The Science of Climate Change:

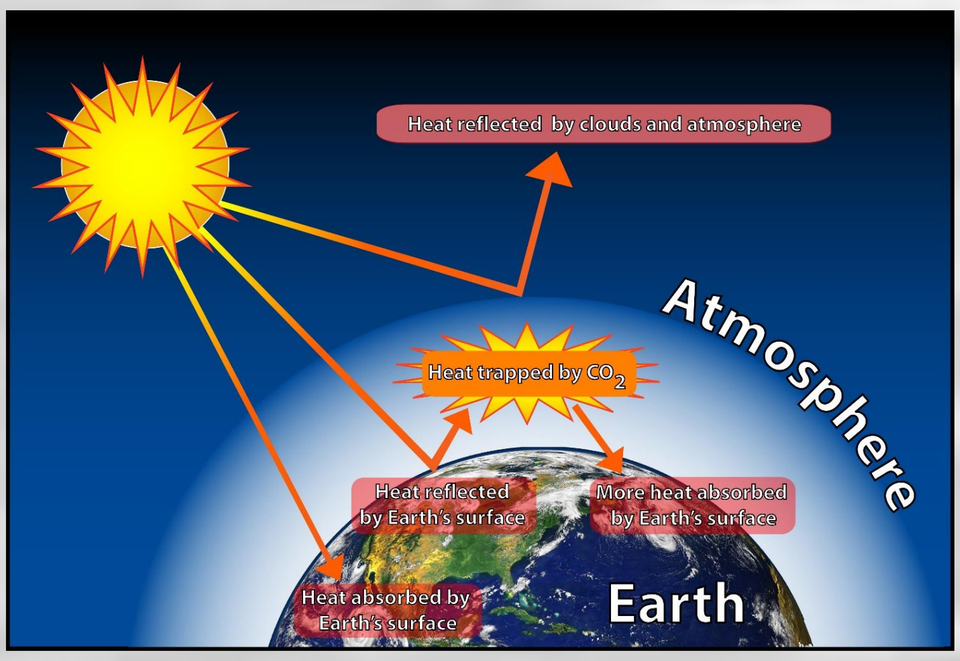
Changing Climate

Carbon dioxide in the atmosphere is at a record high, 10 of the warmest years ever recorded occurred in the past 12 years, and global weather patterns are changing.

How do we know?

Background

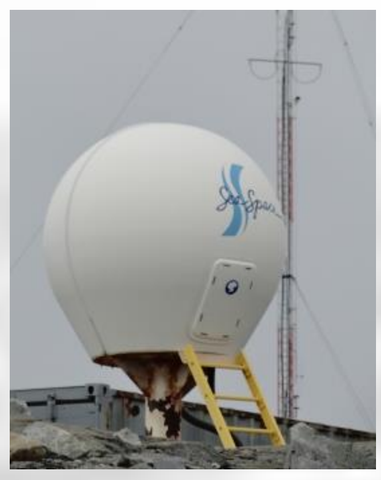
Excess carbon dioxide (CO_2) in the atmosphere traps energy from the sun close to the earth and increases average global temperature. Warmth and energy are not evenly distributed across our planet. Some areas warm more than others, changing the weather and ocean patterns we rely on.



Burning fossil fuels for electricity and cars is putting a record amount of CO_2 into the atmosphere changing Earth's climate.

Data Collection

Scientists use monitoring stations across the planet to track temperature and the concentration of CO_2 in the atmosphere.



A satellite dish for weather monitoring at Terra Lab Palmer Station, Antarctica. Photo by Nell Herrman (PolarTREC 2012), Courtesy of ARCUS.

Scientists use ice cores that contain bubbles of ancient air to measure CO_2 levels from the distant past to learn about past climate.

Scientists measuring an ice core used that is to study Earth's past climate. Photo by Lollie Garay (PolarTREC 2007/2008), Courtesy of ARCUS.

