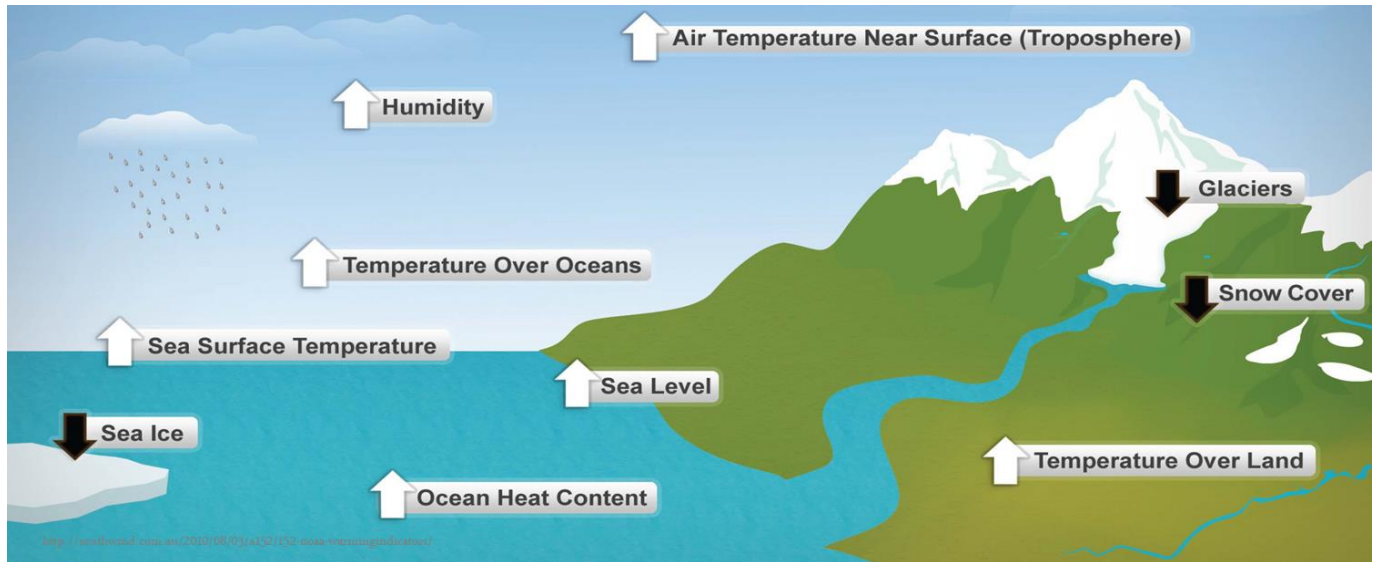
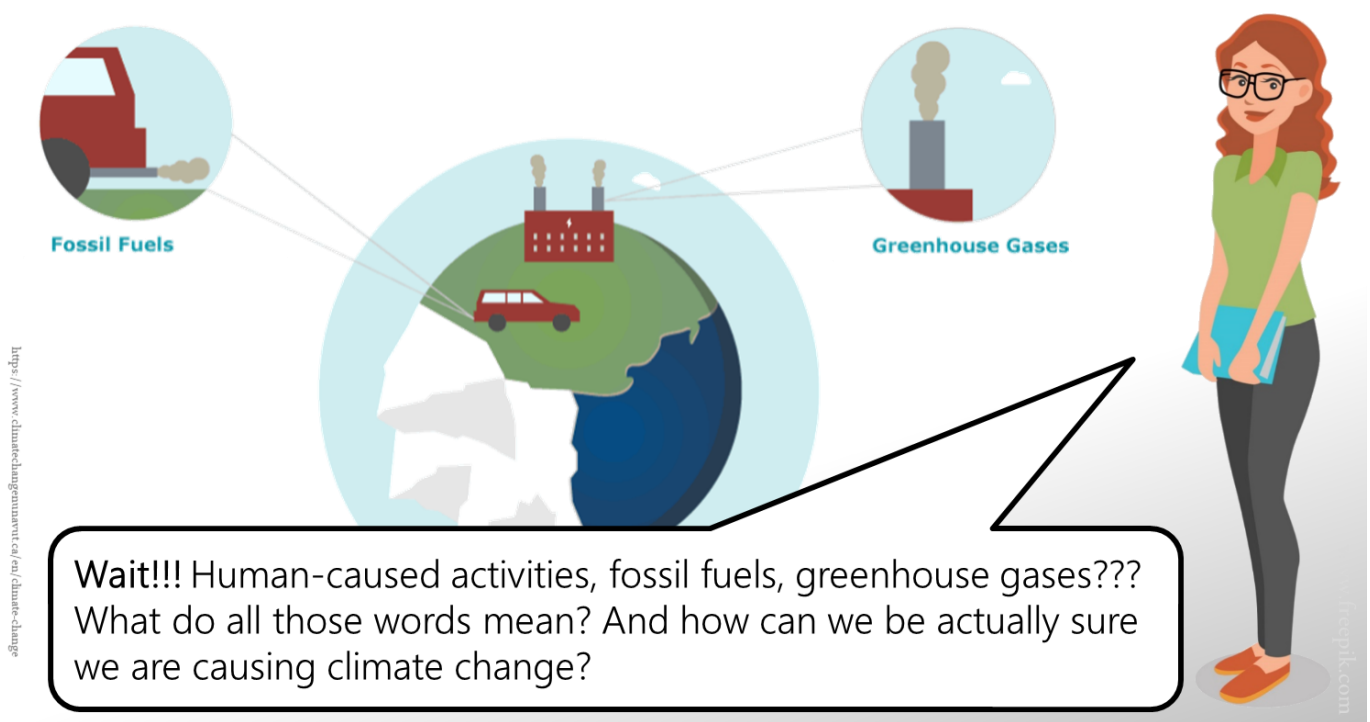


BUT.... the change has always been slow, and now the climate is changing faster, and this change is accelerating faster than at any time in human history.

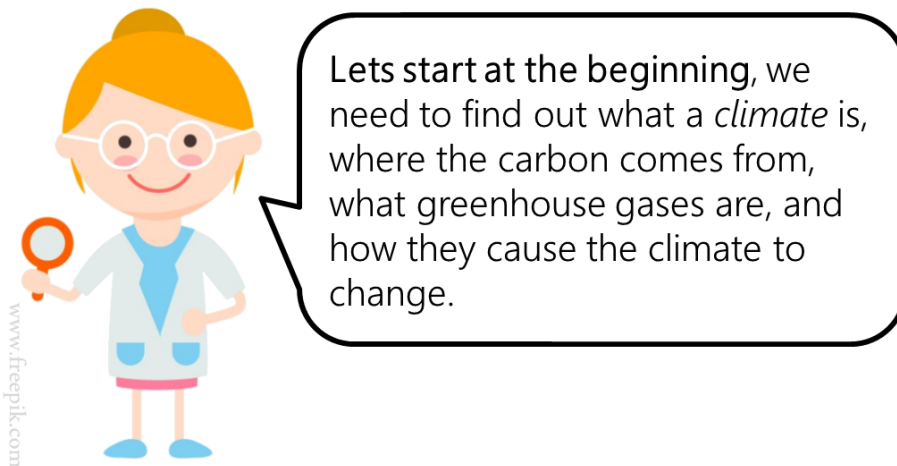


This recent climate change is occurring due to human-caused activities (called anthropogenic activities). Past and present human industry, including the burning (combustion) of fossil fuels, transportation, and agriculture, have increased the concentration of greenhouse gases in the atmosphere.



## Are Humans responsible for climate change?

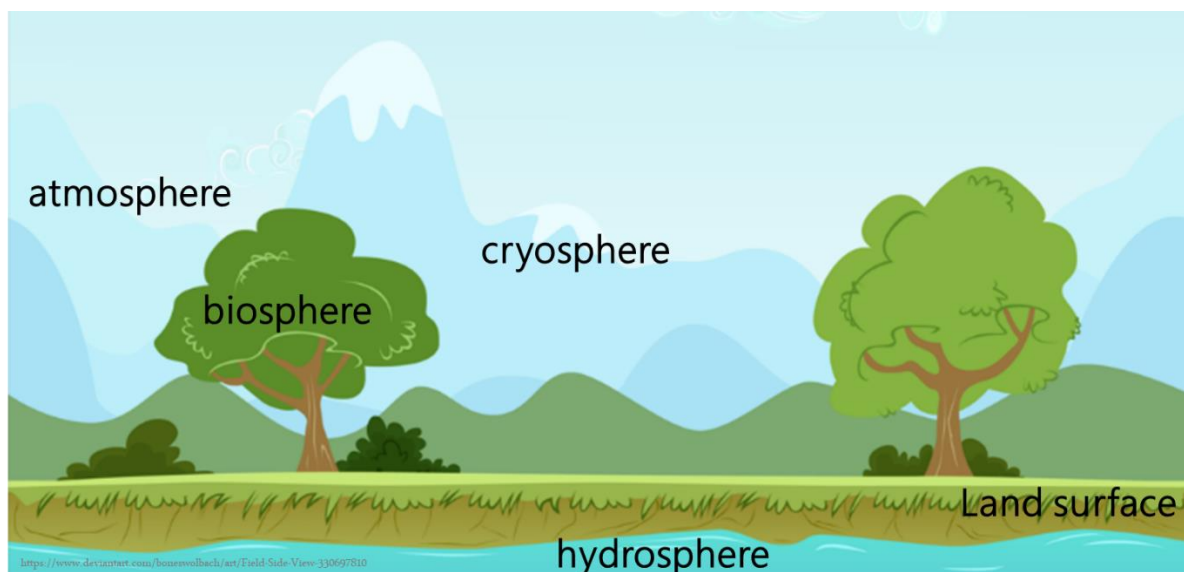
Scientists have been able to collect evidence, and use models, to tell the difference between natural sources and human sources of climate change. Evidence also shows that human made CO<sub>2</sub> is the main cause of climate change.



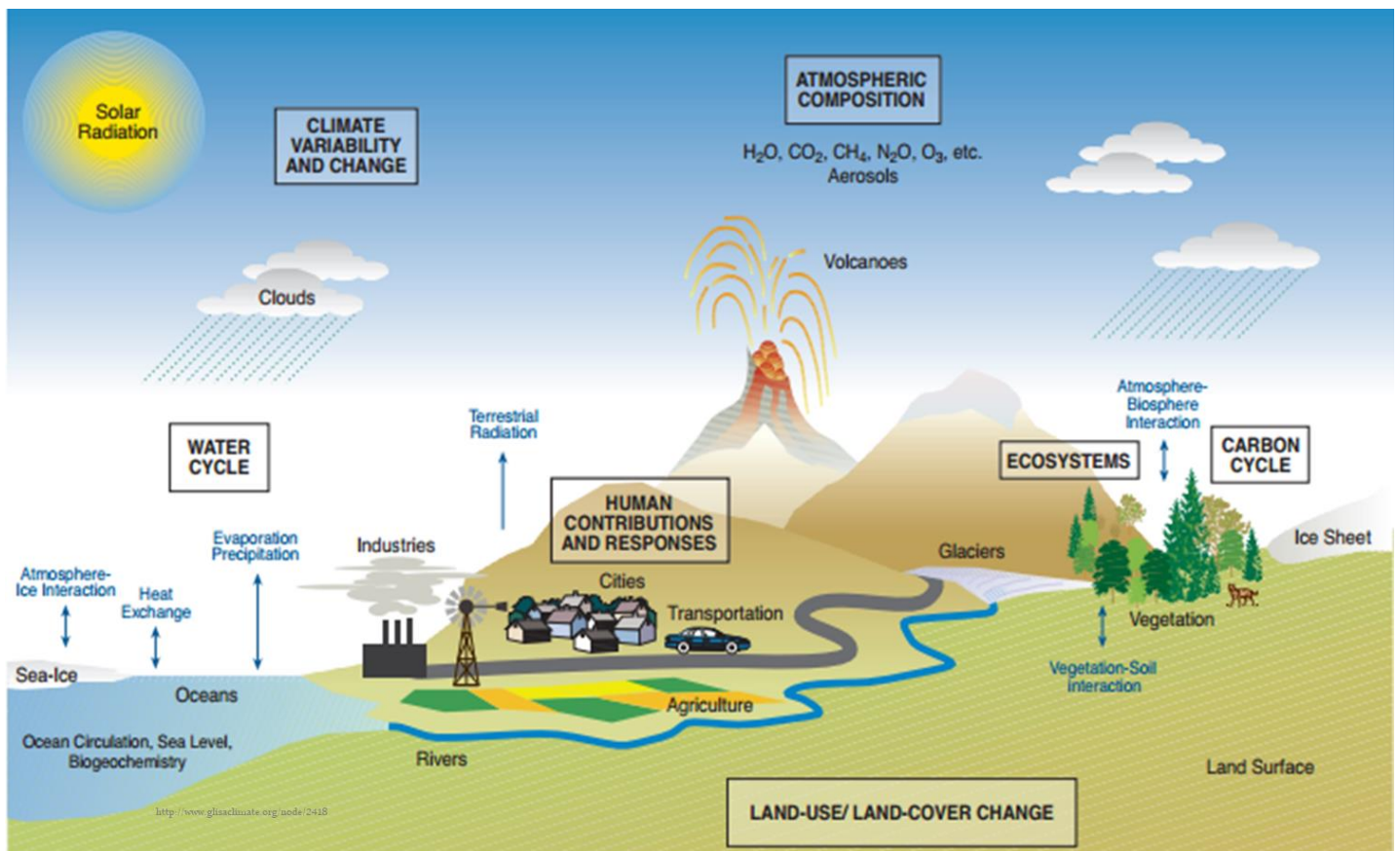
## Components of Climate

The climate system is an interactive system consisting of five major components

Component	Comprised of:
Atmosphere	N <sub>2</sub> , O <sub>2</sub> , Ar, H <sub>2</sub> O, CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O, O <sub>3</sub> , aerosols
hydrosphere	Rivers, lakes, oceans
cryosphere	Sea ice, ice sheets, glaciers, and permafrost
Land surface	The top layer of the Earth, exposed to the atmosphere
biosphere	All living organisms found below, above and on the land



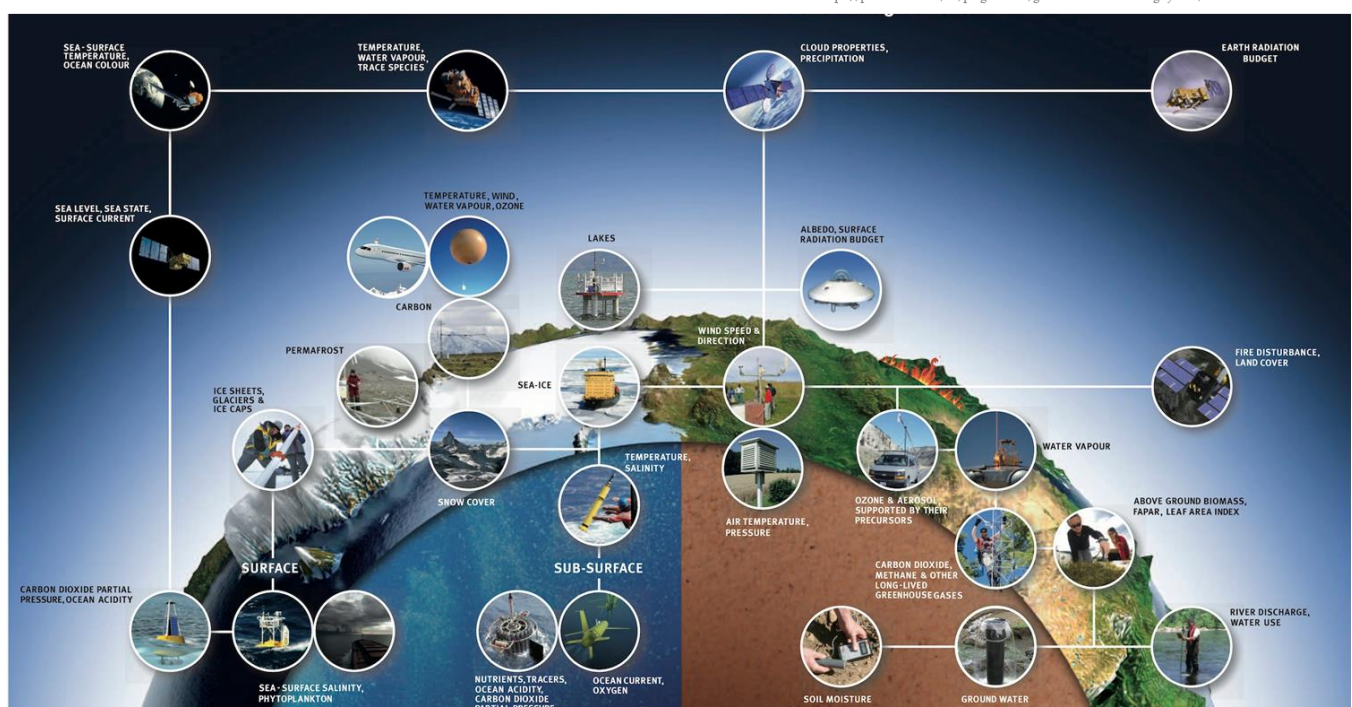
The components are influenced by many variables, the most important of which is the Sun. Any change, whether natural or human caused, in the components of the climate system and their interactions, may result in climate changes.



