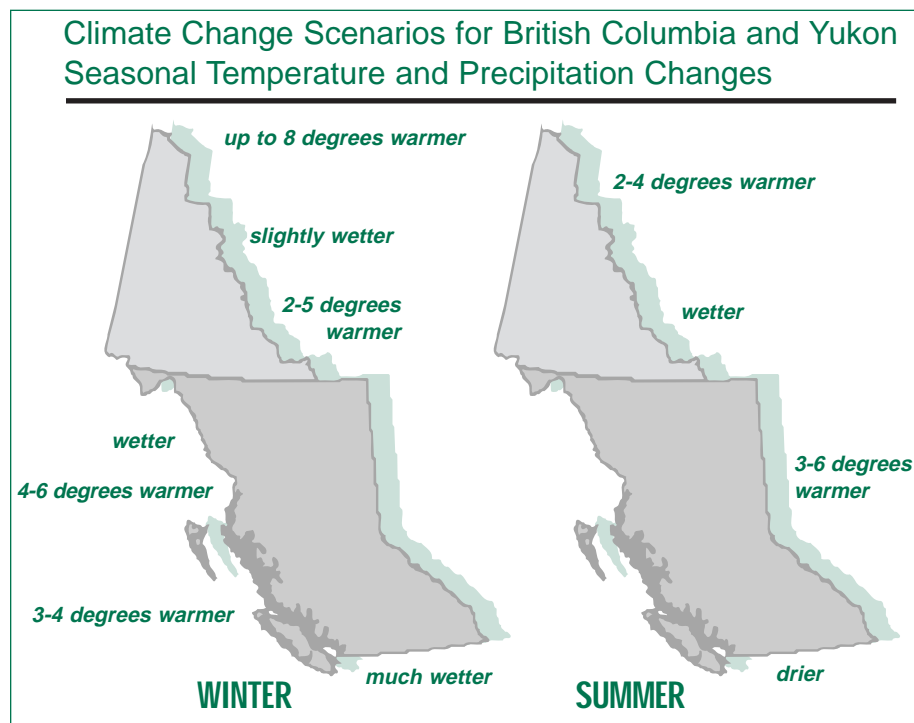
The natural resources, communities and economy of the region will be affected in many different ways by these climate shifts.

### The People

With the majority of British Columbia's population living very near the coast, a rise in sea level and increased storm activity is expected to have a profound effect on people, buildings, roads and commercial and recreational activities. Waterfront homes and port facilities will be especially at risk. Contamination of groundwater in low lying areas by salt water may affect the quality and supply of drinking water and reduce the productivity of agricultural lands. There will be increased construction and maintenance costs associated with breakwaters, dock and flood protection facilities.

Like other life forms, human health and lifestyles could be jeopardized by climate change. Warmer and more humid conditions are likely to benefit parasites that thrive in warmer climates, such as *Entamoeba histolytica* that causes the disease commonly known as Montezuma's revenge and *Giardia* sp., which causes giardiasis, commonly known as beaver fever. Fleas and mites that are now killed by cold winter temperatures would continue to multiply, even in only slightly milder conditions. Infestation rates will also increase for any parasites which can migrate northward faster than the people and natural environment can adapt.

Heat related deaths could increase during heat waves, which will last for prolonged periods in some areas. Extreme temperatures will be higher than at present and, in urban areas, these temperatures could be driven even higher as the population density increases.





Respiratory disorders and related health costs could increase in areas such as the Lower Fraser Valley where air quality will suffer as a result of higher summer temperatures and deteriorating air quality, the latter caused primarily by motor vehicle exhaust emissions. Health costs could rise even higher with an aging population.

Aboriginal people, whose lifestyles are strongly tied to resources on their traditional lands, will also be affected by climate change. The Village of Old Crow, Yukon, for example, relies on the Porcupine caribou herd for food and to maintain traditional lifestyles. However, the Porcupine caribou could decline as warmer summers increase the number of mosquitoes and winter snow depth increases.

Not all effects of climate change will be negative. Warmer, longer and drier summers will provide more recreational opportunities and draw more tourists to the region. On the other hand, milder winters with more rain and less snow will shorten the ski season in the mountains of the Lower Fraser Valley.

