Impacts of Climate Change High School Backgrounder 7

The Changing World of Water and Ice

Everyone needs water to survive. Humans, wildlife, birds, fish and plants all need water. Some live in the water, on the water or near the water. It keeps us all alive one way or another.

We also use water to travel on – sometimes when it is open, sometimes when it is frozen. Polar bears hunt on the sea ice. Seals and walruses raise their young on the ice and use it as place to rest. People in northern communities get to their camps, traplines and other towns by travelling across frozen rivers and lakes. Companies exploring for oil, gas or minerals use winter roads that cross frozen lakes, water channels and land.

This backgrounder looks at how climate change is affecting the world of water and ice.

Shrinking Sea Ice

When you think of the Arctic, what comes to mind?

Ice is likely one of the main things; solid ice, floating ice, icebergs, and then bears, seals and walruses on ice. These are all images of the Arctic. Most of the year, the ocean water in the Arctic is covered by ice. Even in the summer, many areas of the Arctic Ocean are ice-covered.

However, recent studies show that the sea ice in the Arctic is both shrinking and getting thinner and thinner than it used to by the end of summer. It's like a human losing weight and getting shorter at the same time. The ice in the Arctic is shrinking as the temperatures in the north increase.

Sea ice in the Arctic covers about 10–15% less area in the spring and summer than it did in the 1950s

The ice is now also estimated to be about 40% thinner in the late summer and early fall than it was in recent decades. That's quite the diet!

More open water means even more ice will melt

Have you ever watched a pond or lake melt? After the snow goes, the ice gets shiny. Then a dark spot appears where the ice is thin and the darker water can be seen underneath. Suddenly, the melting seems to speed up and the ice is soon gone!

The shinier, white ice reflects most of the sun's heat away. But where the darker coloured water shows through, the sun's heat is absorbed and the remaining ice above it melts. It's like when you wear darker clothes and stand in the sunshine. Darker colours make you warmer than you are when you wear light coloured clothes. The sun shining on the thinning ice works this way too.

Once the darker water starts absorbing the heat, the ice at the edges of the open water quickly melts away and the darker area gets bigger. This bigger area absorbs more heat, and then gets even bigger. The melting speeds up.

This melting pattern is likely happening on the Arctic Ocean. As climate change causes warmer temperatures, more ice will melt simply because the air is warmer. But the open water will also directly absorb the sun's heat and speed up the rate of melting of the sea ice around it.

So what's the big deal with less ice? Well, less ice means there is less ice on which humans and animals can travel, hunt or rest. Thinner ice also makes travelling on ice more dangerous *(see Backgrounders 10 & 11)*.

> "It used to be calmer out when the ice was around more; now we stay closer to shore when we go out."
>
> L. Carpenter, Sachs Harbour quoted in *Climate Change and Arctic Communities: Impacts and Adaptations in Sachs Harbour, Banks Island, NWT* (August 2000)

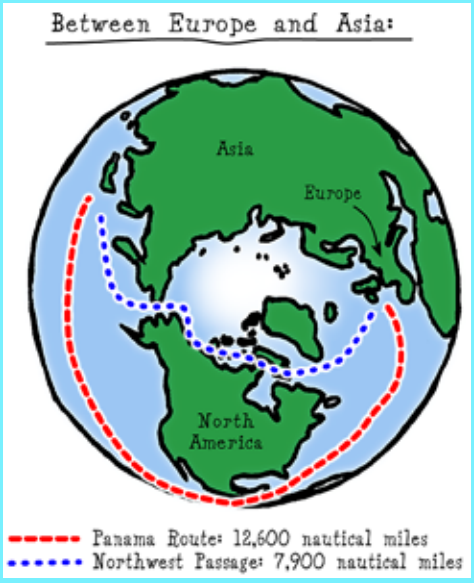
Cruising the Arctic Oceans

Some scientists predict that there might not be any Arctic sea ice in the Northwest Passage and other areas in the late summer months by the year 2050. This could mean that more ships will be able to travel around parts of the Arctic Ocean without any assistance from icebreakers (icebreakers are ships that are designed to clear a path through the ice).

Some people are excited by the economic development that this might create for northern communities along the coasts. It could reduce the cost of bringing in things like construction materials and food. It could make it easier to ship out natural resources like oil and gas or minerals. And more tourist ships will likely venture north into the open Arctic waters.

Canadians are not the only ones interested in new shipping opportunities! Other countries are also very interested in seeing the Canadian Arctic's Northwest Passage become a regular shipping route.

Currently, most ships carrying goods between Europe and Asia travel through the Panama Canal. This route is about 12,600 nautical miles long. If the same ships could go through the Northwest Passage, the trip would be only about 7,900 nautical miles. A shorter trip would save many businesses a lot of money!



