Weather and Climate

"Climate change" is making the news these days. But around the dinner table, it is the weather, not the climate that people talk about. Are climate and weather the same thing or different?

Climate is what you expect, weather is what you get!

This backgrounder helps to clarify the difference between weather and climate. It also describes how weather – and climate – are created.

Will the Weather Wednesday Be Wet, Warm or Weird?

Weather is what we experience day-to-day. If it is snowing and windy when we get up, that is our weather for the morning. We might listen to the weather forecast at night to see if we will be staying in and playing video games or heading outdoors to ski or snowmobile. Temperature, precipitation, humidity, clouds, wind and sun all contribute to the weather.

Climate is the Weather + Weather + More Weather

Climate is based on the weather. It is the longer, typical pattern of weather that we get. Climate is what we expect to happen season to season.

For example, everyone expects the climate in Hawaii, Florida or Mexico to be warmer than Northern Canada based on historical experience. That is why these places are popular winter holiday spots! However, now and again disappointed vacationers come home complaining about the unusually cold weather that kept them off the beach and in the hotel.

Climate is the long-term pattern. Weather is the short-term reality that can make or break our fun outdoors!

Both can change. Weather changes daily and we see it. But climate only changes noticeably over the long-term, over decades, centuries and even longer time periods.

What Makes Weather and Climate?

So what makes weather and climate? How do things change from day-to-day, or season-to-season?

There are three main things that help define what kind of climate a region will have:

- How hot or cold it is on average in its different seasons;
- How much rain or snow (precipitation) it usually gets every month.
- How much the temperature and precipitation varies from day to day and season to season.

Move that Heat Around!

The temperature in a region is mostly caused by:

- How the heat of the sun is *absorbed* by the earth and atmosphere (the layer of gases that surrounds our planet); and
- How that heat *moves* from one place to the other.

Have you ever felt the heat coming off of a rock warmed by the sun? The rock has absorbed the sun's heat. All around you, the land and water are absorbing the sun's heat when it shines. In the summer, the north gets more sun and therefore absorbs more heat than it does in the winter. In the winter, there is less sun and the snow also doesn't absorb the heat, it reflects it away.

The heat that is absorbed by the land and water is slowly released back into the air.

Convection! Cool!

Have you noticed in your house how it is often warmer near the ceiling than it is near the floor? This is because hot air rises. And as the hot air goes up, cool air from surrounding areas rushes in to fill the gap. This is called convection and it can create strong air currents.

At the global level, the strongest convection happens around the equator as this part of the world receives more direct sunlight than any other place on earth. In the north, the sun hits the earth at a lower angle. Because of the angle, the sun's heat has to travel

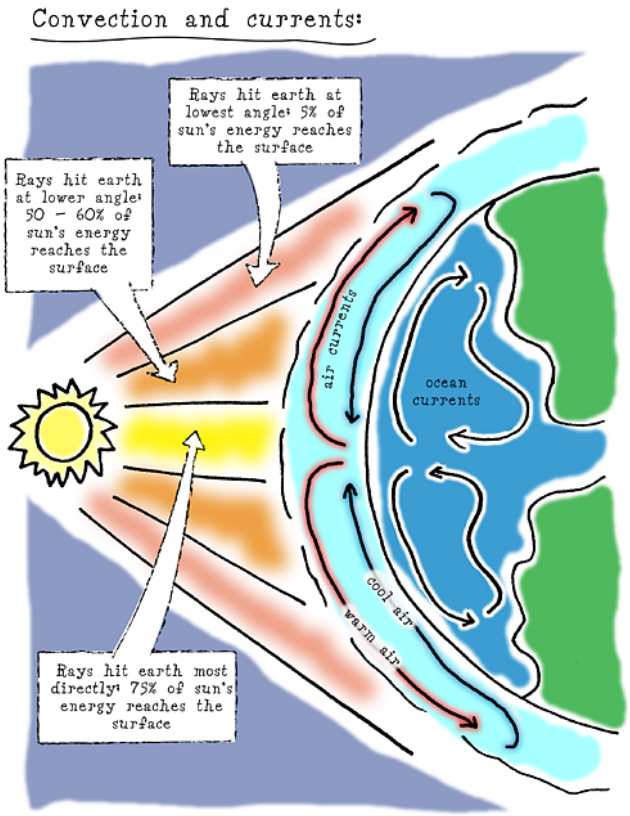
farther through the atmosphere on its way to the north so it has lost more energy by the time it reaches the land and water. Furthermore, the incoming energy is spread over a larger area. That's why we get less heat from the sun in the north.

Currents in the ocean are created by this movement of the air (as the winds blow the water around) and also by differences in temperatures and the amount of salt in the water. Cold or salty water sinks and warmer or fresher water rises. This movement creates ocean currents.