Scientific Method in Action

Researcher Heidi Roop collecting sediments to study Earth's past climate to help us understand current climate changes. Photo by Julian Thomson, Courtesy of H. Roop.

Researcher Heidi Roop of the Antarctic Research Centre, Victoria University of Wellington, studies sediments from the bottoms of lakes to reconstruct changes in Earth's temperature and precipitation over the last several thousand years. This can help us understand and predict current and future changes in climate.

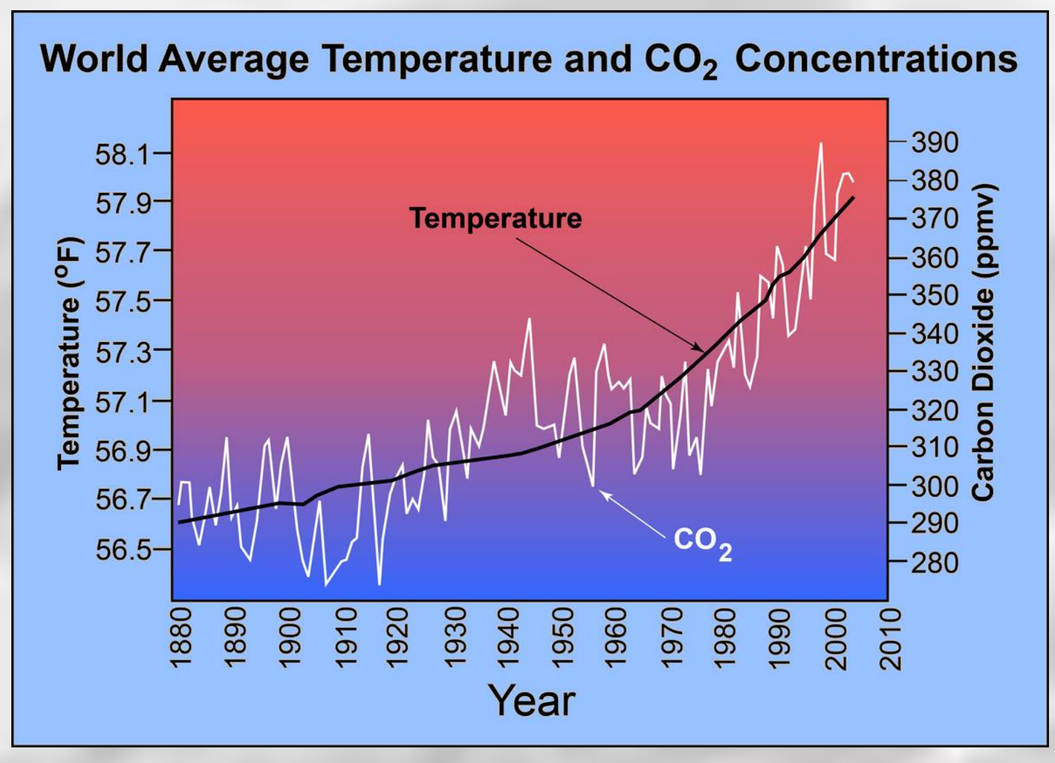
Explore On Your Own

Scientists use what they've learned to ask new research questions. Do some research on your own into climate change, ocean acidification and other current scientific studies. Some great places to start include:

www.climate.nasa.gov

www.epa.gov/climatechange

To learn more about Earth's changing climate and what you can do to help, visit the "Climate Change" and "Green Solutions" exhibits in the Aquarium's Courtyard.



As atmospheric carbon dioxide (CO_2) increases, average temperature increases worldwide leading to a change in global climate.

Scientists at the Atmospheric and Environmental Research Center study how increased atmospheric CO_2 changes climate which leads to changes in weather patterns resulting in drought, increased storms, and even extreme winters.