Right now, the Canadian government considers the Northwest Passage to be in Canadian waters, but some countries are challenging this idea. The United States of America has even had a military vessel in these waters without the Canadian government's permission. Usually countries request permission to enter another country's waters.

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Cruising the Arctic Oceans (continued)

However, shipping through this route might not be as safe as some people claim it will be. The long, dark days of winter will ensure that the Arctic will always have winter ice cover. So shorter trips for ships will only be possible in the months of late summer and early fall.

And even if the Northwest Passage does become free of ice most summers, there may still be cold summers where the ice won't clear completely. At anytime, there may also be chunks of super hard pack ice floating in from other parts of the Arctic Ocean.

These hard chunks of pack ice can easily knock holes in ships. If this were to happen, it could threaten the safety of people on board, result in the loss of a ship's cargo and cause pollution in the sensitive northern environment. Sending in rescue and clean-up crews to remote locations would be expensive and take time.

So even if it gets easier to take ships through the Northwest Passage, the risks might outweigh the cost savings. What do you think?

Sea Levels

Canada has over 240,000 kilometres of coastline. If you look at a map, it's easy to see that most of this coast line is in the north, along the shores of the mainland and the islands of Nunavut and the Northwest Territories.

Over the last 100 years, the sea levels in the world have risen by about 10–25 centimetres. These levels are projected to rise by up to 88 centimetres by 2100 (check that out on a ruler!).

There are two main reasons the sea is rising:

- More of the ice on land has been melting and draining into the ocean as climate change causes temperatures to increase.
- When things warm up, they expand. This is called "thermal expansion." Water in the ocean will do the same thing. If the water warms more than usual with climate change, it expands more than usual. This means sea levels will be higher than usual.

Even though less than one metre of sea level rise might not sound like a lot, it can cause a lot of damage. Can you think of some of the impacts that higher sea levels might have? Some of the key impacts are:

- More flooding in coastal areas. This can damage heritage resources and coastal ecosystems. It could also cause ground water to get salty.
- More erosion of the coastline. Higher sea levels mean that the waves will hit the shore higher than they used to so they can do more damage. This can destroy buildings and roads that are along the coast.
- More areas of land will be permanently covered by the ocean.

Earlier break-up changes derby date!

In the coastal town of Coral Harbour, Nunavut there used to be a local ice-fishing derby in mid-April. However, for three years in a row, participants kept getting their snow machines stuck in slush as they travelled out onto the ice in April. Spring was happening earlier in the year. So the derby is now held in March.

Can you think of any winter or spring events that have been cancelled or changed because of early or late break-up?

Rivers and Lakes

In 1960, the ice on the Mackenzie River in the NWT typically broke-up during the first week of June. Now it's more common to see it break-up in mid to late May. By 2050, it is predicted that the ice-free season on the Mackenzie could be up to a month longer than it is now!

The ice on most lakes and rivers in the north will break-up earlier than it used to because climate change is causing temperatures to rise.

It's also predicted that most of the Arctic will get 10–20% more precipitation (rain) in the summer months. Some extra snow will also fall in the winter but the amount will vary depending on where in the Arctic you are. So the pattern of rain and snowfall will be different in different areas in the north. Some parts of the Arctic may be wetter or drier than others.

You might think that the areas that get more rain and snow would end up having more water in the lakes and rivers. But that might not happen. Can you think why this might be?

It's because warmer temperatures will cause more water to turn into water vapour (to evaporate) and travel into the atmosphere. Also, because the ice is melting earlier and freezing later in the year, there will be more weeks in the year when the water in lakes and rivers isn't covered by ice. This means that water will have more time each year to evaporate. So more rain and snow doesn't necessarily mean more water in the rivers and lakes!

Warmer temperatures also cause more rapid melting in the spring. If things melt too quickly, there will be more flooding. This flooding will affect rivers and streams, and nearby communities.

What does snow cover have to do with ice thickness?

Did you know that the depth of the snow affects how thick the ice will get on a lake or river? Do you know why?

When the water in rivers and lakes is directly exposed to the freezing cold air, it freezes. However, once the snow starts landing on the new ice, the snow acts like a blanket and insulates the ice from the cold air. If it is blanketed by snow, the ice won't thicken as quickly. And the deeper the snow, the slower the new ice forms.

For example, in winter in the NWT, about 30–40 centimetres of snow piles up on the lakes close to the town of Inuvik. The average ice thickness on these lakes is about one metre. To the north of Inuvik, only 10–20 centimetres of snow piles up on the lakes near the Arctic coastline because the coastal winds keep blowing the snow inland. On these coastal lakes, the ice is twice as thick as the ones close to Inuvik that are covered by more snow!

So more snow means thinner ice! If the north is going to get more precipitation – more snow – in the winter because of climate change, this means the ice may be thinner that it used to be in the winter. This could create dangerous conditions for people and animals that travel across the ice.