These air and ocean currents move the sun's heat – its energy – around the world. This movement of warm air and water creates our daily and seasonal weather patterns.

Up and down, and all around

At the equator, warmer air rises. Some of this warmth is trapped by the atmosphere, while the rest continues up through the atmosphere and into space. The warm, trapped air travels north or south over top of cooler air that moves along the earth towards the equator to fill the gap left by the rising warm air. As the warm air higher in the atmosphere starts to cool, it will begin to fall to earth again – north or south of where it started.



Without this movement of air from the equator, the North would be even chillier than it is! These air currents – or winds – also help move warmer ocean water from the equator into the polar regions, which is another way of keeping the North a wee bit warmer.

This movement of cool and warm air creates air currents at the local level as well. Have you seen birds hanging in the air without flapping? They are taking advantage of the rising warmer air, called updrafts. Dropping cool air can create downdrafts. Bush pilots are wary of hitting strong downdrafts when they are landing and taking off. These local air currents can also affect the local weather.

So the movement of air, both locally and globally, can have a lot of impact on our weather and our climate. The strength of the air currents – and the amount of warmth they carry – normally changes season to season. But any long-term changes to the pattern of air currents will change our climate.

Keeping the heat in!

The atmosphere is a mixture of gases that extends 800 km above the earth's surface (while 800 km may seem thick, if the earth was an apple, the atmosphere would be its skin). This layer of gases plays a lead role in regulating our weather and climate.

Most of the atmosphere is made up of nitrogen and oxygen. But it also includes water vapour, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and other trace gases that are called "greenhouse gases" or GHGs for short. They are called greenhouse gases because they absorb and slow the escape of the sun's heat into space.

Without these GHGs the temperature on earth would be an average of -18°C instead of the current average of 15°C. Imagine that – a 33° difference! Brrrrr! It's one thing to have -18°C now and again. Having it all the time would mean there would be almost no liquid water on earth – only snow and ice!

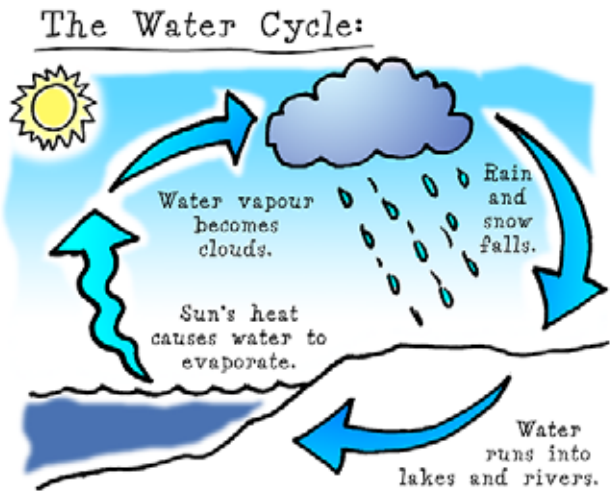
So GHGs help to keep the world from becoming an icebox. But when there are too many GHGs in the atmosphere, they can trap in too much heat and start to make things uncomfortable. And that is what scientists think has been happening in the last 50 years or so – there have been too many GHGs in the atmosphere and the greenhouse is getting too hot for comfort! This is what is causing climate change. *(For more details on how the atmosphere and GHGs are warming up our world, see Backgrounders #2 and #3)*.

The World of Water

We've been talking about how the heat in the world moves around and affects our weather and climate. Another key part of weather and climate is how much moisture – or water – there is in the air. This moisture creates rain, snow, and clouds.

When we shower, we see the water disappear down the drain. It might look like it is on a one-way trip but nothing in the world of water is one way. The earth's water is limited – there is only so much of it to go around. And this water keeps circulating between the air, land, and oceans or lakes.

As the sun heats up the earth, it causes water to evaporate and turn into water vapour. This vapour catches a ride on the rising hot air and travels higher into the atmosphere.



As the air becomes loaded down (saturated) with this vapour, it creates clouds, and eventually it rains or snows. That is one reason many warmer climates are more humid – the hotter weather evaporates more of the available water.

The colder climates are starting to get warmer because the atmosphere is trapping in more heat. In fact, northern parts of the world are expected to heat up even more than the rest of the world *(see Backgrounder 1 and 2)*. So we can expect that more water will evaporate in northern places, as they get warmer. This could affect water levels in lakes, rivers and wetlands in the north. More evaporation could also change the pattern of rain and snowfall.

Some Pretty Influential Kids!

Have you heard of 'El Niño'? Fishermen in South America first used this Spanish name for "little boy" or "Christ child" to describe the warmer ocean currents that occur every so often near Christmas in their area. El Niño usually occurs every three to seven years (it is expected to happen more frequently as the climate changes).

This warm ocean current provides a good example of how the different climates of the whole world are connected.