The Science of Climate Change:

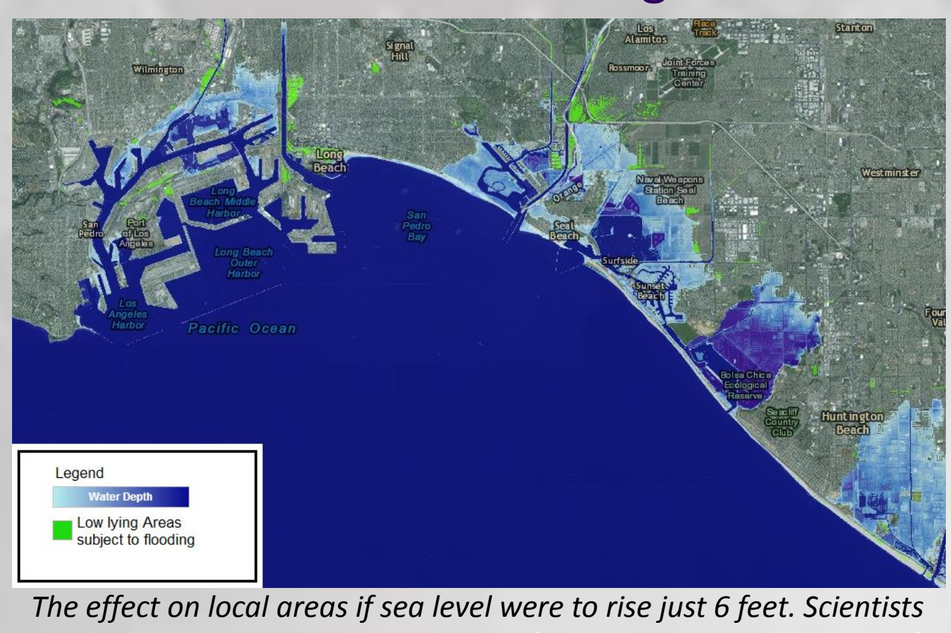
Sea Level Rise

Global sea level has risen about 6.7 inches in the last 100 years and is now rising at a rate twice as fast as in the last century.

How do we know?

Background

As average global temperature increases, glaciers and ice sheets are melting faster than ever before. Melt water runs into the ocean causing sea level to rise. Ocean water also expands in volume as it warms, further raising sea level. This is called "thermal expansion." Higher sea level threatens coastal cities with the risk of flooding, strong storm surges, and contamination of fresh drinking water sources.

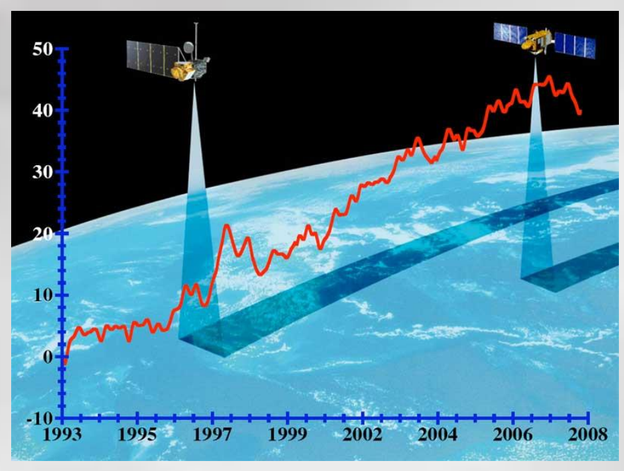


The effect on local areas if sea level were to rise just 6 feet. Scientists predict this could happen by the end of the century. Map courtesy of NOAA.

Data Collection

Scientists use tide gauges around the world to track the height of the water level for long periods of time to obtain an average sea level.

A water level observation station, part of the National Water Level Observation Network. Photo courtesy of NOAA.



NASA satellites observe the rate of sea level increase year over year, in millimeters. Photo courtesy of NASA/JPL-Caltech.

Scientists also use satellites to measure sea level from space. The satellites bounce microwave pulses off the ocean surface to determine sea level height accurately within a few centimeters.

