How do the ocean and the climate affect one another?

Alert!

We have some breaking news from WPHO. Team GoNorth! needs your help.

There's something strange happening to our ocean! It's warmer than it used to be. It's less salty than it used to be. And it's more acidic than ever before.

That's a problem, because the ocean is vital to life on earth as we know it! Oceans cover more than 70 percent of the earth. At any given moment, 97 percent of the world's water is in the ocean. And of the 3 percent on land, 75 percent of that is frozen solid in glaciers and ice caps! That means that all the rivers, streams, lakes, wetlands, clouds, wells, and aquifers represent a minuscule fraction of the world's water.

All water, both in the ocean and the freshwater on land, is connected in a water cycle. Warmed by the sun, surface water in the ocean or on land turns into water vapor and floats into the atmosphere where it cools down and turns into water again. This atmospheric water falls back to earth as rain or snow. Some is stored in glaciers or deep underground in the aquifer. The rest of it runs off to lakes and rivers—to start the cycle all over again. This cycle has a big impact on climate.

A perfect balance in the mixing of the ocean's saltwater and the land's freshwater and how this is transported around the earth makes for even temperatures so perfectly suited for life here on earth!

In a cycle known as the thermohaline circulation, the ocean circulates warm water from the equator to the cold polar regions and back again in a cycle much like a conveyor belt: Less dense than cold water, warm water travels on the surface of the ocean, then sinks down as it cools, and drops to the bottom of the ocean to cycle back when it's cold. Often called "the conveyor belt," this circulation warms up the mid-latitudes between the poles and the equator.

But the oceans getting warmer and saltier affects density, and these changes threaten to disrupt the thermohaline circulation.

Why are these changes happening? They are a result of climate change. Since the Industrial Revolution, humans have been burning more and more fossil fuels, like coal and gasoline, to power machines. That releases carbon dioxide into the atmosphere. Carbon dioxide is already in our atmosphere—and it's a good thing, too. Like ocean currents, it is part of what keeps our planet evenly warmed at a temperature just right for life. But too much of it traps too much of the sun's heat next to the planet, and that warms up both the ocean and the land—and that causes serious problems.

One of these problems is melting sea ice. In Greenland, where Team GoNorth! is heading in 2010, the land and water are covered with ice. While the amount of sea ice fluctuates over the course of a year, the land ice stays put—and it has been there for literally millions of years, since the last ice age. However, today both sea ice and land-fast ice are rapidly melting and moving due to climate change.

In Greenland, Kalaallit hunters report that they can't get out to where the game is because the sea ice is too unpredictable. Animals like polar bears, which spend their entire lives on the ice, are experiencing the same problem. Like all organisms, polar bears have basic needs for food, shelter, territory, and water that are supplied by their habitat—in this case, the sea ice. If their habitat disappears, polar bears might, too.

Like the Arctic sea ice, Greenland's ice cap is melting in the warming Arctic climate. Covering 85 percent of Greenland, this massive sheet of ice is the size of the U.S. state of Alaska or the country of France, and at its thickest, it's nearly two miles (more than three kilometers) deep. When you add freshwater melting from the ice cap to that of melting sea ice (which has a lower salinity than seawater), as well as increased runoff from melting snow and ice on Arctic soils, the freshwater flowing into Arctic seas is now very significant and it is threatening to disrupt the balance that keeps the conveyor belt flowing.

The ocean is also affected by the increased release of CO_2 in that it is making it more acidic. The world ocean is naturally earth's largest "sink" for collecting CO_2, or carbon dioxide. Seventy percent of the earth is covered by water, meaning most of our atmosphere touches ocean water at the surface of earth. When the atmosphere touches water it mixes with the water! In that way carbon dioxide from fossil fuels enters the ocean water at its surface, where microscopic plants called phytoplankton actually use carbon dioxide and sunlight to make carbohydrates from which they grow their own plated bodies. This process has two major benefits to the rest of us living beings on earth: It creates more than 50 percent of the oxygen we breathe, and it also more or less permanently removes carbon dioxide (CO_2) from the carbon cycle!

The problem is that the ocean's "green machines"—the phytoplankton—can't keep up with the pace of our emissions, so the ocean has become oversaturated with CO_2. This turns the ocean more acidic.

That, in turn, is a serious problem for phytoplankton. Their tiny carbon-based bodies dissolve in acid. And whatever is a problem for phytoplankton is a problem for the rest of us. For one thing, literally 99 percent of the life-forms in the ocean either eat phytoplankton or eat other organisms that eat phytoplankton. Take away these microscopic plants, and the entire marine food chain is in upheaval! For another thing, when phytoplankton are dissolved by acid, they release their carbon back into the atmosphere as CO_2, increasing the problem of climate change. Finally, again, phytoplankton are pretty much the lungs of our earth as they produce more than 50 percent of the world's oxygen.

As they head to Greenland to investigate the state of the Arctic Ocean, Team GoNorth! reports that they urgently need your help with three things: First, they need you to explore ocean processes and their influence on climate. Next, they need you to investigate the Arctic food web and how changing habitats affect organisms. Finally, they urgently need you to explore the causes and impacts of ocean acidification—and what all of us can do to reverse these changes by curbing CO_2 emissions.

Good luck, explorers!