During an El Niño year, the warmer ocean current causes the air currents to change. This change in air currents causes warmer winters in western North America. But in South America, they get heavier rains, and Southeast Asia experiences drought (dry) conditions.

Occasionally, La Niña (El Niño's sister) visits instead. This cooler ocean current happens when the winds blow in the normal direction, but are much stronger than usual. It also affects air currents elsewhere, but in a different way. With La Niña, Western North America is cooled by Alaskan air, while the eastern part of the North America gets warmer and drier weather.

Through most of this century, El Niño and La Niña have alternated every two to three years. However, since the mid-1970s, El Niño has predominated. Some people believe this is because of the warming temperatures in the world.

Why Are There No Monkeys in the North?

Different regions have different types of plants and animals partly because of the climate. For example, warmer, wetter tropical climates usually have rainforests that are full of thousands of species of birds, insects, snakes, frogs, monkeys and much more. You can grow mangoes and bananas in a tropical climate.

Cold and dry polar climates have tundra. Much of Nunavut, the Northwest Territories and northern Yukon have this type of climate. Tundra is an open landscape of shrubs and small vegetation that is home to far fewer and different species like caribou, bears, ground squirrels and mosquitoes. Low bush cranberries and crowberries grow in this type of climate. But it is not a climate suitable for monkeys or bananas!

Ecosystem: An ecosystem refers to the community of all of the living things in an area. It includes surroundings, plus all the ways in which the living things interact with each other and their surroundings. Ecosystems can be big or small. A small pond can be an ecosystem or a whole range of mountains can be an ecosystem. It depends where you want to draw the boundaries.

Biomes: A biome is a very large ecosystem. There are six main biomes in the world: tundra, taiga (boreal forest); desert; tropical rainforest, savannah (grasslands); and marine. The climate in a region, along with the soil, terrain and elevation, helps to define what kind of biome it will have.

A change in the weather is something that the plants and animals in a region are used to. Some days it rains or snows, other days it is sunny and hot, and on others there might be a storm. Some years are colder, or dryer, than others. Some years there are even droughts. This changing weather is simply part of the natural variations that can happen in any climate.

But if the longerterm pattern of weather – the climate – changes, then plants and animals in the area will start to be affected. If a polar climate gets too warm, it might become a more suitable area for boreal forest (taiga) instead of tundra. Species that need warmer weather to survive should be able to start moving north as the climate gets warmer. And plants and animals that need cold weather may have to go even farther north – if they can.

It's All Connected

We've learned that our weather and climate are made up of the heat and water that is cruising the air and ocean currents of the world. Next time the wind and snow are blowing in your face, stop and think about how that air and water may have come from countries at the equator! What other people in the world might it have touched already?

We've also learned that the blanket of gases that surrounds the world, the atmosphere, is key to keeping the world at the right temperature. However, because of human activities, there are more greenhouse gases in the atmosphere and they are holding in too much heat. This is changing climates everywhere in the world.

Although climates on earth have always changed, this latest change is happening faster than other changes – in the past. To learn more about how the fast change is affecting the north and other parts of the world, check out Backgrounders 6 to 12.

Key Points

- Climate is what you expect, weather is what you get.
- Weather changes daily and seasonally. Climates change naturally, as well, but over a very long period of time. The recent changes to our climate are happening much faster than historical changes.
- Weather and climate are mostly defined by temperature (heat) and moisture (water), and how they vary over time.
- The North is warmed by heat that is carried by air and ocean currents that travel from regions near the equator.
- The greenhouse gases (GHGs) in the atmosphere keep the sun's heat from escaping quickly into space.
- The world's water is limited. It keeps circulating between the earth and atmosphere. When temperatures are warmer, there is usually more evaporation.
- Different climates help to create different types of plant and animal communities.

Want to Know More?

Here are some websites to help you find out more about weather and climate:

- **Encyclopaedia of the Atmospheric Environment:** www.doc.mmu.ac.uk/aric/eae/english.html – Find out more information by clicking on 'Climate' and 'Weather' and choosing from the list of topics.
- **Environment Canada (El Nino):** http://www.msc-smc.ec.gc.ca/education/elNino/index_e.cfm – All you ever wanted to know about El Nino, and its effects on Canada's climate.
- **Environment Canada (Hydrologic Cycle):** http://www.ec.gc.ca/water/en/nature/prop/e_cycle.htm – Learn about the way water cycles throughout our earth and affects our climate.
- **National Oceanic & Atmospheric Administration:** http://www.ngdc.noaa.gov/paleo/globalwarming/paleo.html – A good overview on weather and climate, plus a closer look at paleoclimatology – the study of past climatic patterns.
- **University Corporation for Atmospheric Research:** http://www.ucar.edu/learn/1_2_1.htm – Tells you all about climate.