Scientific Method in Action

Dr. Frank Nitsche of the Lamont-Doherty Earth Observatory studies the coastline of Antarctica with acoustic mapping techniques to determine how vulnerable large ice sheets are to melting and impacting global sea level rise.

Dr. Nitsche and crew working aboard a research vessel off the coast of Antarctica. Photo by Richard Cullather (2007), Courtesy of F. Nitsche.

The Center for Remote Sensing of Ice Sheets uses new technologies to measure the volume and melting of ice sheets and computer models to predict the response of future sea level rise.

CReSIS researchers preparing for aerial surveys of Antarctic ice sheets. Photo by Gary Wesche (PolarTREC 2009/2010), Courtesy of ARCUS.

Explore on Your Own

Dominique Richardson from Cabrillo Marine Aquarium works with scientists in Antarctica to study ice stream dynamics and educate the public about polar science and climate change. Follow along with their scientific expedition and other current polar research at www.polartrec.com.

Aquarium staff help with current scientific research.

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www.coast.noaa.gov/slr

www.sealevel.jpl.nasa.gov

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The Science of Climate Change:

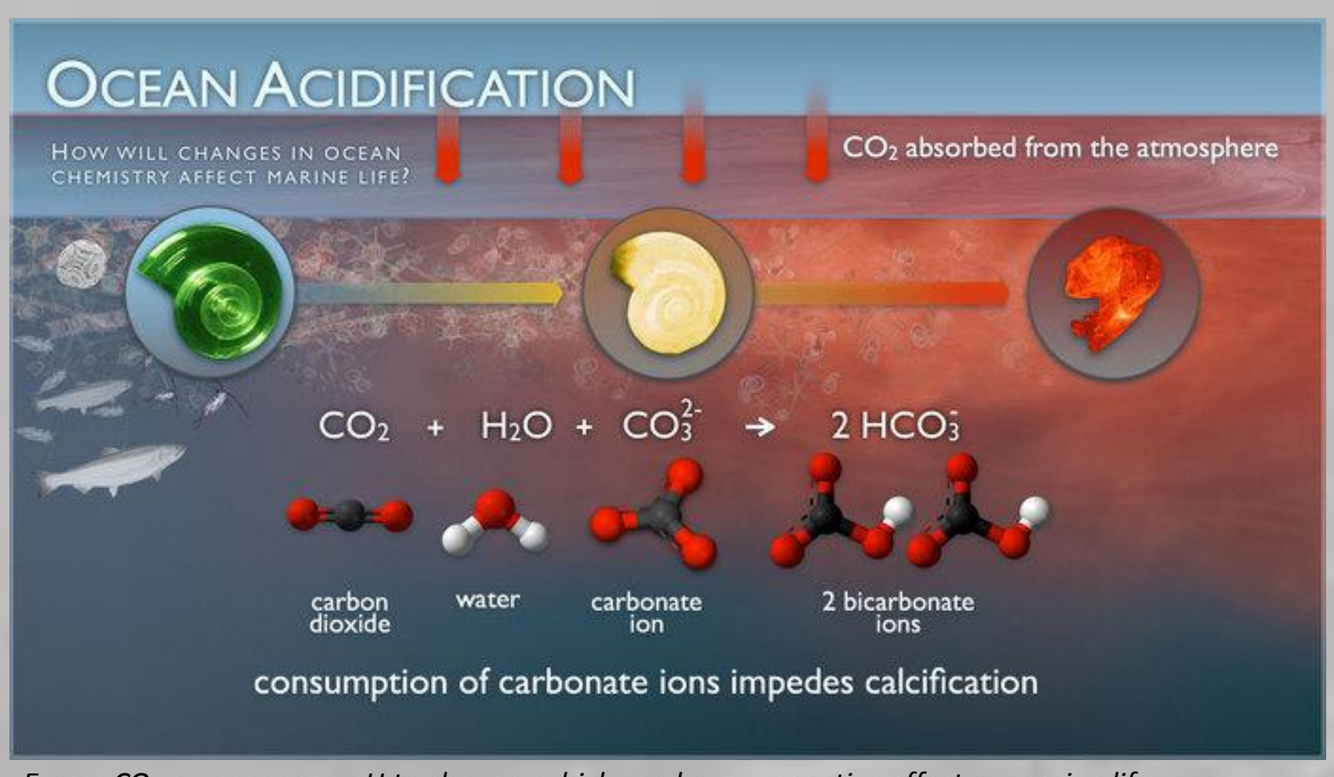
Ocean Acidification

The acidity of the ocean's surface waters has increased by about 30% since the beginning of the Industrial Revolution because of human carbon dioxide emissions.

How do we know?

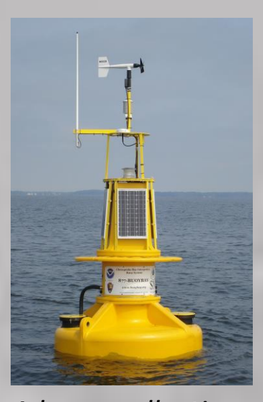
Background

Excess carbon dioxide (CO_2) in the atmosphere dissolves into the oceans, creating a chemical reaction that makes the water more acidic. Acidic ocean water can prevent sea creatures, like fish we use for food and plankton that produce the oxygen we breathe, from getting the minerals they need to develop properly.



Excess CO_2 causes ocean pH to change, which can have a negative effect on marine life. Photo courtesy of PMEL/NOAA.