## Essential Climate Variables

*Climate* is influenced by Essential Climate Variables (or signals) that can be physical, chemical or biological. They include temperature, precipitation, and amounts of solar radiation. Climate is also determined by altitude, longitude, and the distance to large bodies of water, and in contrast to weather, which is normally limited to a smaller area, changes are much more gradual. These are measured to help us understand how the climate is changing

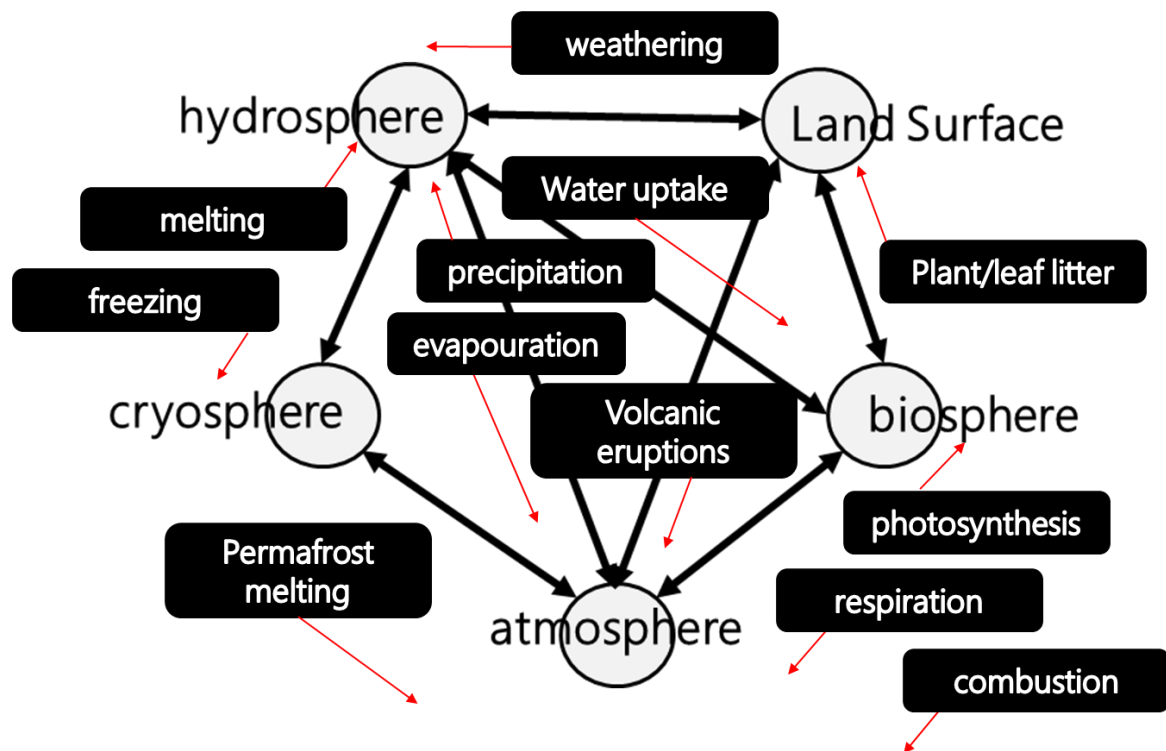
<https://public.wmo.int/en/programmes/global-climate-observing-system/essential-climate-variables>





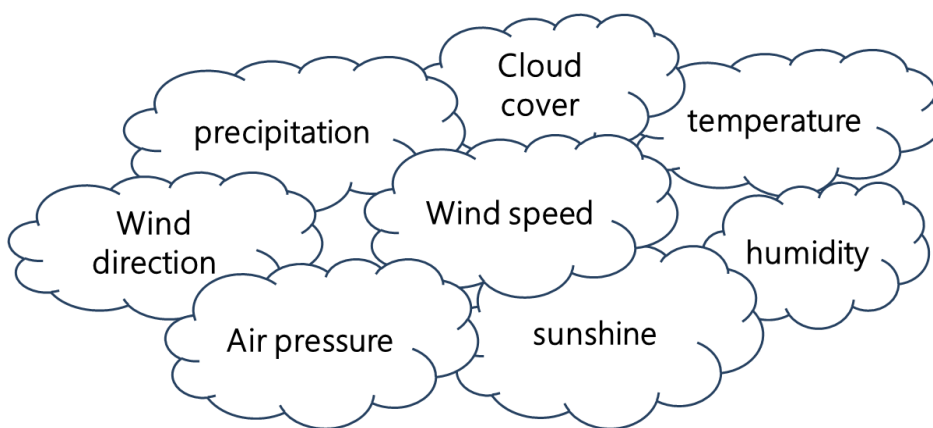
## Influences on Components of Climate

There are many different interactions that affect the climate – these are just a few. Which processes do you think can be influenced by human activity?



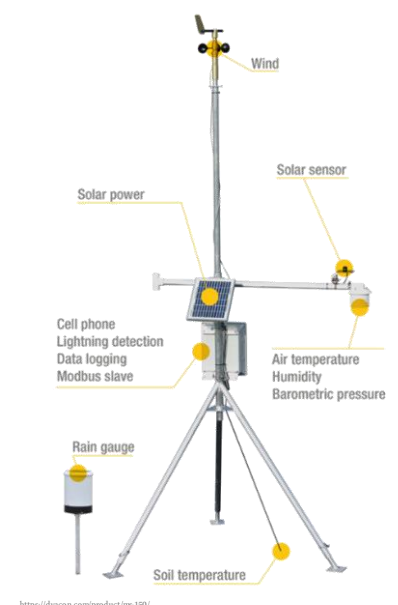
## What is weather?

Weather is the day-to-day changes in the atmosphere around the earth. The type of weather that is likely in any area is determined by the season (wet/dry or spring/summer/autumn/winter) AND the climate of the area. Weather normally occurs within an expected range of conditions. Extreme weather events are rare events that occur outside the expected range.



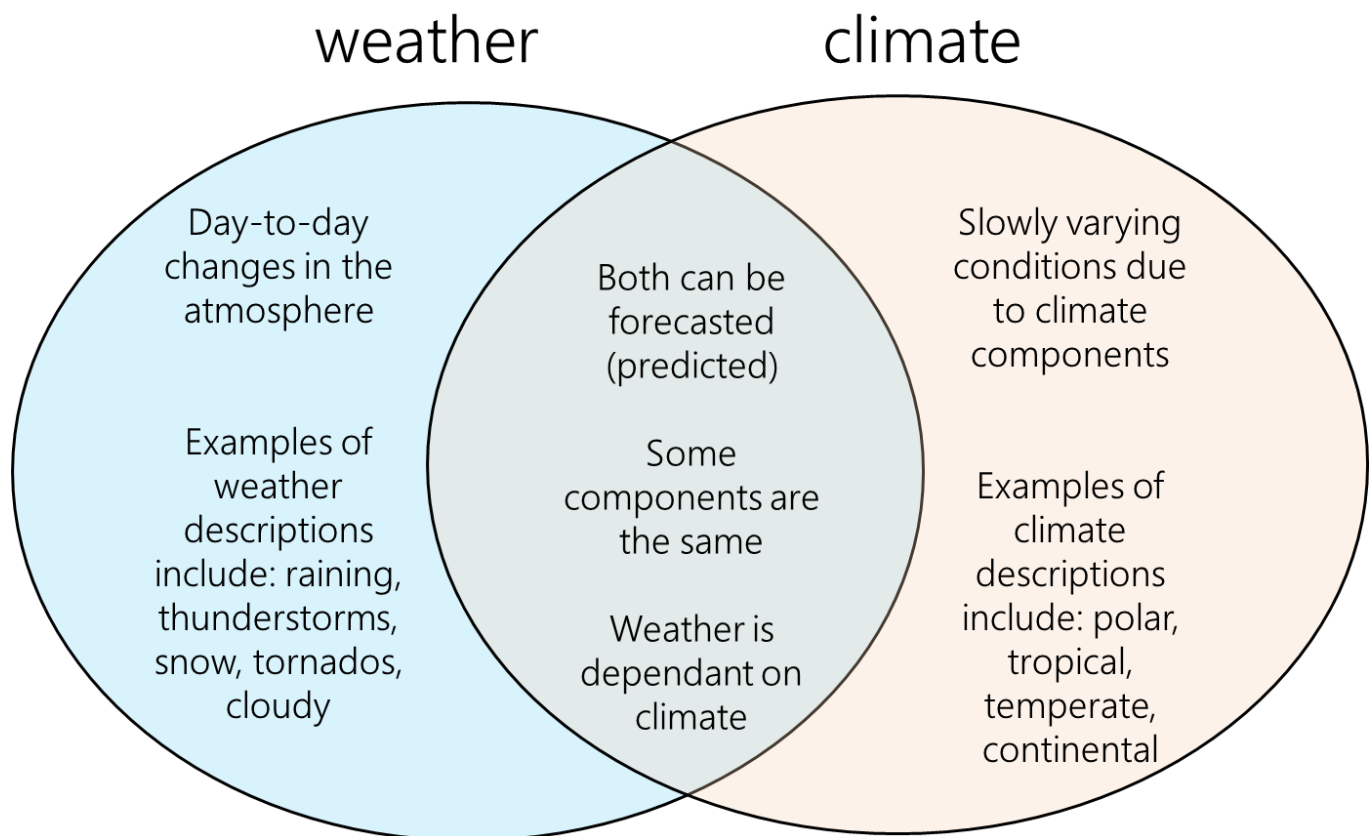
## Recording the weather

Modern portable weather stations have measuring devices to record not only temperature and amount of rain, but the wind amount and direction, the amount of sunlight and the air pressure. All of this information is saved digitally, and can be sent wirelessly to computers and phones. Before this meteorologists (weather scientists) had to go to stations everyday and take physical readings






<https://dyacon.com/product/ins-150/>

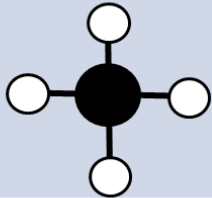
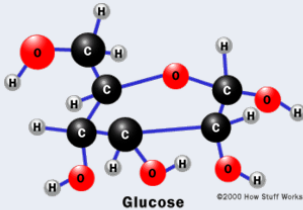
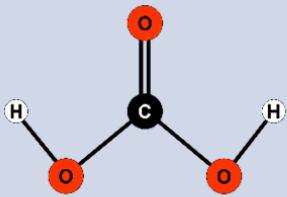
## Weather and climate – What's the difference?




## Carbon Cycle – Where do we find the carbon?

There is a fixed amount of carbon on Earth, much of it combined with other elements forming compounds, that moves through a carbon cycle, from one reservoir (store) to another, with varying processes and timescales.

