CSS Independent Study 2020

ESCAPE THROUGH the UNDERTOW

By: Avani DiLuna



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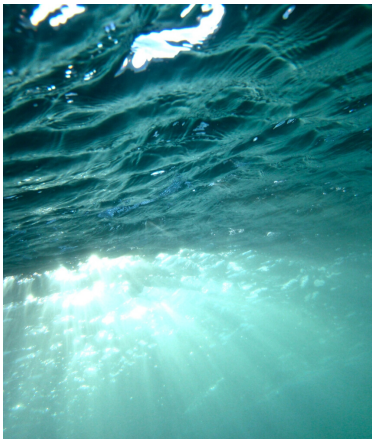
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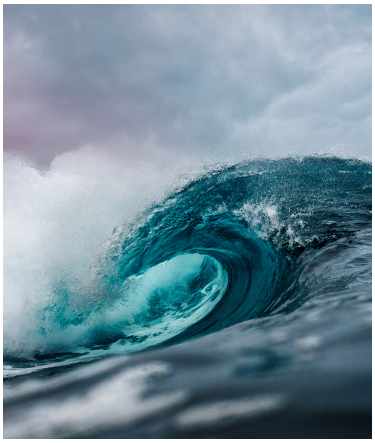
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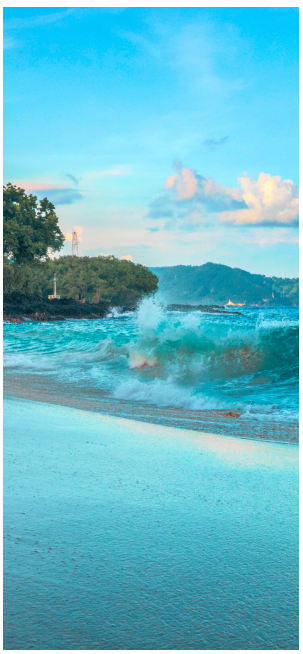












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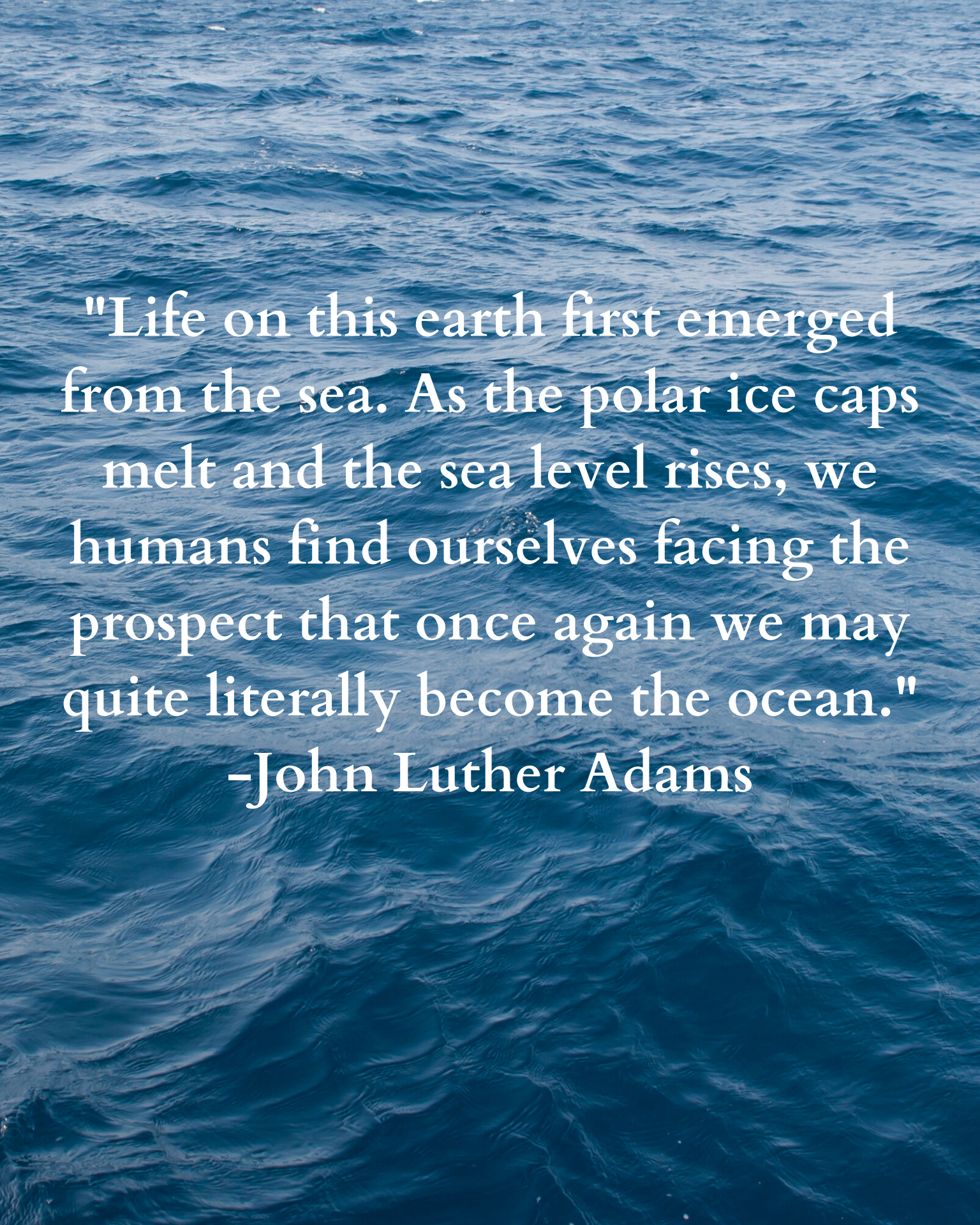
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"Life on this earth first emerged from the sea. As the polar ice caps melt and the sea level rises, we humans find ourselves facing the prospect that once again we may quite literally become the ocean."
-John Luther Adams