Data Collection

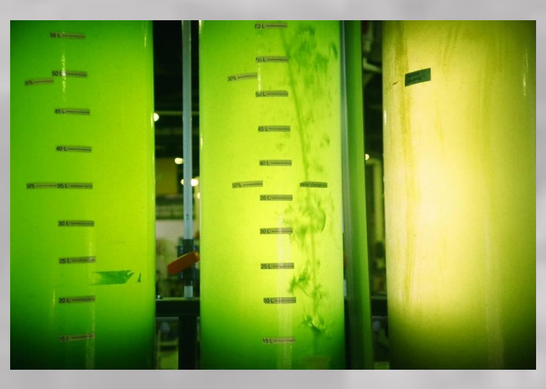


A buoy collecting ocean data. Photo courtesy of NOAA.

Scientists use special buoys and moorings to take regular readings of ocean pH for many years at a time. These buoys transmit their data to laboratories where scientists analyze the measurements.

Scientists use experiments to create lab conditions that replicate changes seen in the ocean. These experiments can show how marine life responds to changing ocean environment, including acidity.

Marine zooplankton raised in laboratory conditions. Photo by Jacob Partida.



Scientific Method in Action

Dr. Chuck Amsler from the University of Alabama at Birmingham studies Antarctic algae and animals that rely on chemical defenses and how these organisms may react to changing ocean chemistry.

Dr. Amsler and experienced Antarctic researcher Maggie Amsler preparing for a scientific dive. Photo by Jim McClintock, Couresty of C. Amsler.

Young Scientist conducting experiments in the Aquatic Nursery.

Young Scientists at Cabrillo Marine Aquarium are studying how larval animals develop in environments of different pH. This will help predict the effects of ocean acidification on these animals.

Explore On Your Own

Scientists use what they've learned to ask new research questions. Do some research on your own into climate change, ocean acidification and other current scientific studies. Some great places to start include:

www.pmel.noaa.gov/co2

www.nrdc.org/oceans/acidification

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Scientists from the Bodega Ocean Acidification Research program study how changing ocean chemistry affects marine animals and plants, including many species we depend on. Acidic conditions make it difficult for organisms that depend on calcium to get the minerals they need to develop and survive.

As ocean acidity increases it can harm marine life, like pteropod snails, that rely on minerals like calcium from the ocean. Photos courtesy of NOAA.