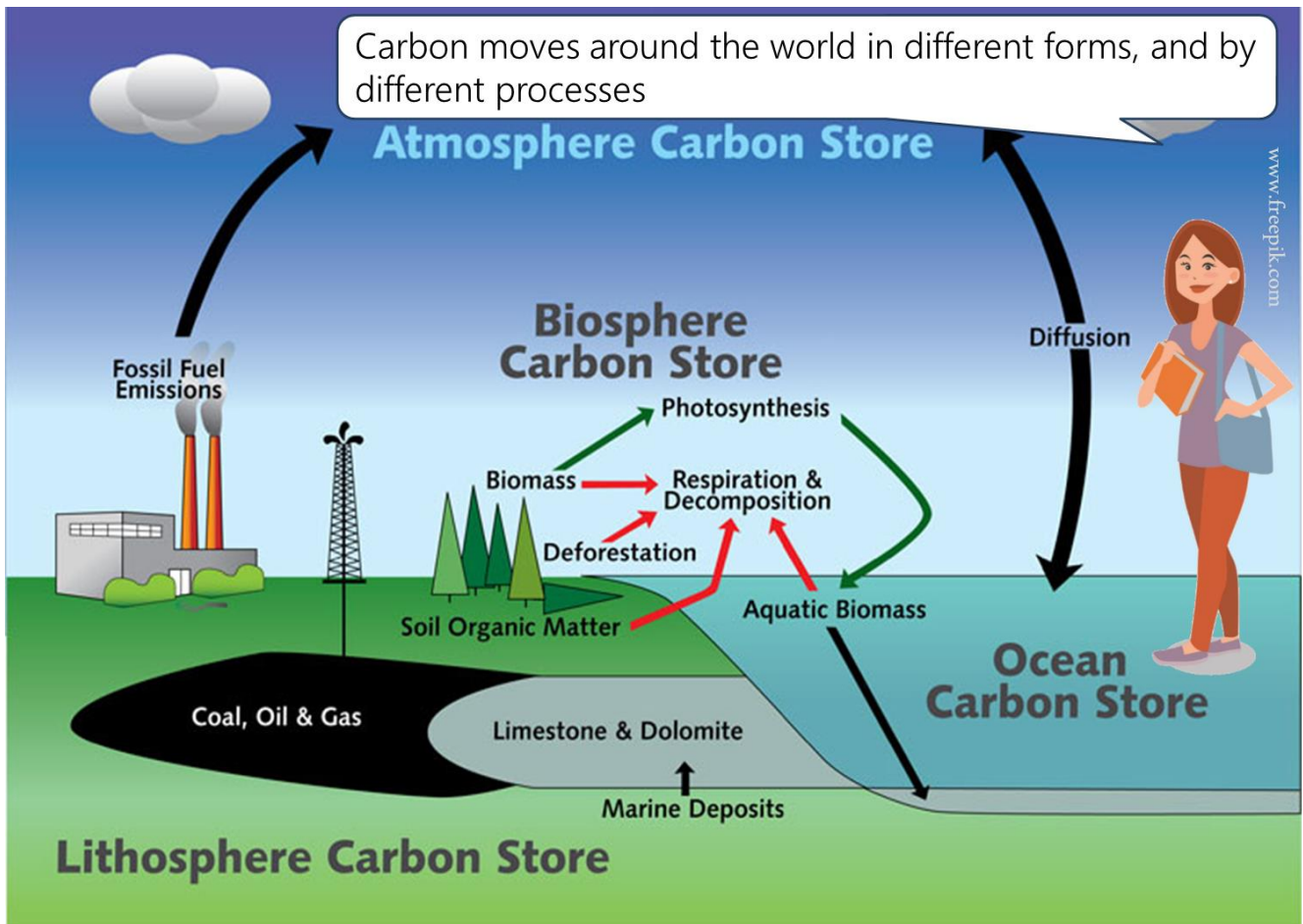
Name	Formula	Model	Where is this found on Earth?	What process creates this?
Carbon (graphite/diamond)	C		underground	Heat and pressure from underground, originally from coal
carbon dioxide	CO <sub>2</sub>		In the atmosphere	Combustion respiration
Calcium carbonate	CaCO <sub>3</sub>		In marine/snail shells In rocks like limestone and marble	Biological shell building  Pressure and heat on shells underground

Name	Formula	Model	Where is this found on Earth?	What process creates this?
methane	CH <sub>4</sub>		In the atmosphere In permafrost (frozen ground) Underground	Decomposition dead plants and animals
Glucose	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub>		In plants In animals	Photosynthesis Transfer from plants to animals by eating
carbonic acid	H <sub>2</sub> CO <sub>3</sub>		In oceans In the air/atmosphere	CO <sub>2</sub> reacting with water in the oceans CO <sub>2</sub> Reacting with water in the atmosphere

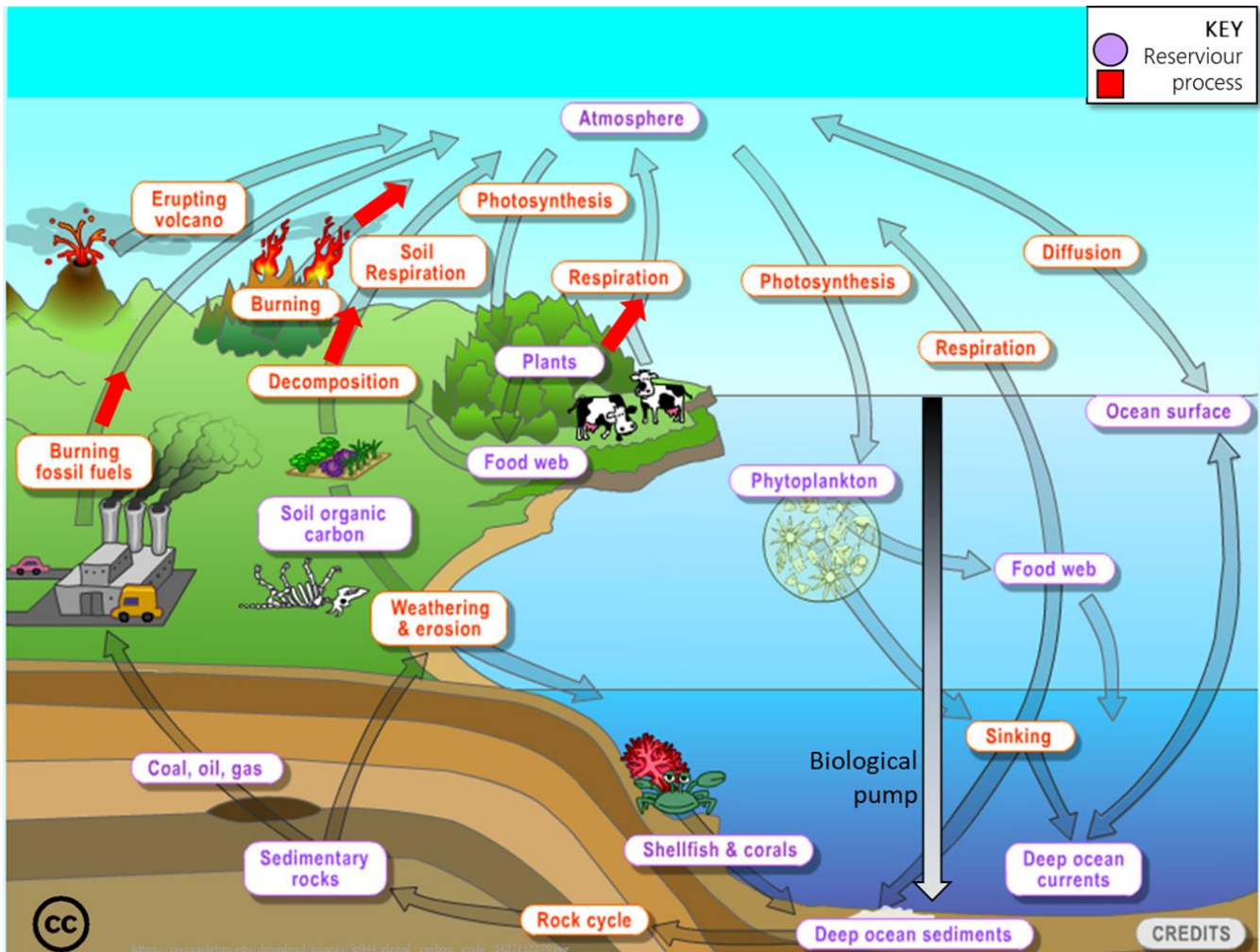
Name	Formula	Model	Where is this found on Earth?	What process creates this?
oil	Carbon and hydrogen molecules		underground	Fossilised sediment remains of marine animals, heat and pressure underground
coal	Mostly carbon		Underground, open cast mines	Fossilised remains of plants, heat and pressure underground

## The Carbon Cycle

Carbon stores (*reservoirs*) are 'areas' where carbon, often contained within compounds, are naturally stored on Earth. The atmosphere is a reservoir where carbon is stored in the form of carbon dioxide gas (CO<sub>2</sub>). However, this is one of the smallest carbon reservoirs, where CO<sub>2</sub> makes up only 0.03% of the atmospheric gases. Another reservoir is held within biological sources, such as trees and fossil fuels. The largest reservoir of carbon is in ocean water, which also acts as a *carbon sink*, with a net movement (more in one direction than the other) of carbon into the ocean from the atmosphere. The atmosphere acts as a *source*, where the carbon originates from.



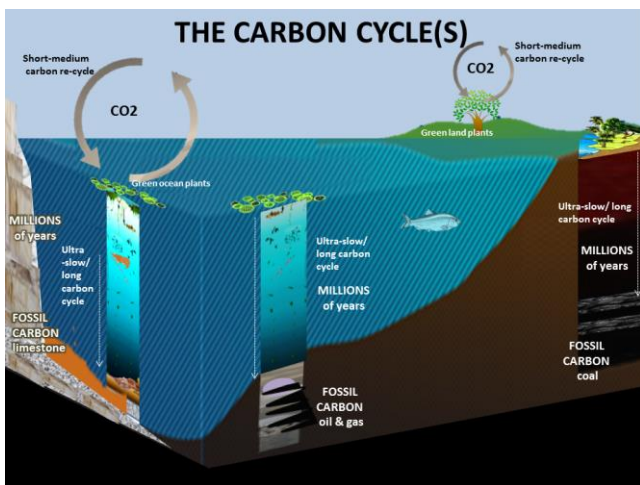
The Detailed Carbon Cycle



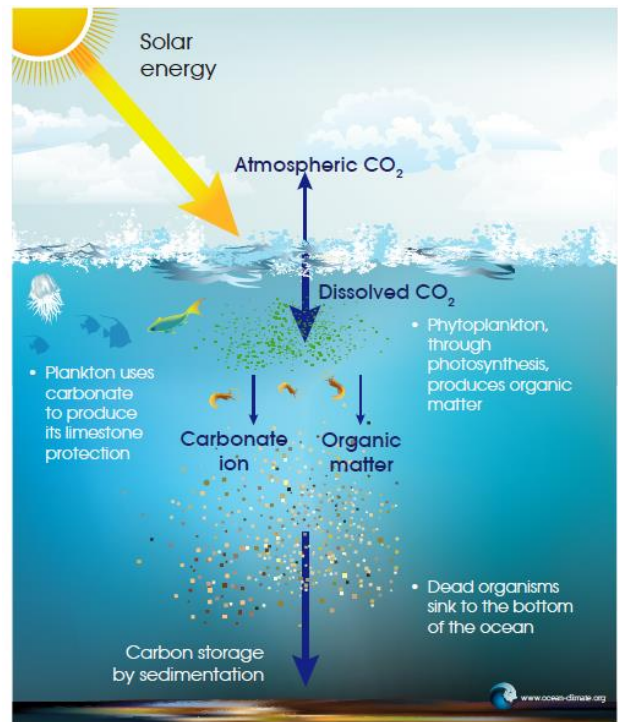


## The ocean, as a biological pump

Once in the ocean, carbon enters the marine food chain via photosynthesis, as well as being utilised for invertebrate (without internal skeleton) shells and outer skeletons made by calcifiers, such as marine molluscs and microorganisms. This *sequestration* (storing away) mechanism acts as a *biological pump*, with carbon moving in one direction through the ocean's organisms.



[https://www.climateenergyinst.state.gov/co2monitoring/climate\\_change.html](https://www.climateenergyinst.state.gov/co2monitoring/climate_change.html)



<https://oceans.taraexpeditions.org/en/m/science/news/plankton-network-linked-to-oceans-biological-carbon-pump-revealed/>

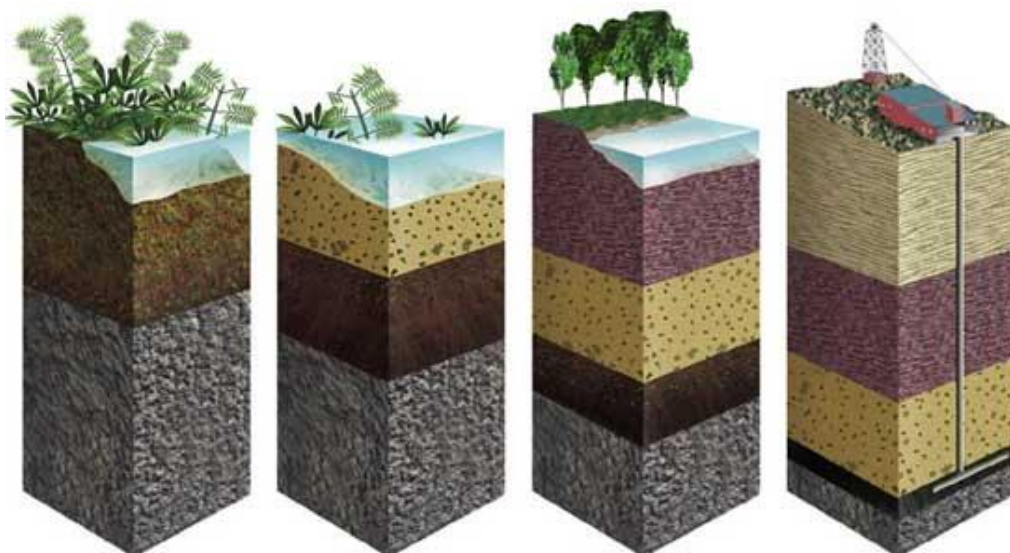
## Fossil fuels as a (store) reservoir

Carbon from the sedimentary remains of marine organisms becomes locked up, often for millions of years, once it is processed into rocks, such as limestone, and fossil fuel carbon reservoirs, with coal forming from ancient plant remains, and natural gas and oil from marine organisms.

## Fossil fuels – forming coal

Coal was formed millions of years ago when plants fell into peat swamps and were buried by heavy earth and rocks. Over millions of years, the weight of the rocks and heat in the ground turned the plants into coal.

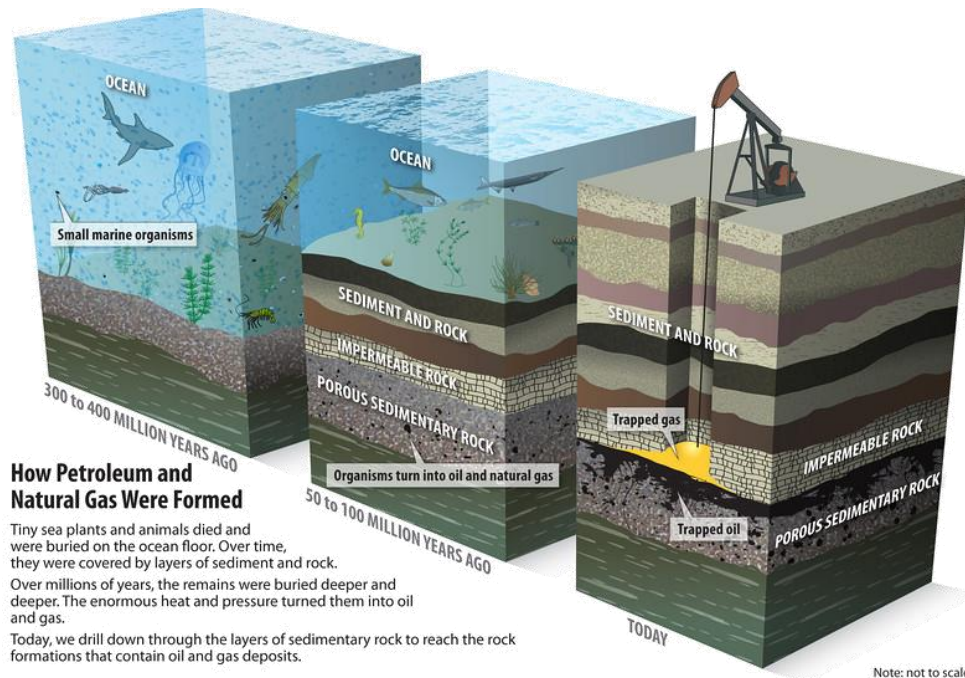
Most of the world's coal was formed 300–350 million years ago during the Carboniferous period that was warm and damp, ideal for plant growth. New Zealand coals are much younger – they were made 30–70 million years ago and they are a less energy rich fuel. Coal is mined either underground or in large open cast mines.