## The Economy

Coastal areas are of particular environmental and economic importance to British Columbia and the Yukon. A rise in sea levels and changes in weather patterns, water quality, streamflows and sea surface temperatures could have a profound effect on coastal environments and communities. While some sectors, such as agriculture may benefit, others will not.

### Fisheries

A rise in sea temperatures will produce a northward shift in fish habitat. Increased wave action and higher runoff will reduce water clarity, affecting seagrass beds which serve as spawning, nursery and refuge areas for fish and shellfish. Oxygen depletion may kill some fish populations.

Higher temperatures, reduced oxygen, increased turbidity and lower summer streamflows in fresh water streams and lakes will

also affect aquatic life. Fraser River salmon stocks are expected to decline as a result. This may be offset by an increase in productivity in northern waters. However, overall salmon abundance may still be lower as marine life is affected by reduced nutrients along the coast. Pacific cod abundance will be reduced. Cold water fish such as trout, char, whitefish and grayling may also suffer as water temperatures rise.

### Forestry

Climate change could have important impacts on the forests of British Columbia and Yukon. Climate change will also result in an up-slope migration of tree lines and transition zones, the sparsely-treed area between the forest and alpine tundra. In the southern interior, higher temperatures and drought will lead to the expansion of the Bunchgrass and Ponderosa Pine zones. Interior forests, such as Douglas fir, will migrate northward. Warmer temperatures and drier summers will increase fire frequency and outbreaks of insects and diseases. Some forested warm and very dry areas, already at the limit of their range, may completely disappear. These effects will be complicated by land use and management practices, including timber harvest and reforestation, insect pest management, fire control and grazing.

British Columbia's forests are presently a sink for atmospheric carbon, the rise in whose concentration results from the burning of fossil fuels such as coal, oil and natural gas. But the rate of carbon accumulation is decreasing as forests age and management practices change. However, there will be increasing pressure to manage forests to offset these fossil fuel emissions.

Under warmer conditions, forest pests such as the bark beetle and the white pine weevil are expected to increase in numbers and range. Reforestation will be difficult because of insect infestations. Warmer temperatures and drier summers could also increase the number of forest fires, altering ground cover and the types of animals and wildlife that populate a particular area.





## Agriculture

Generally, agricultural production in both British Columbia and the Yukon will benefit from climate change. Warmer temperatures will result in more favourable growing conditions, an extended range of existing crops and the introduction of new crops. The availability of water and the potential for irrigation may limit the extent by which agricultural production can increase.

Many areas of British Columbia, particularly in the south, are expected to experience large population increases in the coming decades. A combination of rising population and drier summers will increase demand for water supplies, limiting the quantity available for agricultural purposes in these areas. Warmer temperatures will also increase insect infestations and disease outbreaks in the agricultural sector.

demand for winter heating but increased demand for summer air conditioning by energy consumers in British Columbia, other areas of Canada and the United States.

## Shipping

The shipping industry stands to gain from climate change in the Arctic. A longer ice-free season will make the Northwest passage a viable economic alternative for ships travelling from Northern Europe to Japan. However, with this increase in shipping activity comes the increased risk of cargo losses and oil spills into the Beaufort Sea.