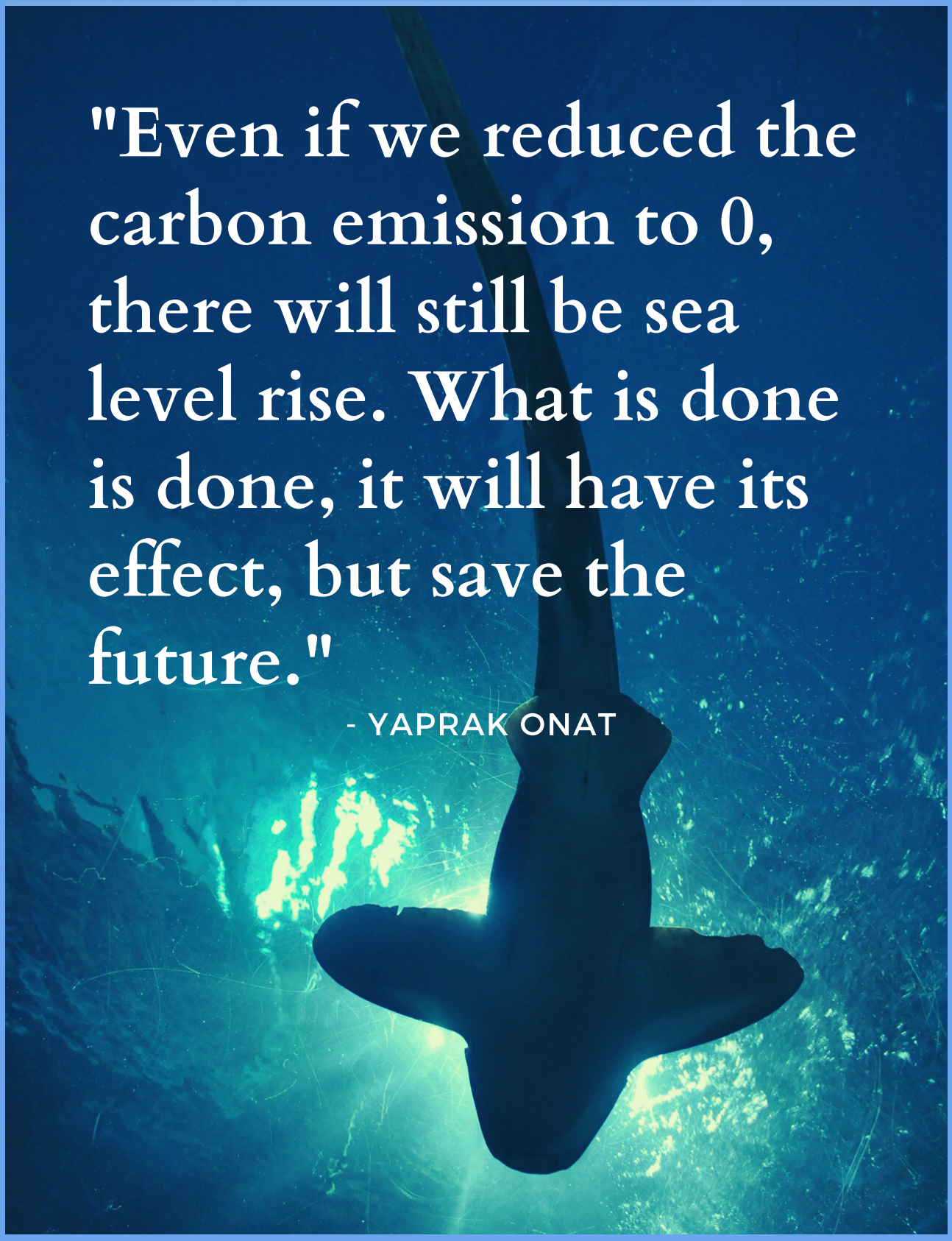
INTRODUCTION

I have learned over the past years that the school I go to is special. Cold Spring School is one of those schools where even if you have left, you will remember your experience there. I'm in sixth grade, the last grade, and we were going to be studying under the large umbrella of sustainability. We chose topics that we were interested in, something we thought was going to be fun to learn about. My topic is sea level rise and the effects on our planet. I came to this choice because I wanted to study animals on land and in the ocean, their habitats, and the effects of climate change. I was trying to find a topic that included all of these and I came upon sea level rise. Sea level rise combines life on land and in the ocean with habitats and effects of climate change-- it was perfect. Sea level rise has a lot to do with sustainability. In order to live sustainably, we have to stop polluting and find a different energy source because the emissions are affecting life all around us. Sea level rise is a problem because of climate change, if we don't stop climate change we won't be able to live in the sustainable world we want to live in. We also connected our topics through the pillars of sustainability, people, profit, and planet. My topic connects through all of them. People and animals are at risk, the whole planet is having problems because of climate change, and major businesses are going to have to move or have to go out of business, affecting the profit. There were a few challenges that I faced throughout my topic. One was that I got stuck halfway through and could not find further information that I needed. I also ended up scraping a bunch of ideas that I had and had to restart sometimes. But through all of that, I improved immensely and was able to make a fantastic research paper. I am extremely proud of all that I have done to get to this point. I thought everything from the beginning would be a straight line to here, but I now realize that it is, and will always be, a curvy line -- some road bumps and some highways. I had a lot of road bumps throughout this process, and I will have more to come.



SEA LEVEL RISE BASICS

Now, you may be thinking, "Well, how do you even measure sea level rise?" As humans, we have multiple ways of measuring the sea level. One way is we put giant towers underwater called a tidal gauge. Tidal gauges are long tubes in the ocean, similar to an upside down tube. It measures the level of the sea by seeing how long an audio signal takes to bounce off the water's surface and hit the top of the tube. Another way to measure sea level rise is to use a specific type of buoy called a moored buoy. These buoys can measure the water's depth, wind direction and speed, the air and sea temperature around it, and the waves' force and energy. Moored buoys have recorded this information every six minutes for the past 20 years. The last way to measure sea level rise actually measures the ocean depth, and that is by using satellites. Satellites are so accurate that, while rotating around the earth, they can calculate the ocean's depth down to the number of inches. They can also calculate any changes in the depth of the ocean, which can tell us how much the sea has actually risen over time. These satellites were the GRACE Satellite pair, the two satellites have been recording data since 2002. In May of 2018, two new GRACE Satellites were sent into orbit to test out more precise and updated measurements. The sea hasn't been rising forever. In the past, it stayed relatively constant. Sea levels started rising between 1905 and 1945, which is when human civilization started to burn a lot of coal. When you burn coal and other resources to produce fuel and other necessaries, it emits carbon dioxide. Excess levels of CO_2 in our atmosphere warms the planet, which leads to melting ice all over the world.


"Even if we reduced the carbon emission to 0, there will still be sea level rise. What is done is done, it will have its effect, but save the future."
- YAPRAK ONAT