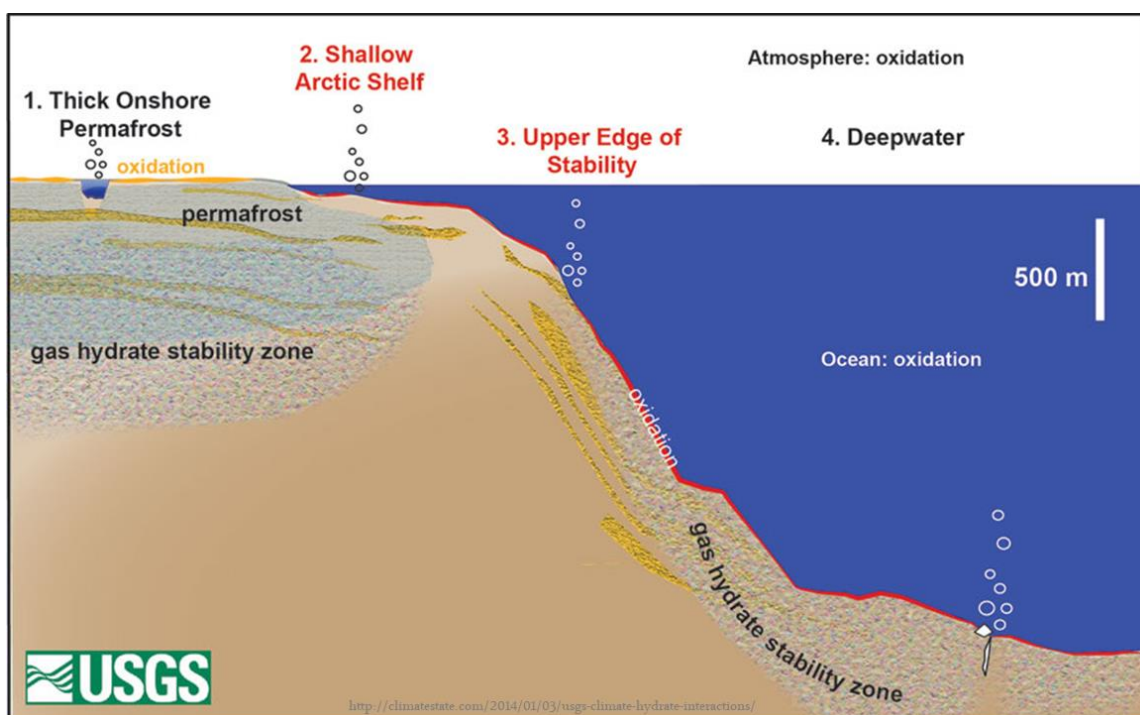
## Fossil fuels – Forming oil

Oil and gas were formed many millions of years ago from dead sea organisms falling to the sea floor and being covered by sediment. Over time the sediment that covered these dead creatures was compressed and formed rock. The carbon and hydrogen atoms that used to be part of the dead organisms bodies reformed into fuel – the liquid form called oil and the gas form. Oil and gas are mined by drilling deep into the ground from oil rigs.



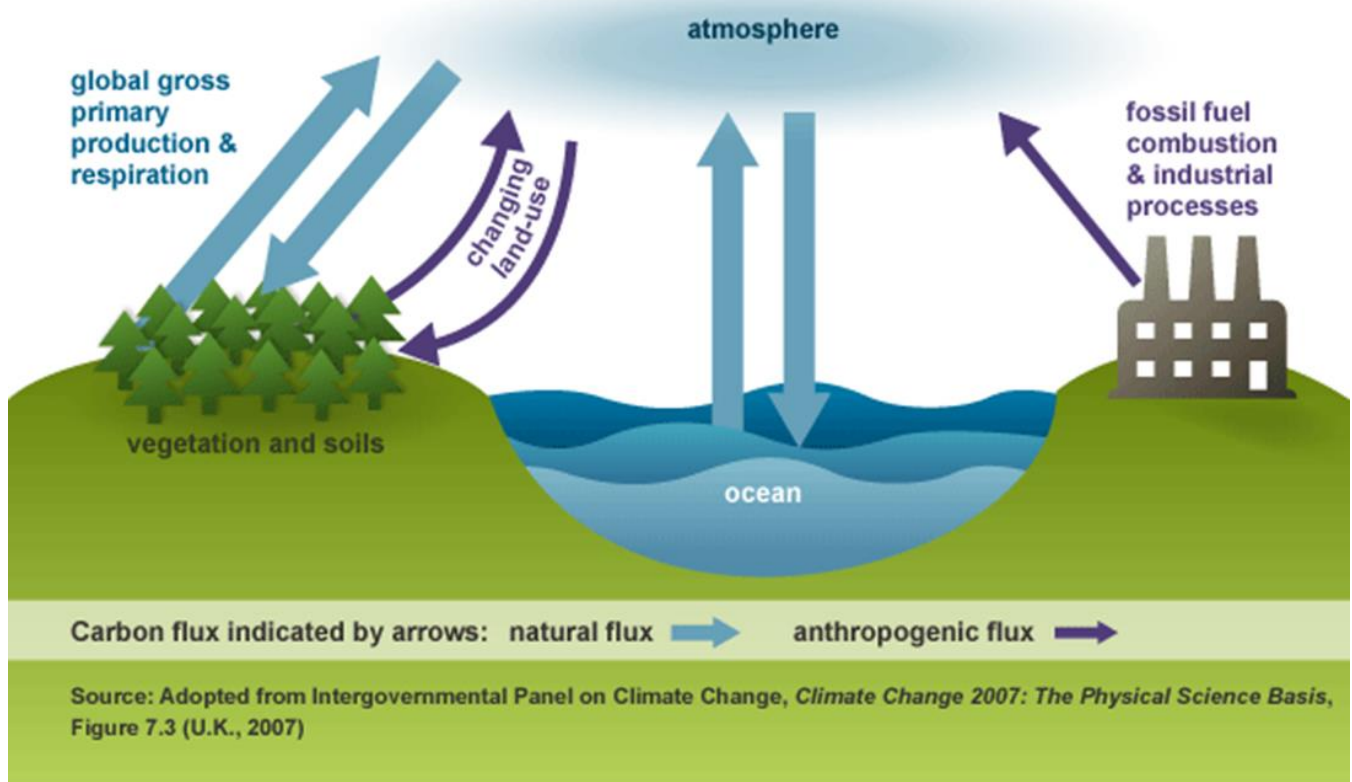
## Stored Methane, as a carbon reservoir

Methane ( $\text{CH}_4$ ), mostly formed through biological processes, is a potent greenhouse gas found in the atmosphere, in permafrost (*frozen ground*) near the poles, and stored under the sea floor in the form of hydrates, *stabilised* by pressure and stable cool temperatures



## Human influence on the carbon cycle

Human activity is increasing the net flow of carbon from other reservoirs into atmospheric CO<sub>2</sub>. Human (anthropogenic) caused combustion (burning) of fossil fuels accounts for the greatest change to the carbon cycle in the post-industrial age (the time after 1780's when humans started using engines to power industry), which converts (changes) most of the carbon locked up in oil, gas, or coal, into CO<sub>2</sub> released into the atmosphere. Changing land-use can influence the total CO<sub>2</sub> emissions as well.



## The evidence for Human influence on the carbon cycle

Past records from ice cores (see below) show that the level of CO<sub>2</sub> in the atmosphere is higher than at any time since humans have been on Earth. "Carbon dioxide concentrations [in the atmosphere] have increased by 40 per cent since pre-industrial times" and currently sits at around 406ppm (parts per million).



## Earth's Energy comes from the Sun

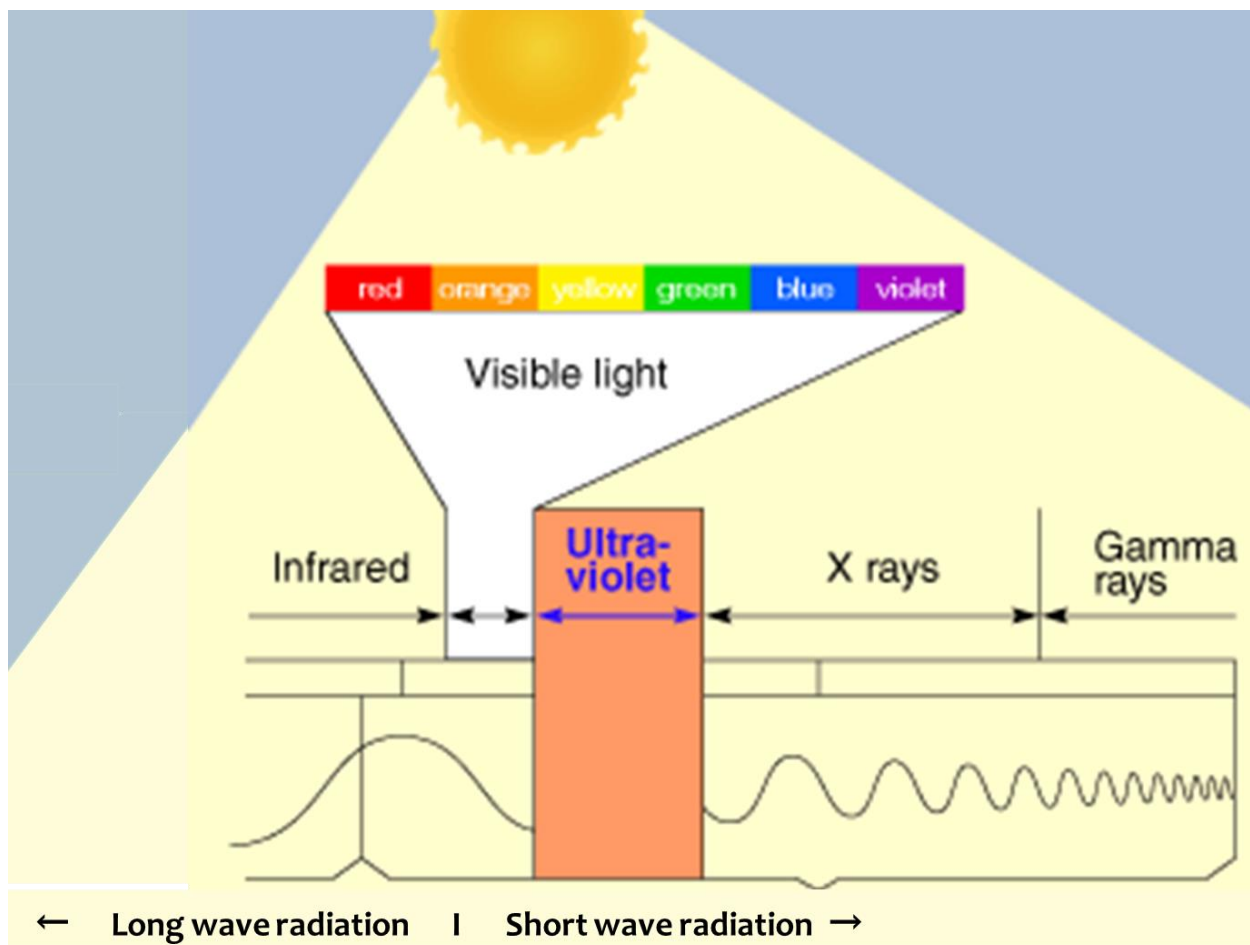
A star is a mass of extremely hot gas. It emits heat and light energy produced by nuclear reactions. The sun consists of extremely hot gases held together in a sphere by gravity. Nuclear reactions occur inside the sun. Hydrogen is changed into helium and huge amounts of energy are released. The interior temperature is 14 million °C, and the surface temperature is 5,800 °C.

The nuclear (fusion) reaction inside the Sun generates electromagnetic radiation in the form of energy: heat (infrared), light (visible), radio waves, Ultra violet. The Sun does make X-rays, but our atmosphere stops them from reaching Earth's surface.

## Energy can be transferred as waves.

Light and other types of electromagnetic radiation from the sun and even further away stars travel through space in a vacuum – an area of very little or no atoms. Light does not need matter or a substance through which to travel. Each particular type of electromagnetic radiation, including each different colour of light, has a unique fixed length of wave, called the wavelength ( $\lambda$ ), that it travels in.

The Sun releases large amounts of energy. The energy can be emitted from the energy source in the form of electromagnetic radiation and travels in electromagnetic waves. Heat (infrared) is long wave radiation, Light is short wave radiation



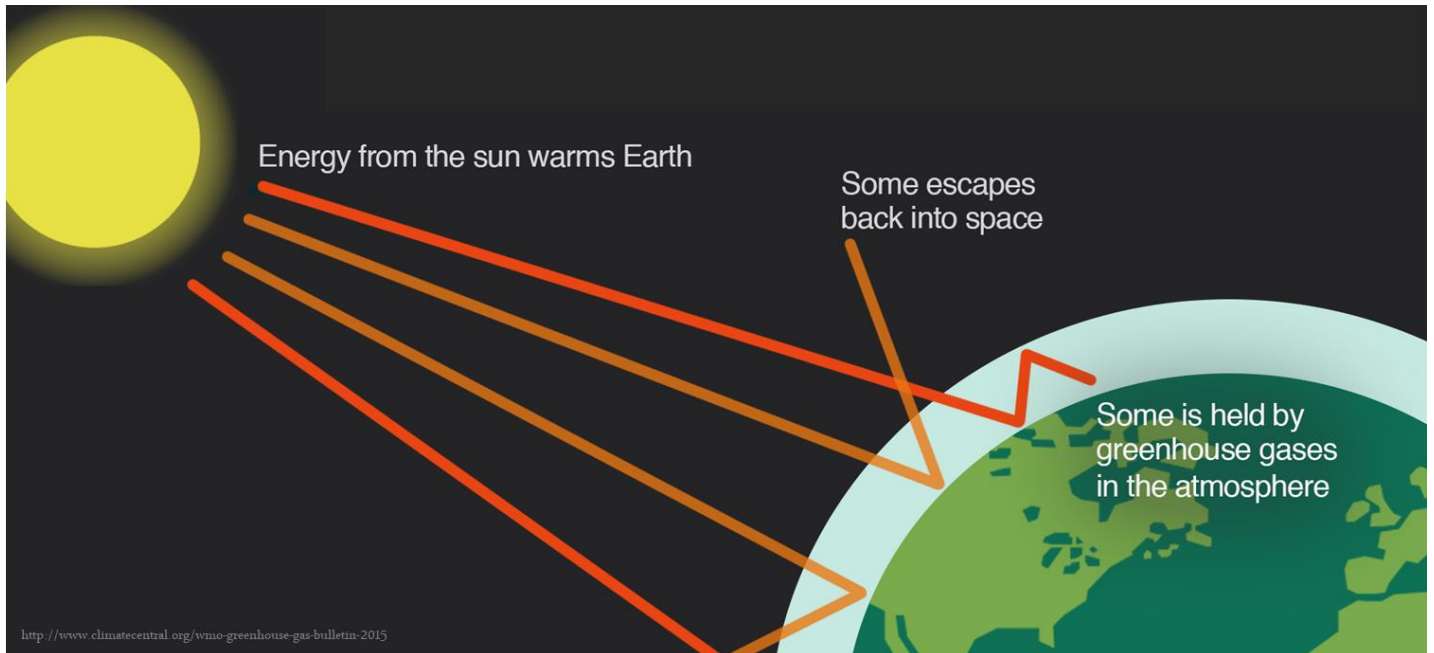
Heat (infrared) radiation has a longer wavelength than light

The temperature of the body (source) determines the main type of radiation that is emitted. The Earth is cooler than the Sun, so mainly emits heat, travelling long wavelengths.