## The Environment

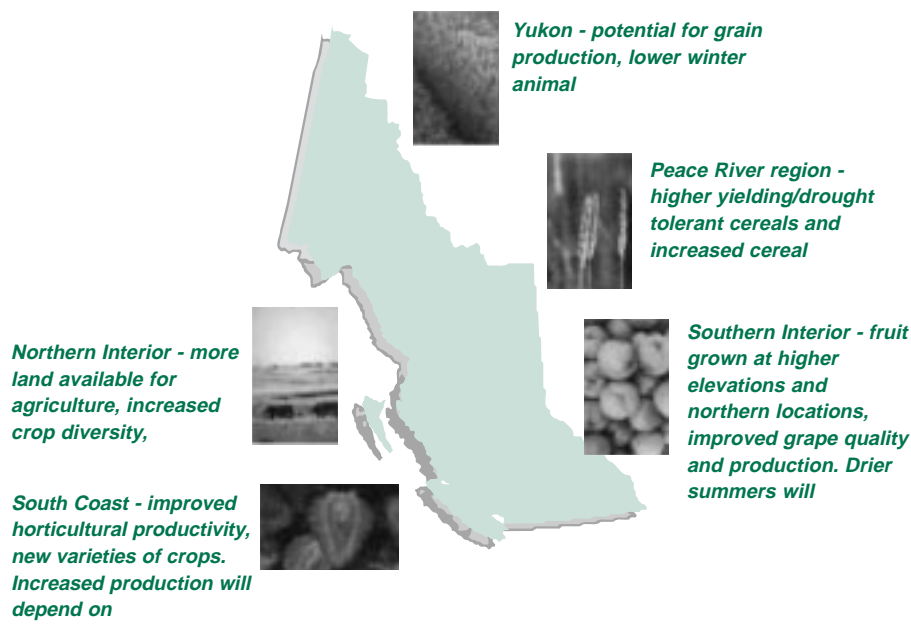
The effect of climate change on aquatic, plant and animal life will depend on their ability to adapt to new conditions. A change in climate could force a migration of many life forms to areas where climatic conditions are more suitable.

Those species able to disperse easily, move up-slope and extend their northern range will survive. On the other hand, those unable to disperse or extend their range will have nowhere to go.

With rising temperatures, there will be a general northward shift in many plant and animal species and a move to higher elevations. The reduction of sea ice in the Arctic will affect the mobility of marine mammals and the hunting habits of polar bears.

As temperatures rise, the tree line will move several hundred metres up-slope. Alpine and sub-alpine areas will shrink in size, threatening the unique species of plants and animals that live there including heather, dwarf willows, cushion plants, grasses, sedges, lichens, deciduous shrubs. Wind, shade, soil depth, snow accumulation and soil moisture will all influence tree line migration.

### Some Examples of Agriculture Impacts of Climate Change



## Energy

Hydro-electric power generation can be very dependent on climate which affects reservoir levels and the quantity of streamflow. Reductions in summer runoff as a result of warmer weather are a major concern to this sector. Climate change will also affect energy consumption with lower



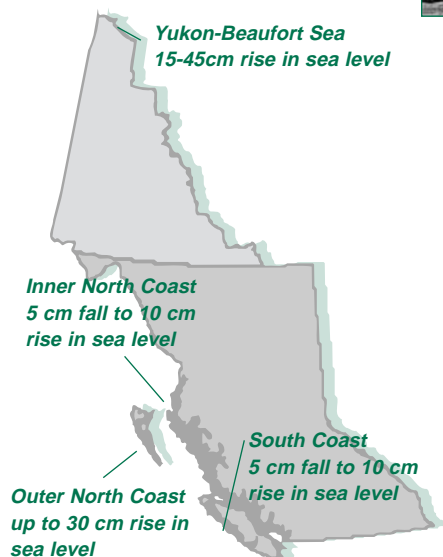
## Climate Trends

The shift in climate conditions to higher temperatures, more rain and less snow in winter, across the Pacific region, will be evident in a variety of ways:

### Sea Level Rise

An expansion of the oceans and melting of land-based ice sheets and glaciers, will result in warmer sea surface temperatures and a rise in sea levels. Scientists estimate that by 2050, the sea level will rise by up to 10 centimetres on the south coast and inner north coast of British Columbia, and up to 30 centimetres in the vicinity of the Queen Charlotte Islands. Estimates of sea level rise for the Yukon coast vary from 15 to 45 centimetres. Such a rise will affect shorelines that are sensitive to erosion and flooding. The range in sea level rise estimates is a result of local rising and falling of the earth's crust.