WATER AND ICE

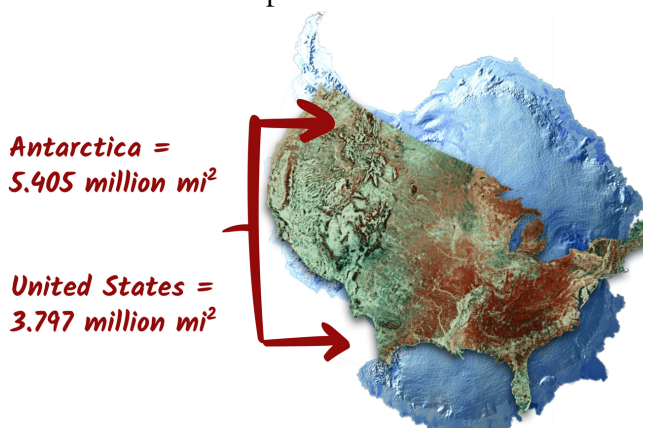


Water has three forms: solid, liquid, and gas. These three forms are based on temperature. When water gets really cold, at around 32˚ Fahrenheit or 0˚ Celsius, it starts to freeze. When water gets super hot, at around 202˚ Fahrenheit or 100˚ Celsius, it evaporates into a gas. The last form is water as a liquid.The molecules of water and ice are one of the only molecules to break the rule of volume. You may have heard that when liquid gets hotter the molecules spread out, which cause the liquid to expand, and when it gets colder, it contracts because the molecules huddle together. Water is a different story. When it gets hotter, the water molecules expand, but instead of contracting when they get cold, water also expands when it gets cold. That goes against a lot of rules. Water is made of two Hydrogen molecules and one Oxygen molecule. The Hydrogen molecules are positive (two positives), and the Oxygen is a negative (-2 in order to keep the balance, +2 and -2). When water gets colder or freezes, the molecules make a hexagonal shape, a positive to a negative from a different water molecule and negative to a positive from a different molecule. That shape allows air bubbles to get inside of the hexagon. Once the air bubbles get in, it causes the frozen water to expand, and that's why if you fill up an ice container you leave a little room at the top for when it expands. If you graph this volume change on a chart, you will see that, when you draw out the line of the heating water and the cooling water, it makes a V shape-- the bottom of the V, meaning the point where the water returns into its normal volume (room temperature); the top points of the V, meaning the hot water volume and the frozen water volume.



ICE MELT

Antarctica is melting because of CO2 in the atmosphere. Antarctica is one of the world's seven continents. It is bigger than the U.S. and covered in ice and snow. For the past 100 years Antarctica has been melting so much every year that it is the main reason for sea level rise. Over 550 trillion pounds of ice has melted from Antarctica every year. That is the equivalent of 275,000 Empire State buildings. Greenland is also having a problem. Even though Greenland is five times smaller than the U.S., it is losing more ice than Antarctica. Over 700 trillion pounds of ice has melted from Greenland every year. That is equivalent to 325,000 Empire State buildings. Over 450 trillion pounds worth of icebergs and glaciers are melting all across the world. CO2 is a serious problem that we need to fix before it's too late. When ice melts in a cup of water the level of water wont go up, because the ice is already taking up space in the water so when it melts the water that it gives makes up the space that the ice took up in the glass. But for ice melt in Antarctica and Greenland, it is as if the ice isn't in the water but is melting and flowing into the water, raising the level drastically. The ice has been melting for years, and even though Antarctica was so much larger than the U.S, it has melted to the point where the Antartica is getting closer to the size of the U.S.





CAUSES OF SEA LEVEL RISE

Thermal expansion and ice melt are the main causes of sea level rise. Thermal expansion is when water expands because of heat. Thermal expansion is caused because of global warming, the heat causes the water to be hot and expands. Because of thermal expansion, some animals will not be able to adapt to the warm waters, but others can-- this is why we must help them adapt to what we have caused. Thermal expansion is one of the main causes of sea level rise. If you take a beaker and fill it with water and mark the level that it starts at and then heat it up, you can find how much the level raised. Every single year because of the heat, 142 million Olympic sized swimming pools are being added to the ocean. One Olympic swimming pool is 660,430 gallons of water. Sea level rise is also caused by ice melt because of global temperatures. As humans increase the carbon dioxide emissions, these raise the temperature in the atmosphere and oceans. According to NOAA "Oceans Absorbing More Carbon" and World Economic Forum, oceans absorb 34 gigatons of carbon dioxide of what humans put into the atmosphere, which causes the temperature of the ocean to rise. When icebergs melt they release a lot of water. Since the planet's waters have gotten warmer, the icebergs have started melting from the bottom up. This is a huge danger to any habitats that use the icebergs as a home.