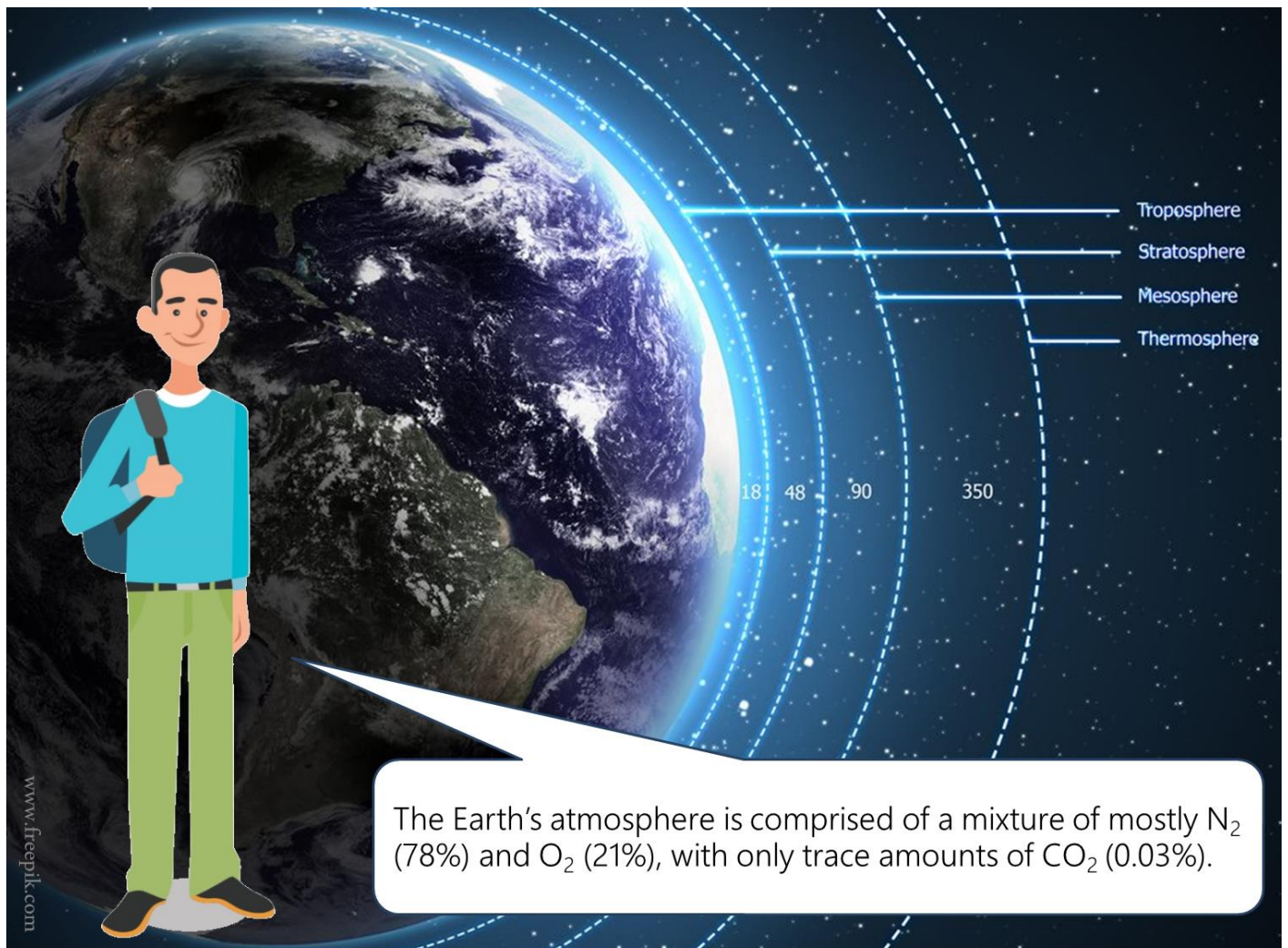


## Energy moving around the Earth

The short wavelength radiant energy from the Sun travels with little resistance through the Earth's atmosphere until it reaches the surface, where it is absorbed, and then most of the energy re-radiated. The Earth is much cooler than the Sun, so energy travels in longer wavelengths, mostly as infrared radiation (heat).

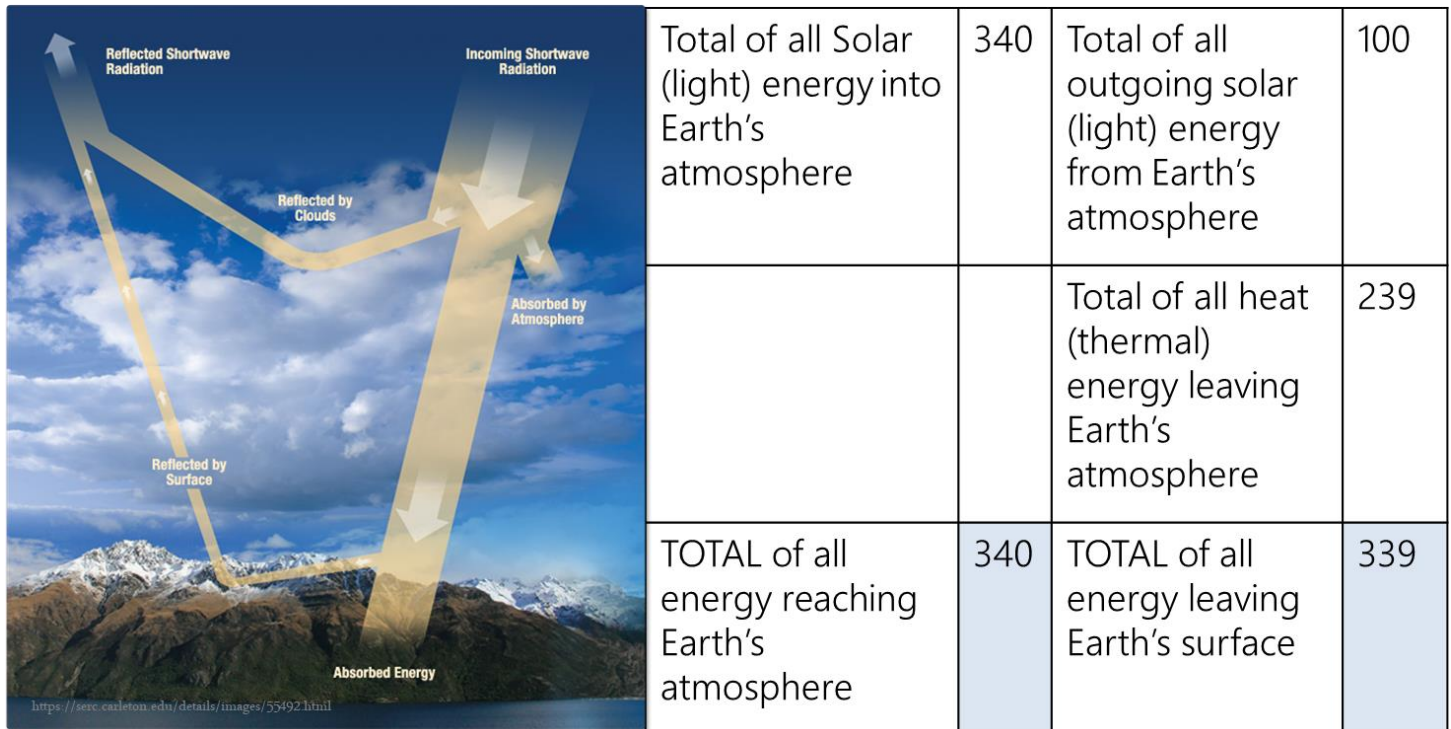


## The atmosphere

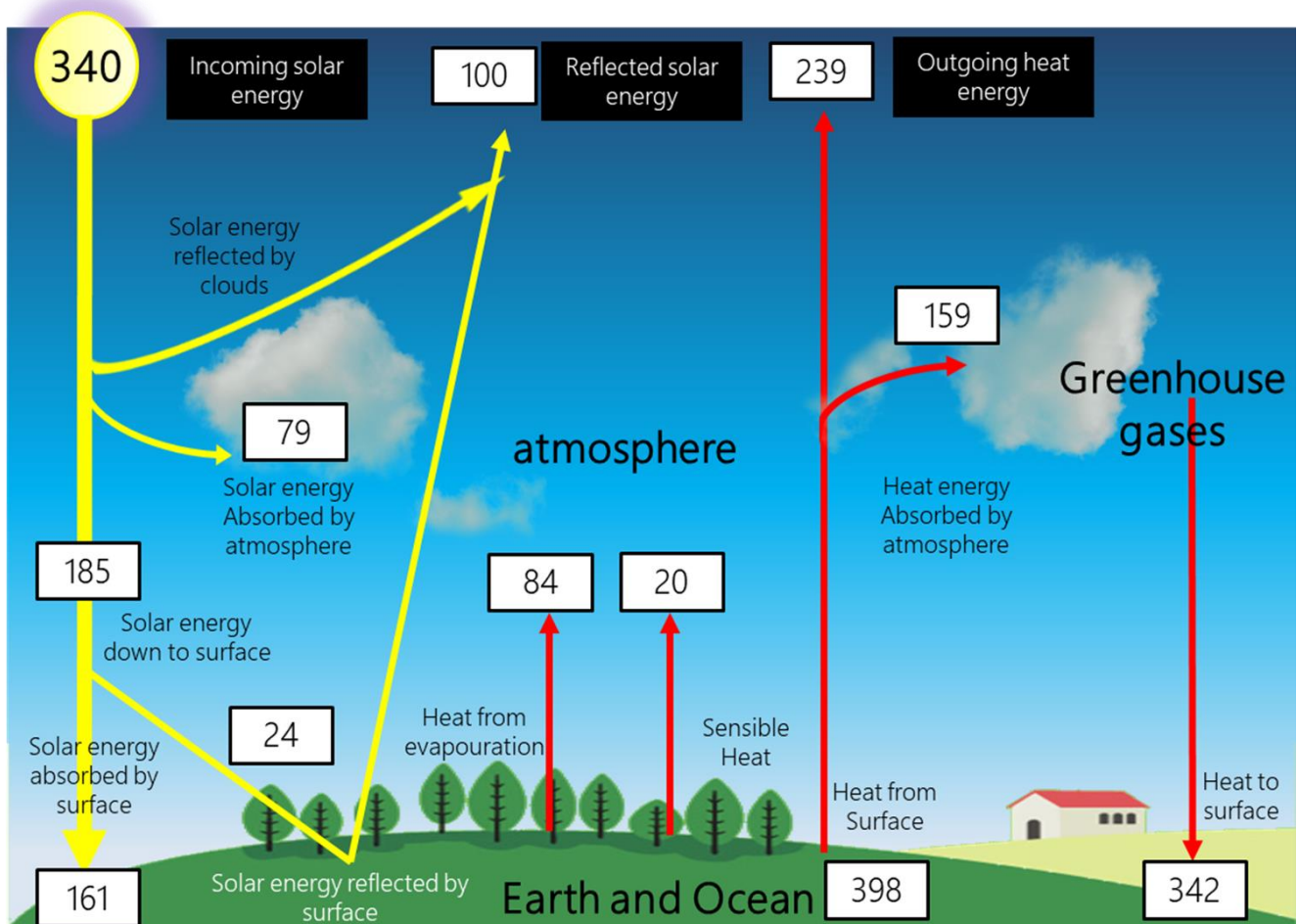


## Calculating Earth's Energy Budget

The Energy Budget calculates the total amount of energy entering the Earth's atmosphere (as light energy), and subtracts the total amount leaving (as light and heat). The amount of energy left over will cause the atmosphere to heat.



Difference in energy IN and energy OUT  $1 \text{ w/m}^2$  into Earth's atmosphere



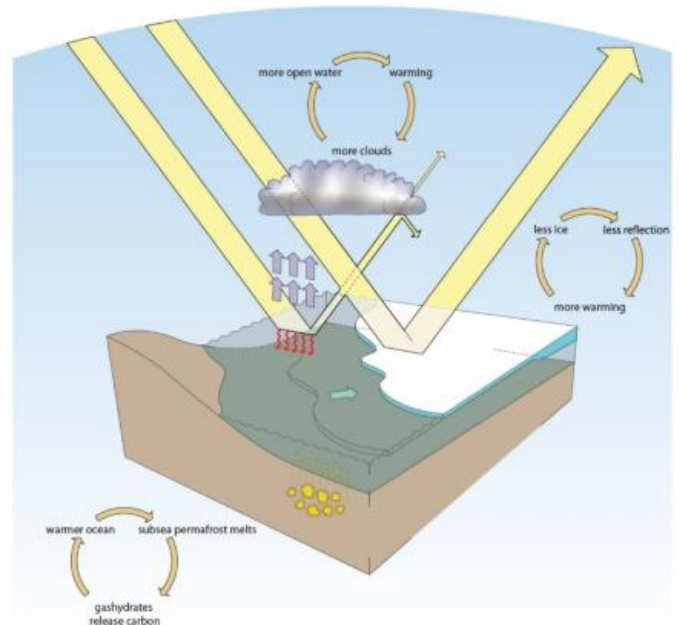


## Albedo Effect

Short wave radiation (light), is either reflected or absorbed when it reaches the ground.

White and silver objects reflect radiation and very little heat energy is transferred to them, called the albedo effect. Black objects absorb radiation and a large proportion of the heat energy is transferred to them. The disappearance of surface ice and snow is reducing the albedo, revealing dark rock or water, therefore, a significantly higher amount of energy is absorbed rather than reflected.

This increases the average temperature near the polar areas and induces even further melting of the ice and snow.