### Sea Level Change by 2050



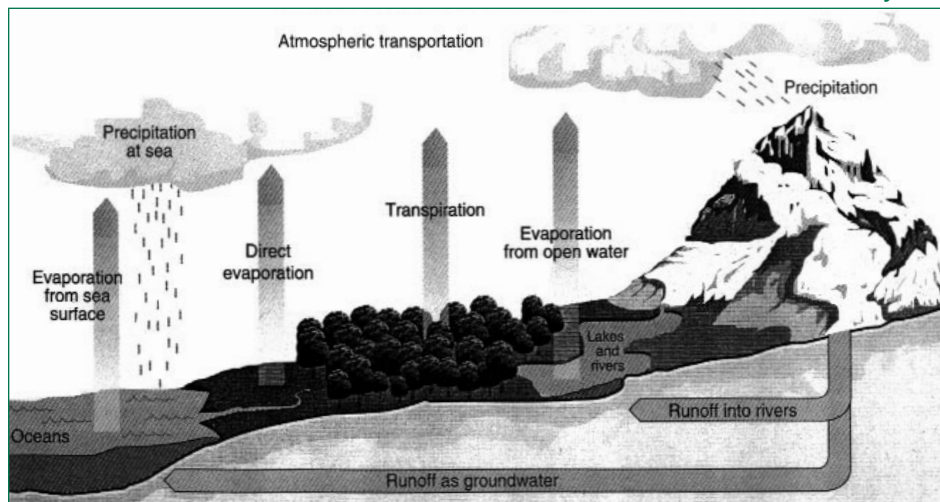
## More Heavy Rain, Snow

A warmer atmosphere is capable of holding more water vapour. This may result in more intense precipitation and more frequent and extreme weather events. Higher summer temperatures will result in drier soil conditions. Both droughts and floods are expected to increase.

## Increased Runoff, Lower Water Quality

More rain and relatively less packed snow in winter will result in higher winter and spring runoff. Soil erosion and landslides from increased runoff, along with warmer temperatures, may affect water quality.

### The Water Cycle



## Glacier Advance and Retreat

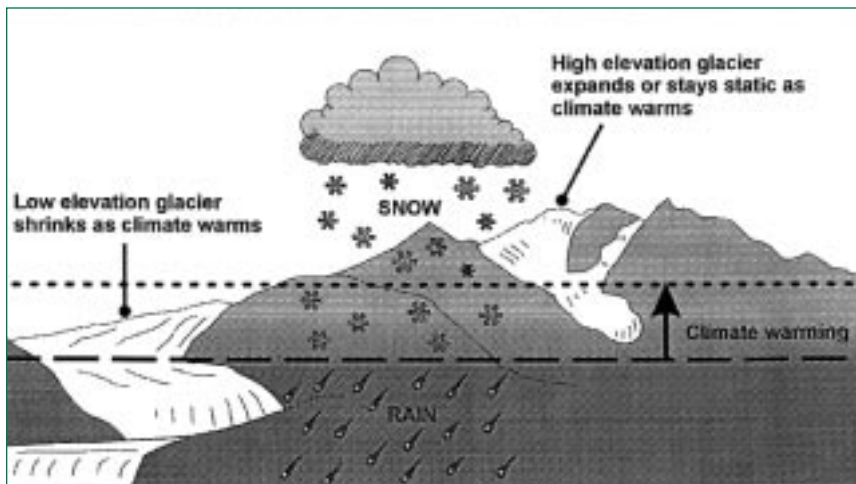
Many southern rivers and streams that are now fed by glacier runoff could be significantly affected by climate change. Most glaciers in southern British Columbia and the southern Rocky Mountains are already retreating. This is expected to continue and perhaps intensify at lower elevations.

The potential retreat or advance of British Columbia and Yukon glaciers as a result of climate change will depend largely on their



geographic location and elevation. Glaciers at higher latitudes and elevations, where temperatures are expected to remain relatively cold, will continue to receive adequate snow throughout the year. Glaciers at low elevations will continue to shrink under a warmer climate due to reduced snowfall and increased summer melting. The disappearance of glaciers may also cause some mountain slopes to become unstable, leading to landslides.

### Glaciers and Climate Warming



### Shoreline Erosion, Flooding

The combination of sea level rise and an increase in heavy rainfall will affect the coastlines of British Columbia and Yukon. The beaches, deltas and wetlands will erode and migrate inland. Wetlands may be caught in a coastal squeeze between rising sea levels and flood embankments. Along the Arctic shores of the Yukon, winter sea ice will decrease significantly, resulting in erosion due to the effects of greater wave action in summer.