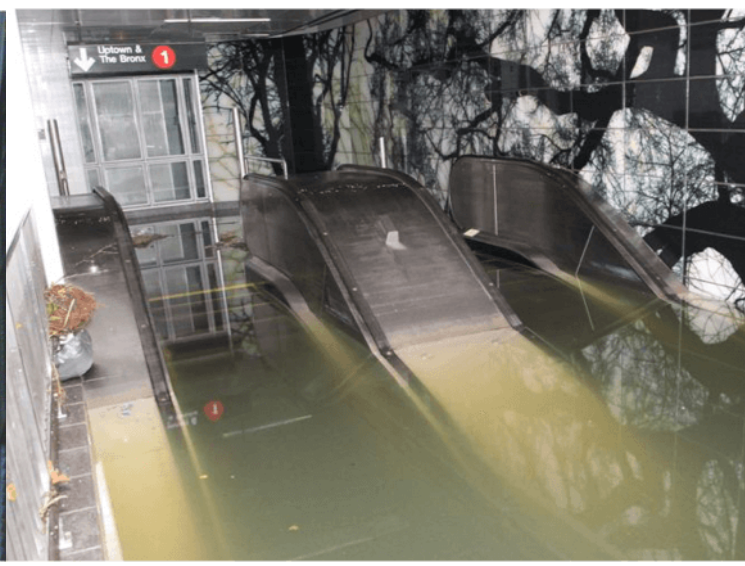
EFFECTS OF SEA LEVEL RISE

The effect of sea level rise is drastic. It inflicts damage to animals, infrastructure, and plants. However the effect on land animals is bigger than it seems. For instance, salt marsh animals are used to having a lot of land to roam on, and they know when the tide is going to come in. However, due to sea level rise, their habitats are being completely submerged. Freshwater animals are also having a hard time. Freshwater habitats have little-to-no salt water. The animals can't survive if the salinity levels are too high. The animals that live underground are very vulnerable; if animals' tunnels get flooded, the animal will drown. If the animal is lucky, it can hold its breath for a short time, allowing it to get to the surface. Habitats are being submerged all over the world because of sea level rise. Interestingly, sea level rise actually has a pretty big effect on ocean animals, too. Warmer seas are a danger to a lot of fish and plants. In fact, according to NOAA's coral bleaching article, most coral reefs are dying because they are not adapted to survive in warmer seas. Now, you can imagine how many animals depend on the coral reefs as a home, or a food source, and maybe a place to hide, but if they are destroyed, all of the sea life that depends on it may die. While some animals can adapt-- for example, certain fish may be able to adapt or certain plants can find a way to survive-- marine life is being impacted severely.

The weather and waves are actually being changed as well. Because of climate change, more hurricanes are likely to happen. Hurricanes use the ocean, they suck up water and deposit it on land in the form of rain. If the hurricane does not have water there will be no rain, but as the sea levels get higher, and cover more land, the hurricanes can cause more damage. They will have more water to use as rain, causing devastating storms.

There will also be a complete change in the wave force and height. There might also be a change in high tide and low tide height. The weather is being impacted because of climate change. Sea level rise causes the land to change constantly. Oceans can shape the land. They can carve the coastline, and they contribute to erosion. This is a problem for habitats that use the land and any animals that call it home. There is also a problem with dams; dams can get completely washed away if they are not taken care of. If a dam were to get destroyed by rising seas, it would submerge habitats around it and damage vegetation. There is also a problem with coast lines. Coast lines are what defines the land from the sea. If coastlines change, it can harm habitats and buildings that are near the coast or use the coast as a home. Sea level rise can impact animals, habitats, vegetation, land, and in addition, sea level rise severely impacts human society. It has, and will, completely destroy structures and architecture, such as hospitals, houses, and roads. Hospitals and houses can be flooded, and washed away, killing those in it. In the past 40 years, the sea has risen over six inches and in the next 15 years it will rise another six inches. 40 years to 15 years with the same amount of sea level rise leads to estimates of how long we have before it gets to the point of submerging buildings. As sea levels rise, roads and other infrastructure can be washed away. At the rate that we are leaving carbon footprints, it is estimated that we will see sea level rise even faster than it already is. Many aspects of human civilization are being impacted in some way because of sea level rise.





These images are the subways and railroad stations in New York.



SEA LEVEL RISE RISKS AND SOLUTIONS

Sea level rise puts many things at risk. The environment is at risk of being destroyed. Hospitals, fire stations, and police stations are being destroyed. Houses and shelters are being flooded, not to mention all of the power lines that are being submerged. Most power lines are partially waterproof, because of rain, but are not meant to be fully submerged. This risks cutting out a lot of power and internet from the community. Drinkable water is being contaminated because the places that we purify water is being overrun with salt water. The water can get in underground or be pushed in with the tide, and all of this leads to water being more expensive or just not found in stores. In fact, some islands are being submerged or flooded because of sea level rise. What about transportation? Subways, trains, roads, and cars are being either flooded with water or washed away.This is a huge problem because we won't be able to drive to get food or actually go anywhere. What can we do to fix this?

There are multiple ways we can slow down sea level rise. One of the ways is slowing down humans' carbon footprint. Some of those ways are to emit less carbon, or humans could be less dependent on fossil fuels. We use fossil fuels for almost everything, but we could run out. Also, when you burn fossil fuels to get the energy, it produces gases harmful to the environment. Humans also have to waste less energy, turn off the lights when they are done in a room, and waste less water-- those simple things can help the cause. All of the problems of climate change are caused by humans.