If you'd like to set up your own project to measure the thickness of ice on lakes near you, check out http://www.taiga.net/coop/projects/lakeprotocol.html

Glaciers

Surprisingly, glaciers and ice caps in the Canadian Arctic are expected to change little as the climate changes. Although glaciers in the far north will likely melt more because of the warmer weather, the same glaciers will gain back what they lose! This is because more snow and rain is expected to fall at higher elevations. It will make up for what melts at other times of the year.

Alaskan glaciers add 13.2 trillion gallons of melted water to the seas each year – the equivalent of more than 13 million Olympic-sized swimming pools.

Kansas City Star, July 31, 2003

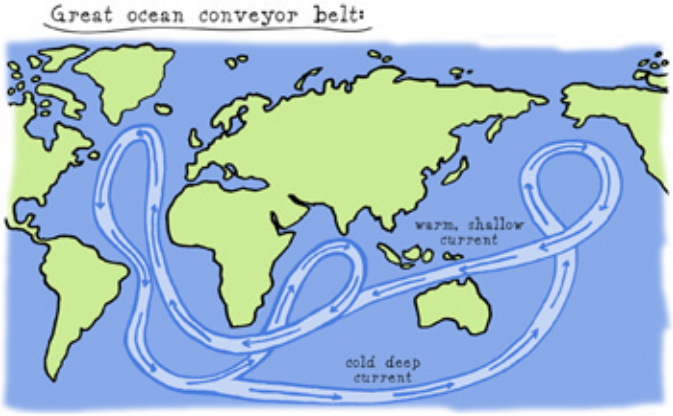
However, glaciers at lower elevations and glaciers farther south won't be so lucky. These glaciers are expected to lose more from melting than they will gain back from more snowfall. Southern and lower elevation glaciers are expected to start shrinking and retreating with climate change. Many glaciers are already getting smaller and more climate change is expected to speed up the pace of their retreat.

Freshwater Could Interrupt Ocean Currents

Water slowly moves around the world's oceans. The movement is driven by a system of ocean currents. Both wind and the rotation of the Earth help to determine the flow of surface currents. They also influence how water moves from the surface down to deeper waters.

The biggest force in the ocean is something people describe as an ocean conveyor belt. The fancy name for this movement of ocean water is the "thermohaline circulation."

This moving conveyor belt of water moves warm water from the tropics towards the north and south poles. When the warm water reaches cooler parts of the world, it cools down. The water sinks when it gets to the colder regions of the world because cold water sinks below warmer water. Warm water travels on top towards the poles, and lower, colder water, moves back towards the tropics. This is what creates the conveyor-belt-like action.



But climate change will likely slow down, and could turn off the conveyor belt. As more glaciers melt, and more rain and snowfalls, more fresh water than usual will enter the ocean. Fresh water floats on top of salt water. This fresh, cold water won't be able to sink through the salt water so it may block the movement of the conveyor belt.

If the conveyor belt stops or slows down, it would have a huge impact on ocean life. It would also change how much heat moved from tropical areas to northern areas. Some areas of the northern hemisphere could start cooling down instead of warming up.

What's This Mean for People and Critters of the World?

To find out more about how the changing world of water and ice will affect animals that live on or by the oceans, read Backgrounder 10. To find out how northern people and people around the world will be affected, check out Backgrounders 11 and 12.

Key Points

- ★ Sea ice in the Arctic is getting thinner and covers less area by late summer.
- ★ Sea levels are rising – which is affecting coastal areas.
- ★ Ice on rivers and lakes is breaking up earlier in the year, and freezing later in the fall.
- ★ Climate change should cause more rain and snow to fall in most areas of the Arctic. But warmer temperatures will also cause more evaporation, so the extra water might disappear into the atmosphere.
- ★ Southern glaciers and ones at lower elevations will likely get smaller because of the warmer temperatures. Glaciers at high elevations or in the far north should stay about the same size.

Want to Know More?

Check out these websites for more information on water, ice, and climate change:

- **Canadian Arctic Resources Committee:** http://www.indelta.com/cgi-bin2/carcpub.cgi?http://www.indelta.com/carc/whatsnew/writings/amitchell.html – *Globe and Mail* article on the impact to Canadian sovereignty if Northwest Passage becomes a trade route.
- **Community Adaptation and Sustainable Livelihoods:** www.iisd.org/casl/projects/inuitobs.htm – Don't miss the video, *Sila Alangotok: Inuit Observations on Climate Change*. You can view a short version at this site, or get information on buying it.
- **Greenpeace Archives:** http://archive.greenpeace.org/climate/arctic99/reports/seaice3.html – A comprehensive scientific article on what's happening to Arctic ice, and why.
- **Icewatch:** www.naturewatch.ca/english/icewatch – Information on the current state of ice.
- **Arctic Borderlands Ecological Knowledge Co-op:** www.taiga.net/coop/indics/water.html – Water levels in Old Crow Flats – how the levels have changed, and why.