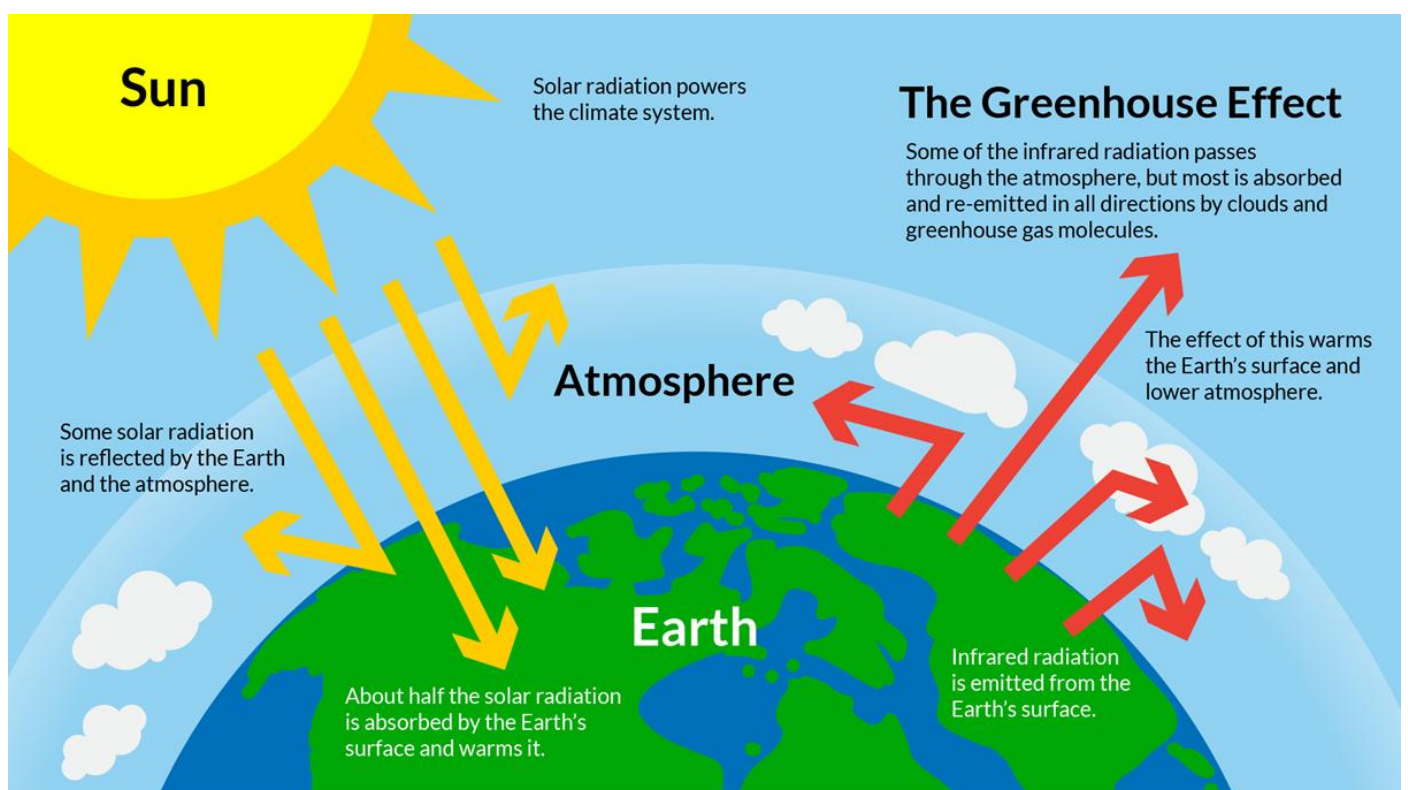


<http://www.npolar.no/en/facts/albedo-effect.html>

## The Greenhouse Effect

The *greenhouse effect* is very important for life on earth. Without it, Earth would be too cold to support life. Even during night time, when that half of the Earth's surface is facing away from the Sun, enough heat is retained to keep it warm.

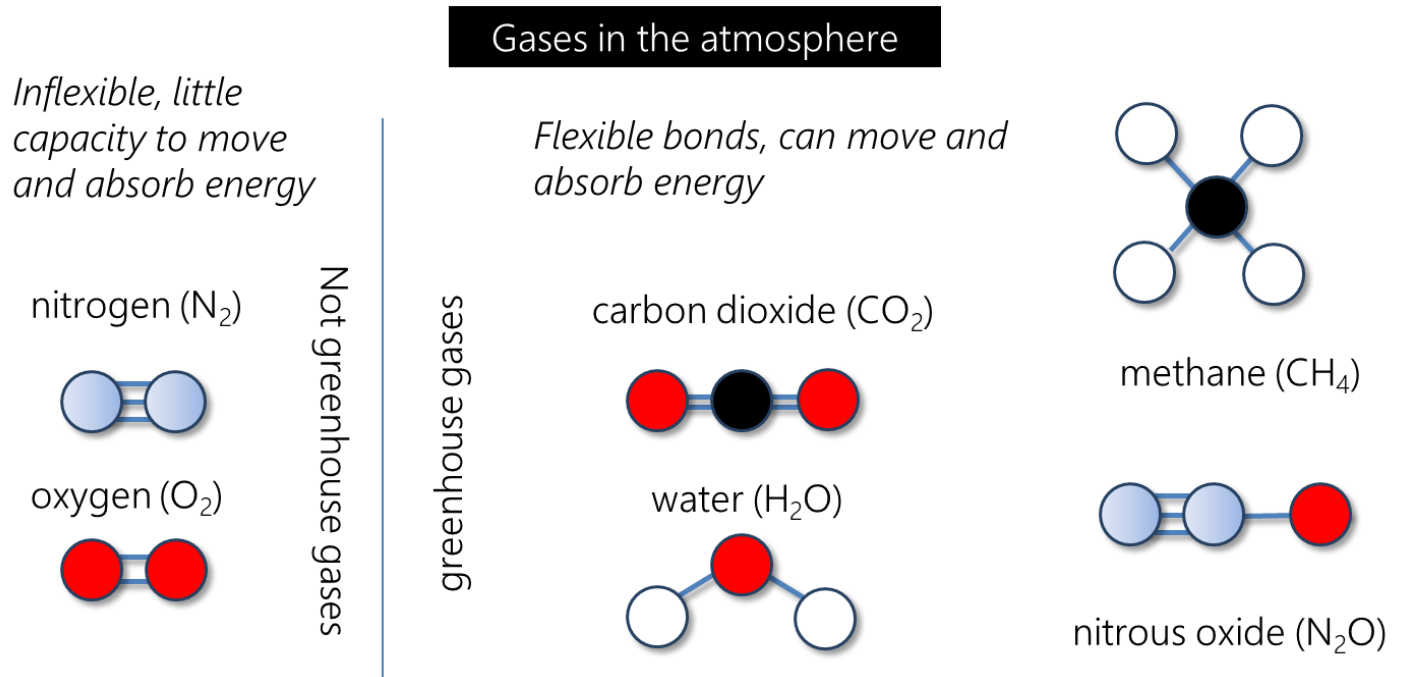
CO<sub>2</sub>, H<sub>2</sub>O, and methane (CH<sub>4</sub>) gases in the atmosphere can *absorb* and *emit* (send out) long wavelength energy (Heat), causing the atmosphere to heat up. The more greenhouse gases, the more energy is kept than released back out into space. This is the principle of the *greenhouse effect*.





## Greenhouse Gases

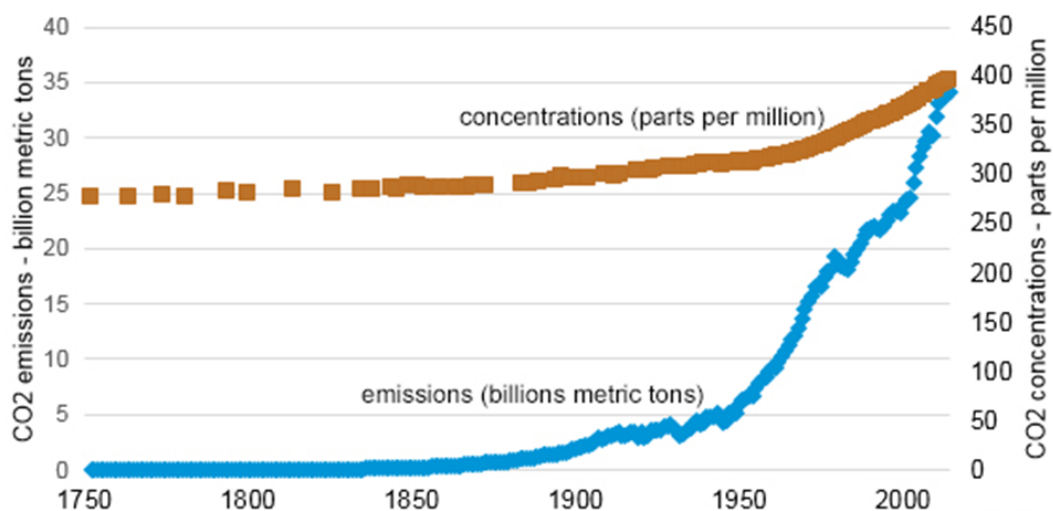
The gases that absorb the infrared radiation are known as greenhouse gases. Some gases, such as  $O_2$  and  $N_2$  are insignificant regarding the greenhouse effect, due to their particular molecular structure.  $CH_4$  and  $H_2O$  are 'stronger' GHG than  $CO_2$ , but due to the shorter time they stay in the atmosphere they have less influence.  $H_2O$  cycles rapidly through the atmosphere and  $CH_4$  breaks down after around 12 years, compared to  $CO_2$ , which remains for hundreds of years.



## Human activity increases Greenhouse gas concentration in the atmosphere

Shifts in the past atmospheric concentrations of  $CO_2$  are linked to natural fluctuations (changes) in the climate, but it is now apparent that the predominant (main) factor in current climate change is human caused emissions of greenhouse gases.

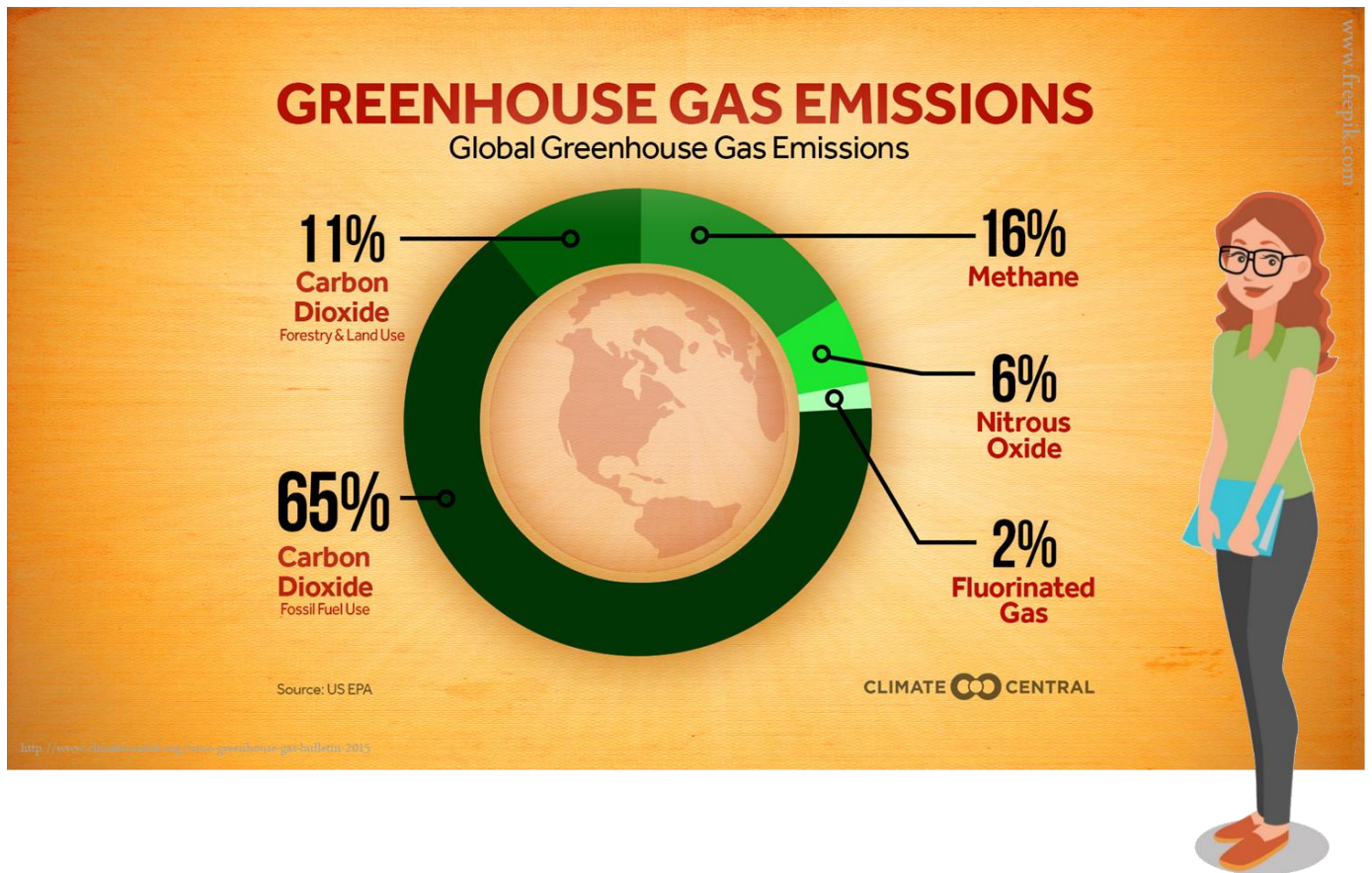
**World carbon dioxide emissions from fossil fuel combustion and global atmospheric concentrations (1752–2014)**



Source: Data from Oak Ridge National Laboratory, Carbon Dioxide Information Analysis Center, accessed July 26, 2017

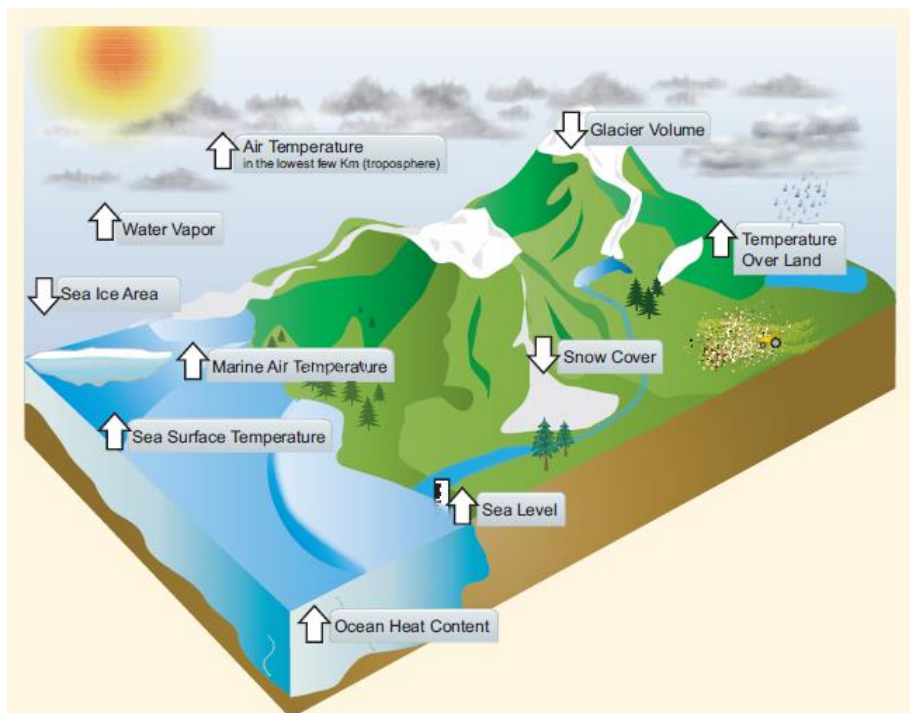


Where are the greenhouse gas emissions coming from?