Another way to combat sea level rise is to adapt to it. There are five ways we can adapt including building higher seawalls, protecting us and raising buildings and important structures, saving us. Raising buildings takes time so we will need to slow down sea level rise if we want to raise all of our important structures. In fact, since we are having trouble slowing down sea level rise, currently there are hospitals or hotels that do not put any important items on the first floor in case it does flood. Doing this ensures the safety of so many people, and saves many lives. Also, another adaptation is raising roads, which allows us to drive and get to places. Sea level rise is flooding roads, and we need to drive to do everyday things so raising roads is one of the items that we need to prioritize. Relocating or retreating back would allow us more time to stop sea level rise. By moving away from the coastline, it ensures that important structures and houses don't get destroyed. Some houses that haven't been moved or relocated have been flooded by the tide.We could also put sand in between the ocean and the structure to ensure that the tide can't get to you, but eventually the structure would be flooded, not to mention how much it costs to put that much sand in. Lastly, we need to help animals adapt. Animals need to be taken care of, as they don't know how to adapt to something that shouldn't have happened. Their habitats are being submerged and the fresh water that some need is being contaminated with salt water. Even humans' fresh water that we drink can be contaminated. Many places around the world depend on reservoirs, wells, or pumping water out of the ground. Sea level rise will contaminate these and harm anyone who drinks it.




You can protect, retreat, or accommodate, but there is not one single category that will be the best option.
- YAPRAK ONAT
Outside my house

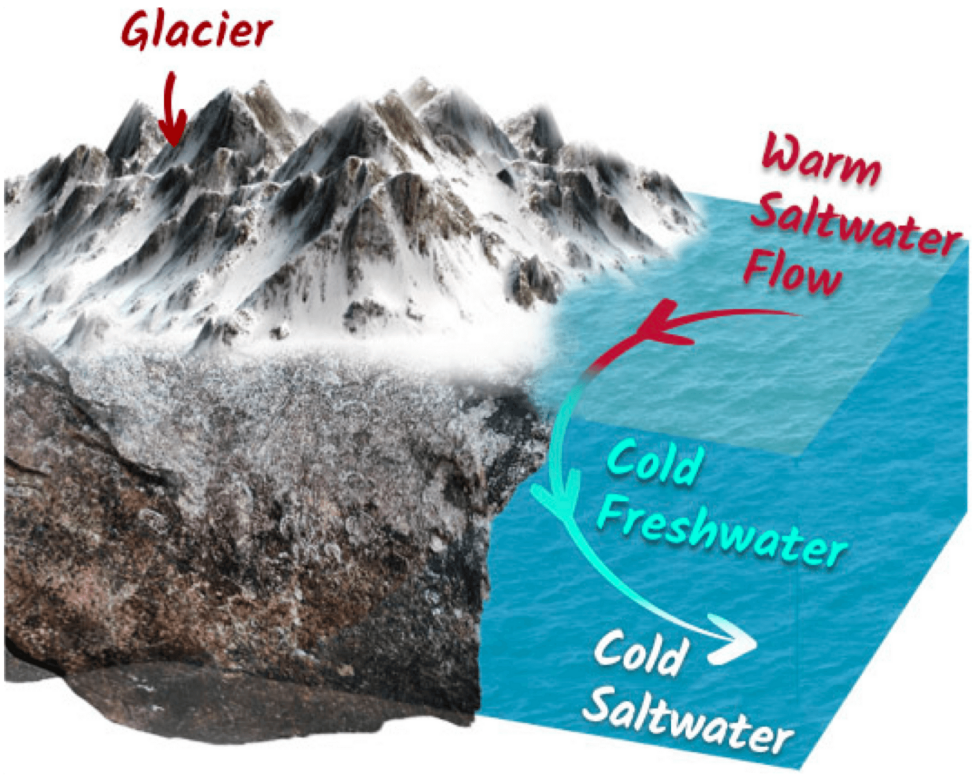
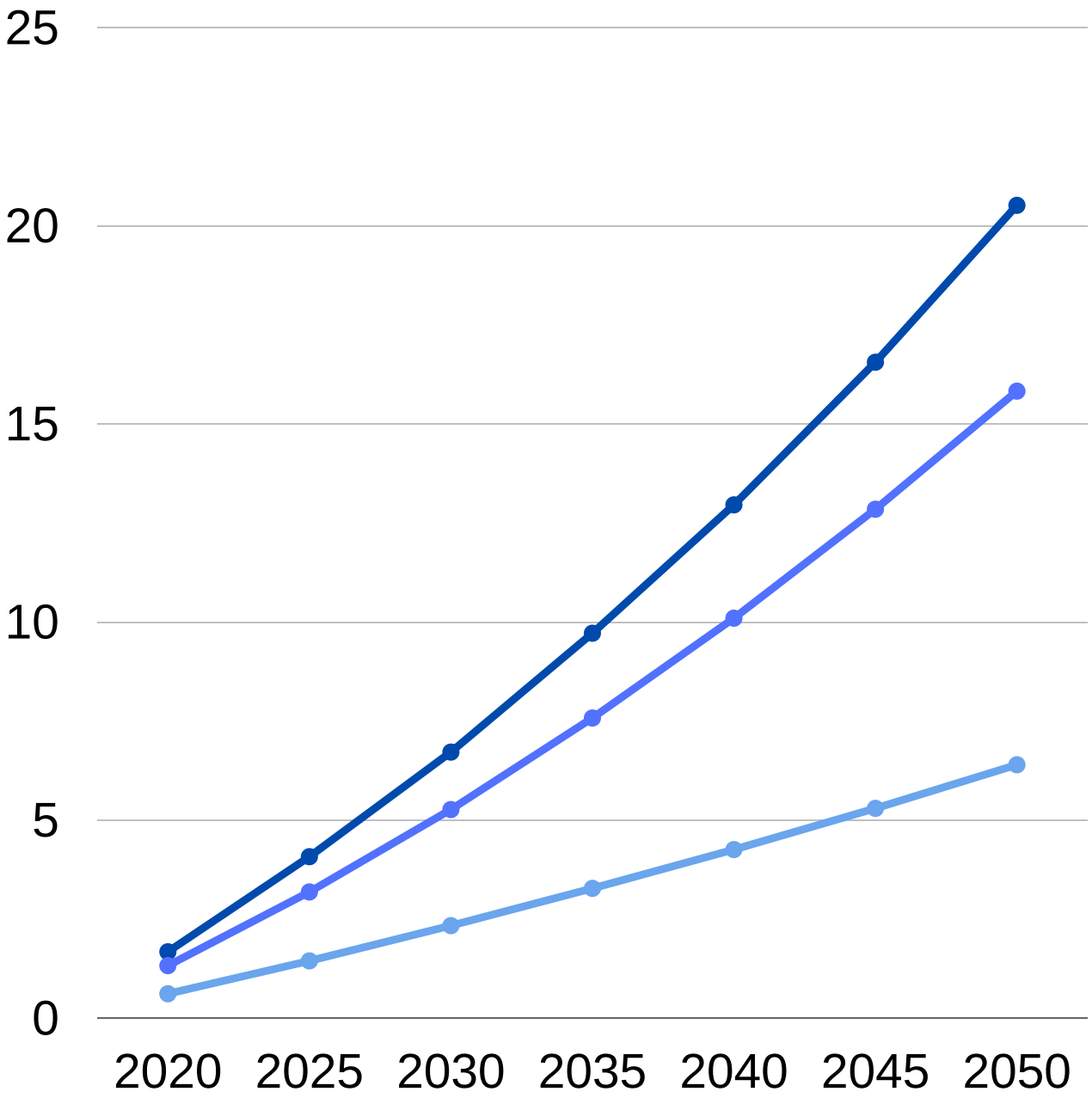