## Can We Adapt and How?

The effects of climate change on our natural resources, our communities and our economy could be significant in British Columbia and

Yukon. We face a choice: find ways to reduce further emissions of greenhouse gases or adapt to the inevitable but uncertain effects that climate change will have on our well-being and our environment.

Even if we are successful in stabilizing or reducing greenhouse gas emissions, this may not be enough to prevent a rise in their concentrations and the accompanying changes to our climate. That is why we must also consider ways of adapting to a warmer climate and all the changes this could bring.

### Water Conservation

Climate change will significantly affect how our water resources are managed. Although annual runoff will be greater, this increase will occur only in winter and spring. As a result, we may need to store larger amounts of water for use in the dry summer season when irrigation and domestic water demand are highest.

Areas without water reservoirs will experience reduced water supplies from rivers and streams during the low flow summer season. Summer water quality may also be affected by higher water temperatures due to low reservoir levels and a warming of the supply mains and concrete storage reservoirs. Increased water temperatures could lead to a higher density of bacteria in the water system.

### Energy Efficiency

If water reservoirs are sufficiently large, the increase in annual runoff may allow an increase in hydro-electric power generation even with lower inflows during the summer. While the demand for energy winter heating will fall, this may be offset by an increased energy demand for summer air conditioning.



### Flood Protection

Existing flood protection structures may not be adequate for the increased severity and frequency of flooding, especially along the coast and across southern British Columbia. Increased runoff from higher precipitation may place greater stress on water and sewer systems. Existing systems will not be able to handle the higher water volumes, resulting in more frequent releases of raw sewage into the marine environment and greater risk to human and ecosystem health.

### Sound Land Use

Environmentally-sound land uses that do not harm soil, grassland cover, wetland areas and forests, will help greatly in adapting to climate change. Maintaining undisturbed or restored forest and natural areas along watercourses will be especially important. Wetlands will be particularly difficult to protect, and measures may have to be taken to control livestock use and water withdrawals.

### Forest Management

Disturbances such as harvesting, fires, disease, and reforestation failures provide opportunities for forests to adjust to the changing climate. Forest management already addresses many of the problems climate change will bring. However, the location and extent of these problems will shift. Alternate tree species cannot be planted now in anticipation of future climatic conditions because the current conditions are not suitable for the new species. It may be possible, however, to plant trees that grow well under a range of conditions and, as a result, produce forests that can tolerate a changing climate.

Parks and wilderness areas will be extremely difficult to manage because intervention is usually not part of a management strategy. Overall, the best approach may be to allow most of British Columbia's forests to adjust to climate change as best they can. It is only in the more productive, harvestable sites that intervention will be feasible.

### Commercial and Sport Fisheries

Climate change is just one of several factors affecting fish abundance. Natural fluctuations must also be taken into account along with the significant effects of commercial fishing. There is an urgent need to understand more about marine and aquatic life and how climate change will make fisheries management even more complex.

## Taking Action

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The potential ramifications of climate change for British Columbia and the Yukon range from very good to very bad. Scientific uncertainty prevents us from clearly understanding the timing and magnitude of climate change and its effects. We do not have all the answers. Clearly, more research is needed to improve scientific knowledge. But we also cannot wait for all the evidence to be in. By the time the effects of climate change are fully understood, it could be too late to take action.

Responding to global climate change must go beyond international agreements and national programs to reduce greenhouse gases. At the local and regional level, adapting to a changing climate may still be necessary even if greenhouse gas emissions are stabilized.

Communities can simply react to climate change when it occurs, or they can prepare for the future by extending their planning horizons. We need to adapt in ways that recognize the sensitivity and vulnerability of a particular region. We need to better understand how the various social, economic and resource sectors interact with one another and how they will be affected.

Land use and transportation managers, aboriginal communities, managers of renewable resources, governments, and the designers and operators of buildings and structures will all need to work together in deciding how to respond to climate change. The challenge will be to respond in a way that includes the interests of everyone.