## Climate signals

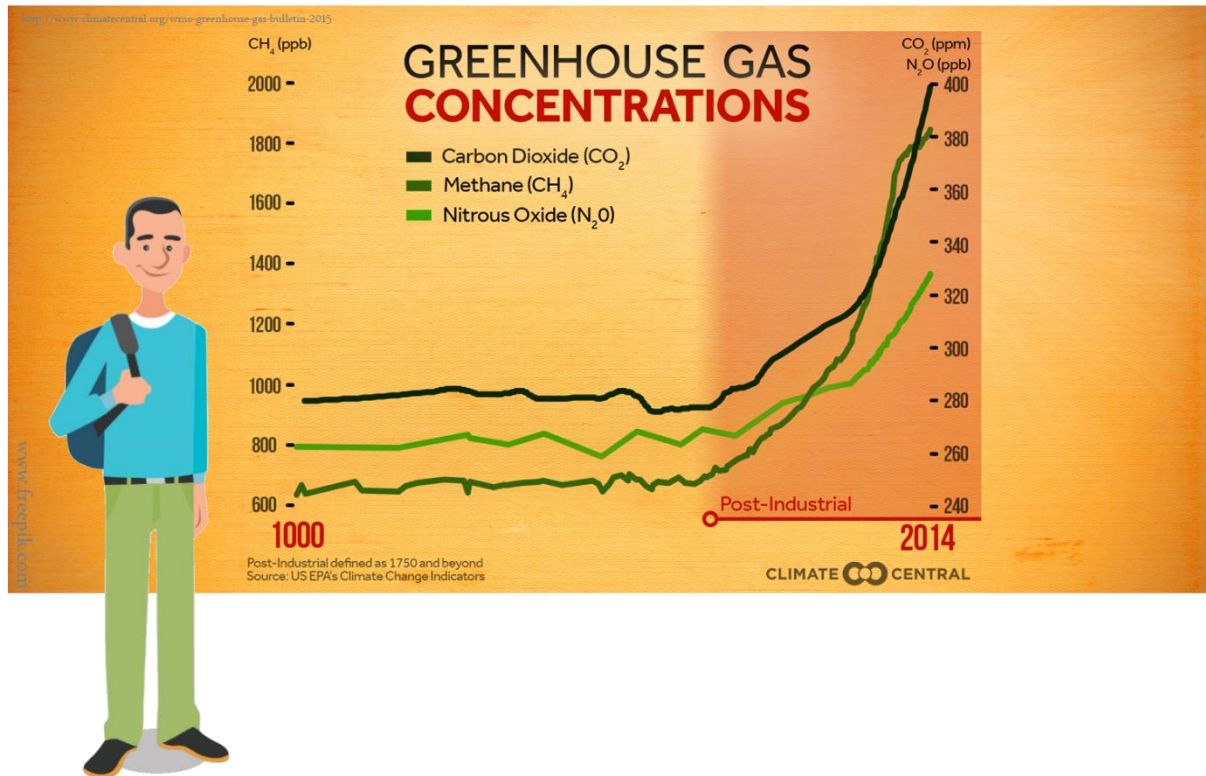
Climate Signals are long-term trends, including temperature, sea level, glaciation, and rainfall patterns, and allow us to tell if there has been any significant movement from naturally expected climate trends



*Features of the climate system (climate signals) affected by climate change. The arrows show the direction of change. (IPCC, 2013)*

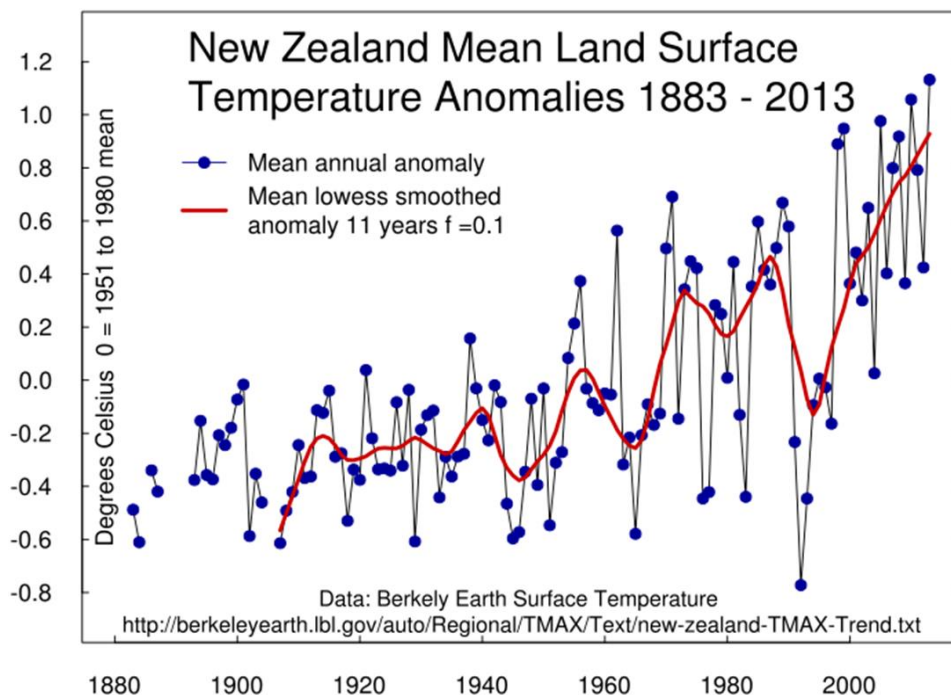
## Comparing pre-industrial climate signals to post-industrial climate signals

Naturally fluctuating (moving) temperature and carbon dioxide signals, prior to human activity, can be compared to post-industrial signals. Using observations and projections, scientists can now state that it is “extremely likely”, with a confidence of 95-100%, that Climate Change is due to anthropogenic (human) influence.



## Temperature changes

The past three decades have been hotter than all decades since temperature observations were recorded in the 19<sup>th</sup> Century, and the warmest has been the most recent decade.

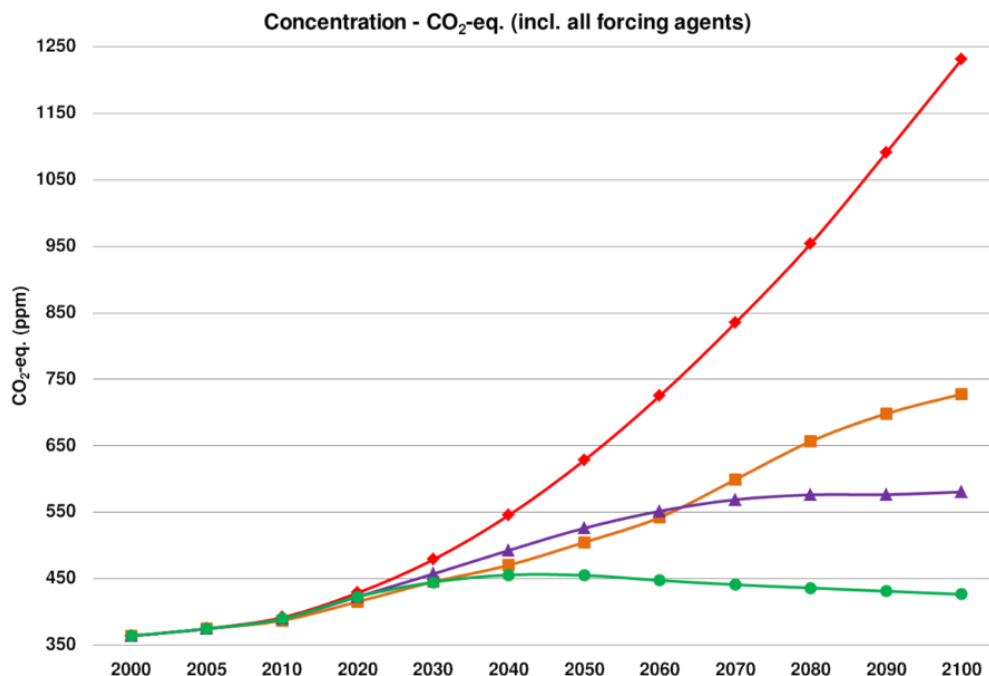




## How much CO<sub>2</sub> will humans produce in the future?

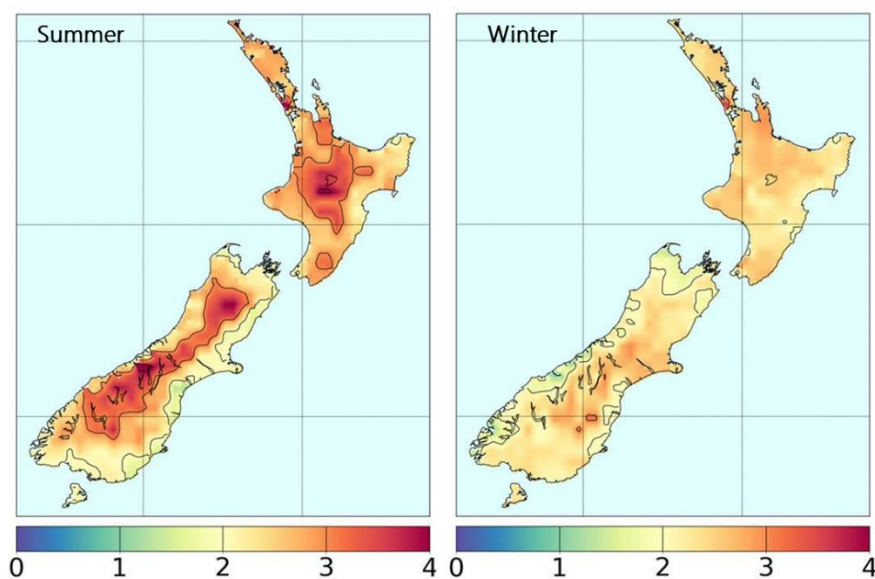
We can measure how much CO<sub>2</sub> we are producing at the moment and releasing into the atmosphere. Predicting the future amounts of CO<sub>2</sub> becomes more difficult, as we look further into the future. By making big changes to how we live and finding ways to remove current CO<sub>2</sub> in the atmosphere, we may be able to limit the projected rise of the earth to under 2°C. (green line).

At the other extreme, if we do nothing, and even increase the amount of CO<sub>2</sub> we release, the temperature rise (and sea level) could reach levels that completely change the Earth. (red line). It is more likely that we will end up somewhere between these two predictions.



## Temperature rise predictions

Predicted increase in average temperature (°C) by 2090, relative to 1986–2005. (for highest CO<sub>2</sub> emissions prediction)



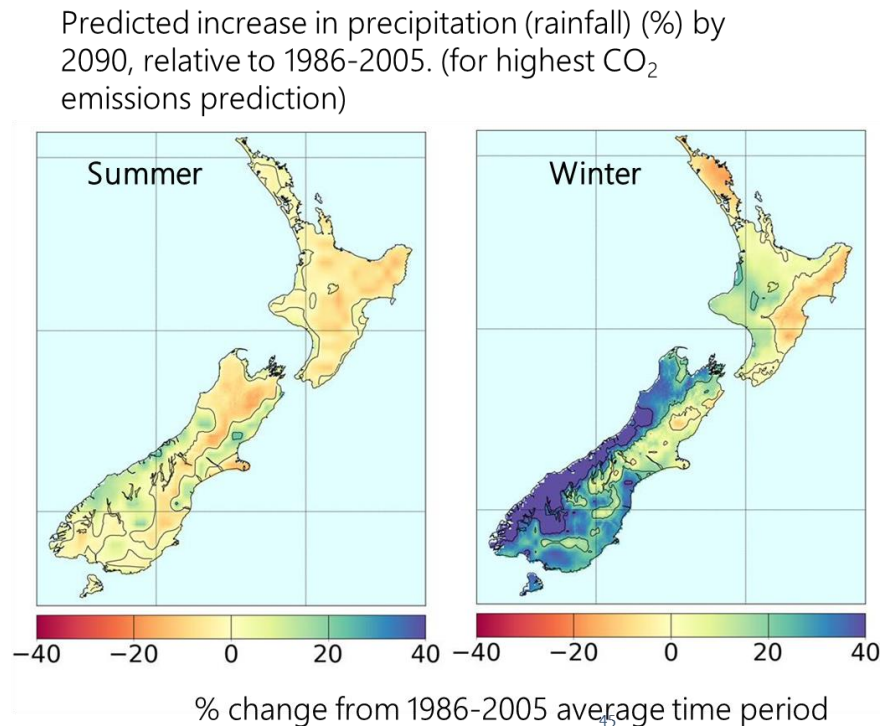
°C change from 1986–2005 average time period

Using climate models generated from the NIWA supercomputer, for a medium CO<sub>2</sub> emissions scenario, NZ may experience a temperature increase of:

0.8°C by 2040, 1.4°C by 2090, and 1.6°C by 2110, relative to the 1986–2005 period" with a maximum of 5.0°C in 2110, using the highest emission scenario.

## Climate Change rainfall predictions

Changing rainfall patterns can also be predicted using CC models, and in NZ it is projected that the west of both Islands will become gradually wetter and the north and east will become drier in climate. In future, it is also predicted that NZ will have "more hot days" and fewer frosts". Temperature and precipitation extremes have increased and become more frequent around the world.

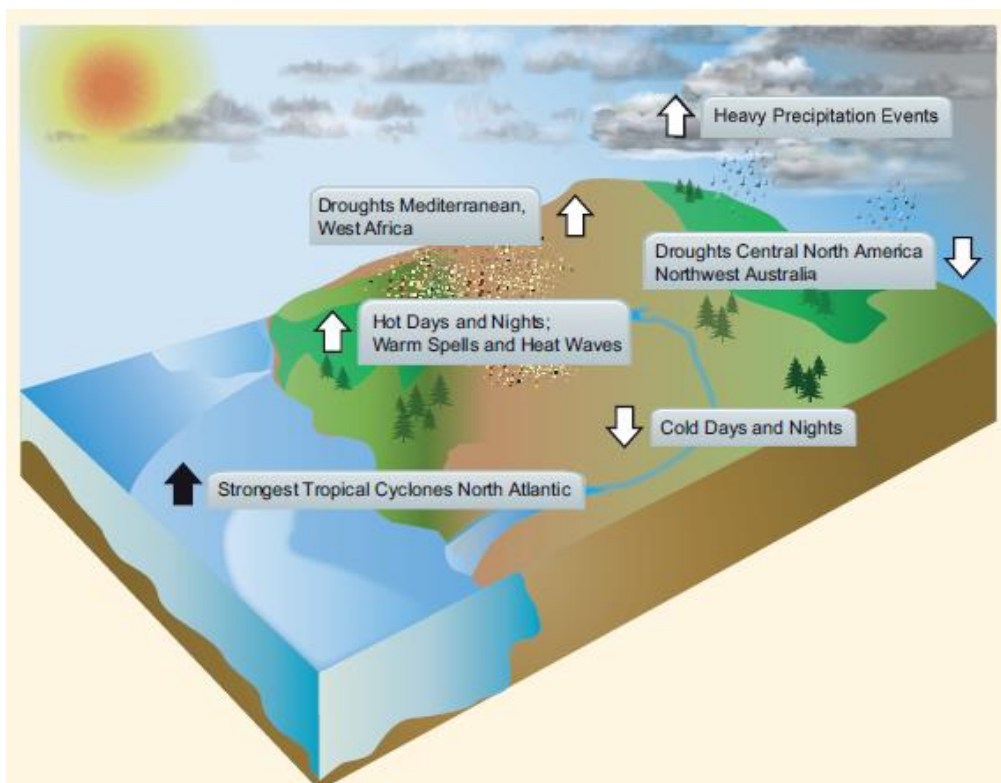


Sourced from: <https://www.niwa.co.nz/our-science/climate/information-and-resources/clivar/scenarios>

## Climate Change - Extreme Weather Events

Extreme weather events are stronger, and occur less often than typical weather. Extreme weather events are induced by both natural and human-activity causes

These cause a shift in the balance of Earth's energy, which powers the climate system. Extreme weather events include droughts, storms, deluges, heat waves, and tornados, and have increased in frequency since the 1950's.