Diagram of Glacier melt/ Salinity diagram
(salt water sinks and fresh water rises to the top of the ocean)

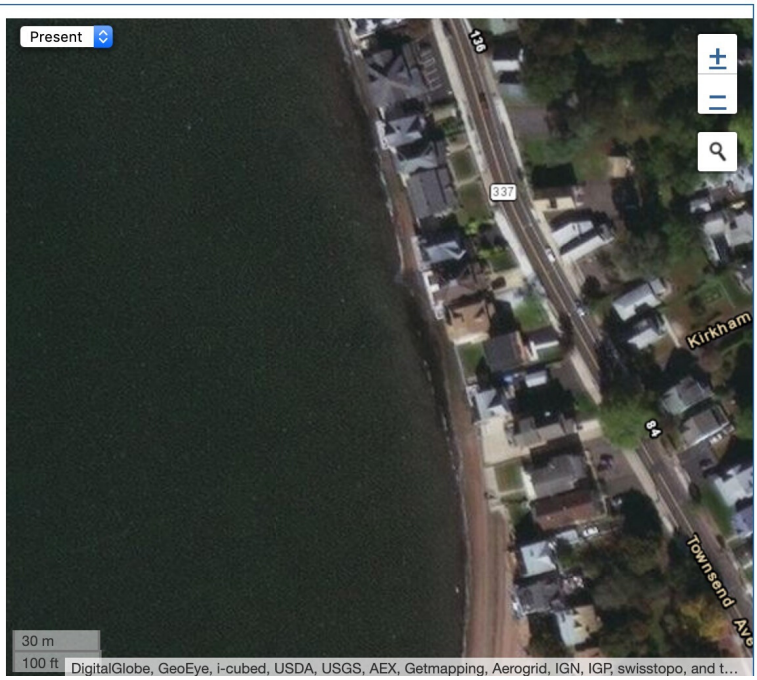


Hospital in Charleston, South Carolina
that was flooded because of sea level rise.

Light Blue: If you start at 2020, this is the lowest amount of sea level rise that will happen between 2020 and 2050 in inches.
Medium Blue: If you start at 2020, this is the predicted amount of sea level rise that will happen between 2020 and 2050 in inches.
Dark Blue: If you start at 2020, this is the highest amount of sea level rise that will happen between 2020 and 2050 in inches.



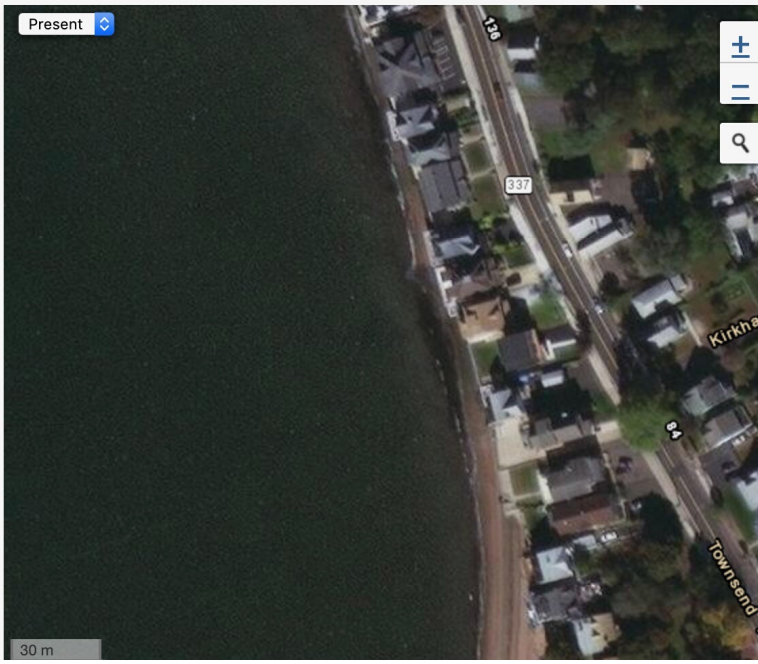




1934 COMPARED TO 2020

My house is in the middle of all of these photos. This was so long ago, sea level rise probably just started right about now. Apparently there used to be a whole huge-sized beach.

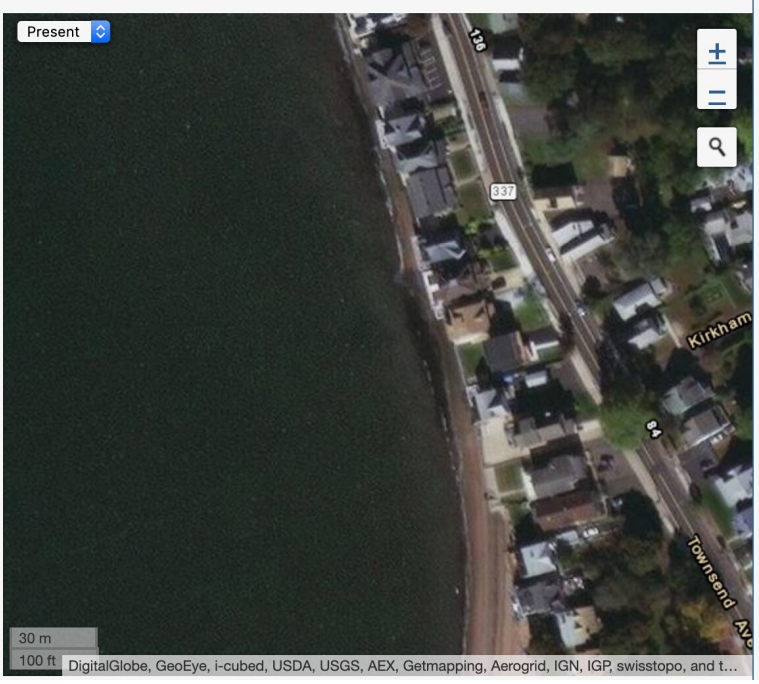




1990 COMPARED TO 2020

There is still a whole-sized beach here but it is smaller and the shape of the coast line changed.





2004 COMPARED TO 2020

This is a few years before my parents moved in and apparently there was a whole beach and a volleyball net.

All of the pictures on the right side are about as low as it pretty much gets. Sometimes the waves come up onto the back deck. The ocean is so close to the house that we actually fish off the back deck. If the sea level rises too much, we may have to relocate or put the whole house on stilts. Many casual storms have flooded the basement, disabling internet access.

Outside my house at low tide sunset

Morse Cove, New Haven, CT.











“We know we’re going to have sea rise. This is literally a one-way street now. The only thing we’re discussing now is how fast, it’s not whether anymore, and then eventually how much.”

— Dr. Harold Wanless, Chairman of the Department of Geological Sciences at the University of Miami