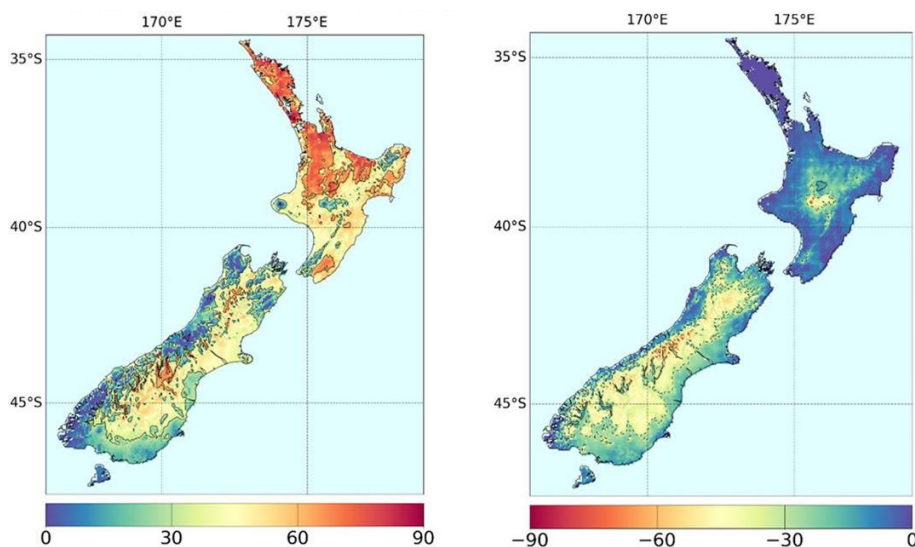


## Climate Change - Extreme temperatures

Predicted change in number of extreme temperature days by 2090, relative to 1986-2005. (for highest CO<sub>2</sub> emissions prediction)

Days above 25°C

Days below 0°C



Number of days change from 1986-2005 average time period

Sourced from: <https://www.niwa.co.nz/our-science/climate/information-and-resources/clivas/scenarios>

Extreme weather events in NZ are predicted to increase in frequency, and include both extreme rainfall events and drought across the country.

## Melting of the Cryosphere and sea level rise

Multiple lines of evidence show that global warming, because of climate change, has caused the reduction of the *cryosphere*, consisting of sea and land ice, glaciers, and permafrost, in the past 30 years. Paleo (pre-history) records show that previous episodes of naturally induced global warming, around 2°C warmer than current temperatures, had produced a sea level rise (SLR) of more than 5m above present levels.

Change in Fox Glacier, West Coast, New Zealand from 2008 to 2014



Sourced from: <http://glacierhub.org/2016/07/26/as-glaciers-melt-tourists-keep-on-coming-in-new-zealand/>

Change in Franz Joseph Glacier, West Coast, New Zealand from 2009 to 2013

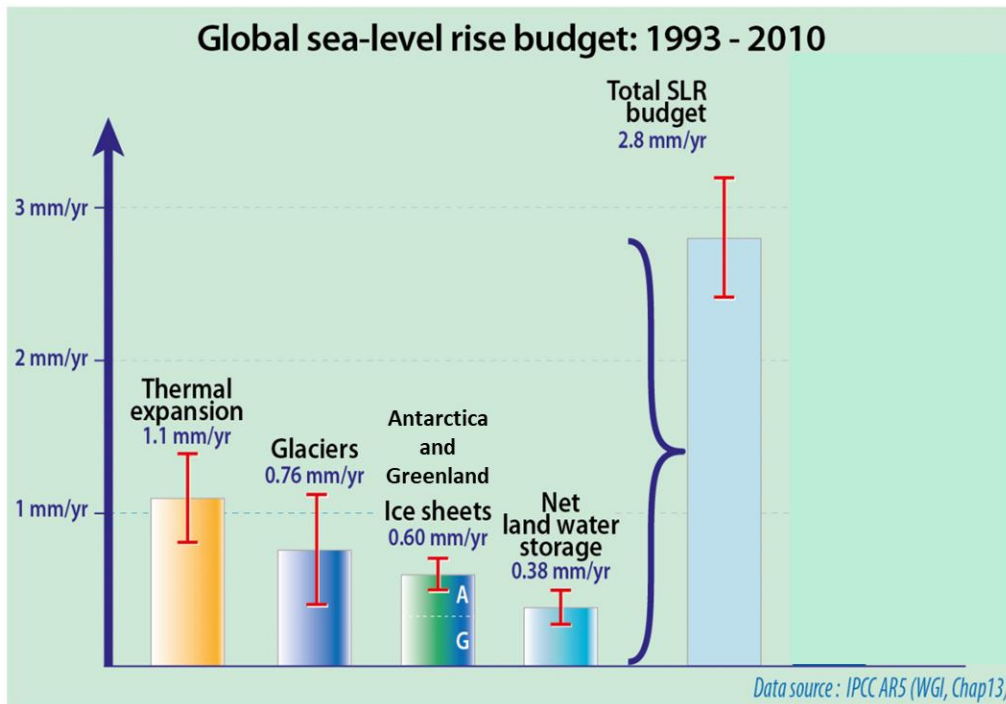


Sourced from: <http://glacierhub.org/2016/07/26/as-glaciers-melt-tourists-keep-on-coming-in-new-zealand/>



## Disappearing ice.

Observations now show that the Arctic sea ice is becoming thinner and smaller with each passing year. Continued warming of the planet could cause some large ice sheets, such as Greenland, to totally disappear, adding nearly 7m to long-term sea level rise.

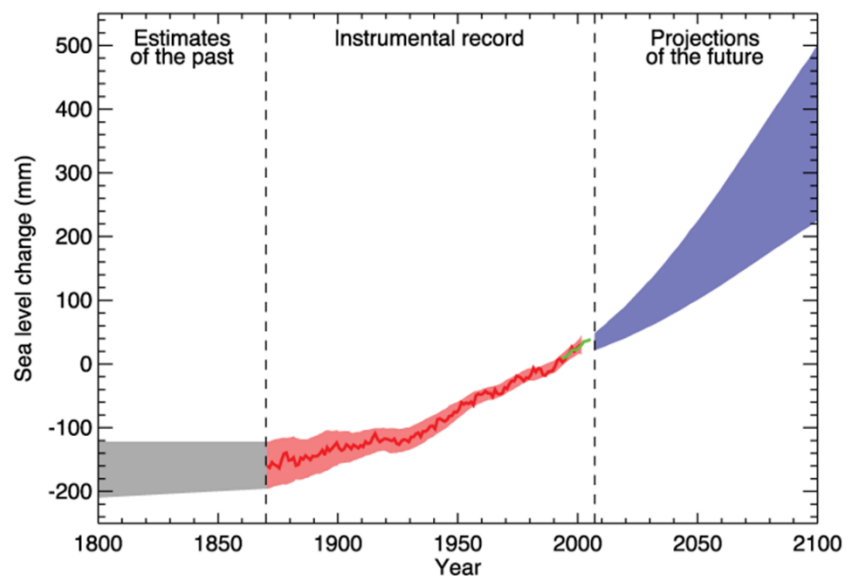


The main contributors (75%) to sea level rise have been the melting of glaciers, predicted to continue shrinking even if the temperature stabilises and more recently the Antarctic and Greenland ice sheets. Calving glaciers make up 90% of the continental ice loss.

## Sea level rise predictions

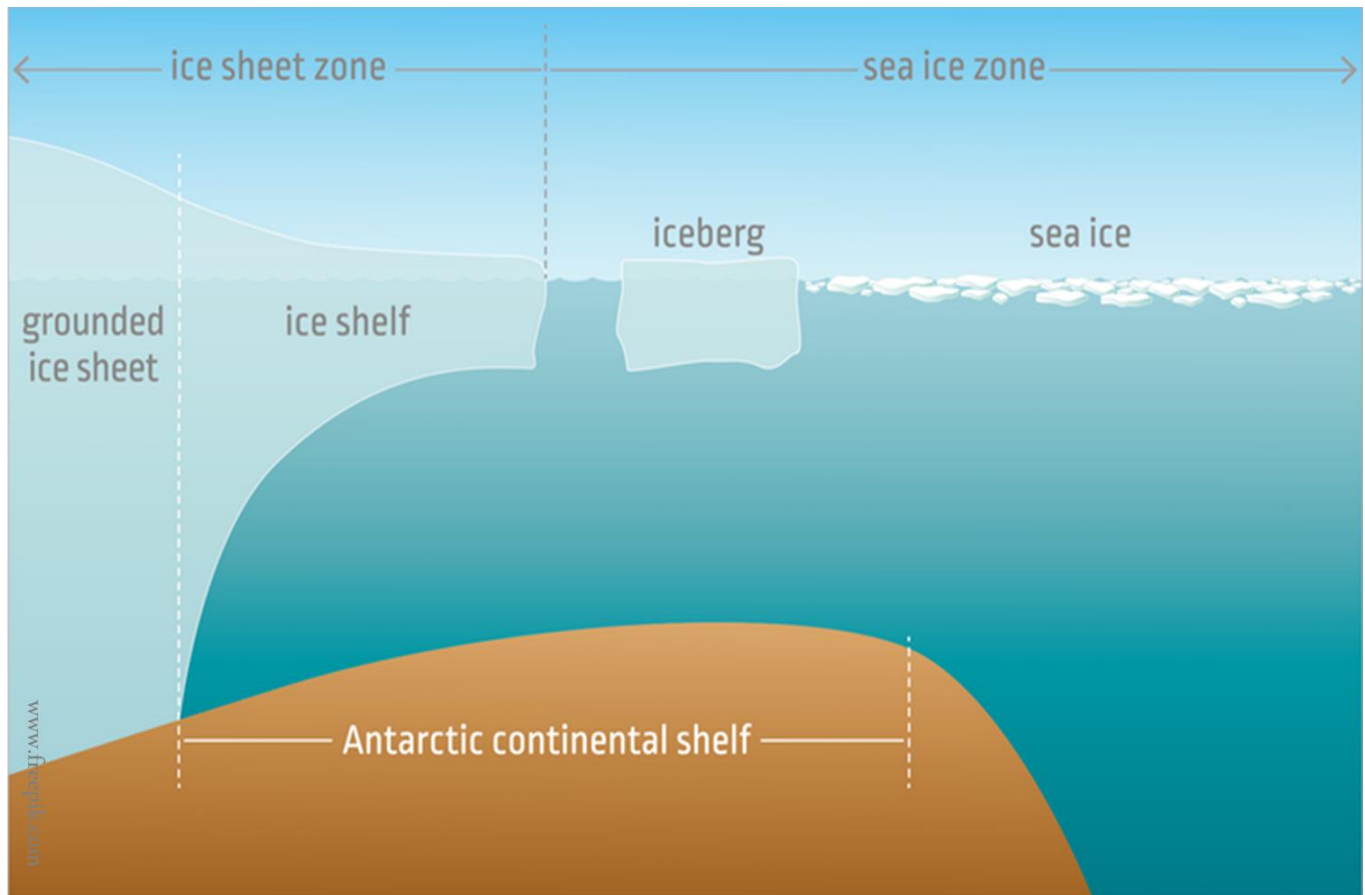
Predicted ranges for sea level rise by 2100 are from 0.26 to 0.98 m, depending upon future emission levels. In the last decade the rate of sea level rise is double that compared to the previous century, with small islands most exposed to risk.

NZ is particularly susceptible to sea level rise, due to the long coastline, and the position of many communities, and major cities, in low-lying areas near to the coast. The rising sea levels will cause coastal land erosion and flooding and result in reduced land area.



## Why does only land ice contribute to sea level rise (and not sea ice)?

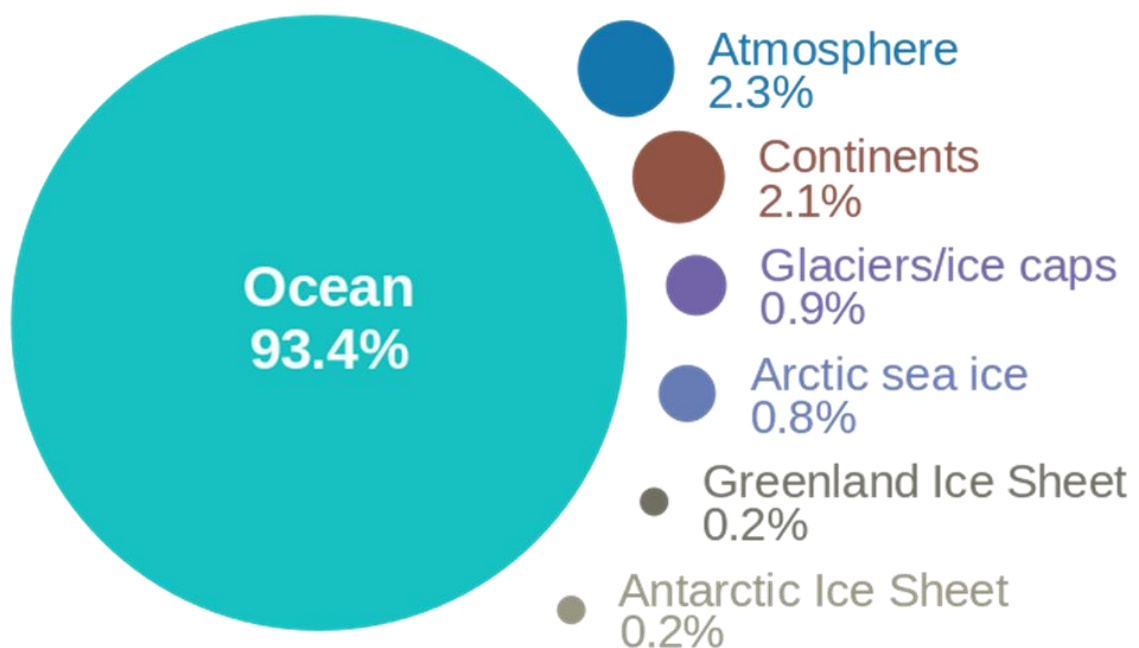
Ice that is floating in the sea (like in the Arctic) is mostly displacing (taking up space in) water already, so when it melts there will not be much sea level rise. Land ice (like in Greenland or the Antarctica) melting displaces much more water.



## Heating Oceans

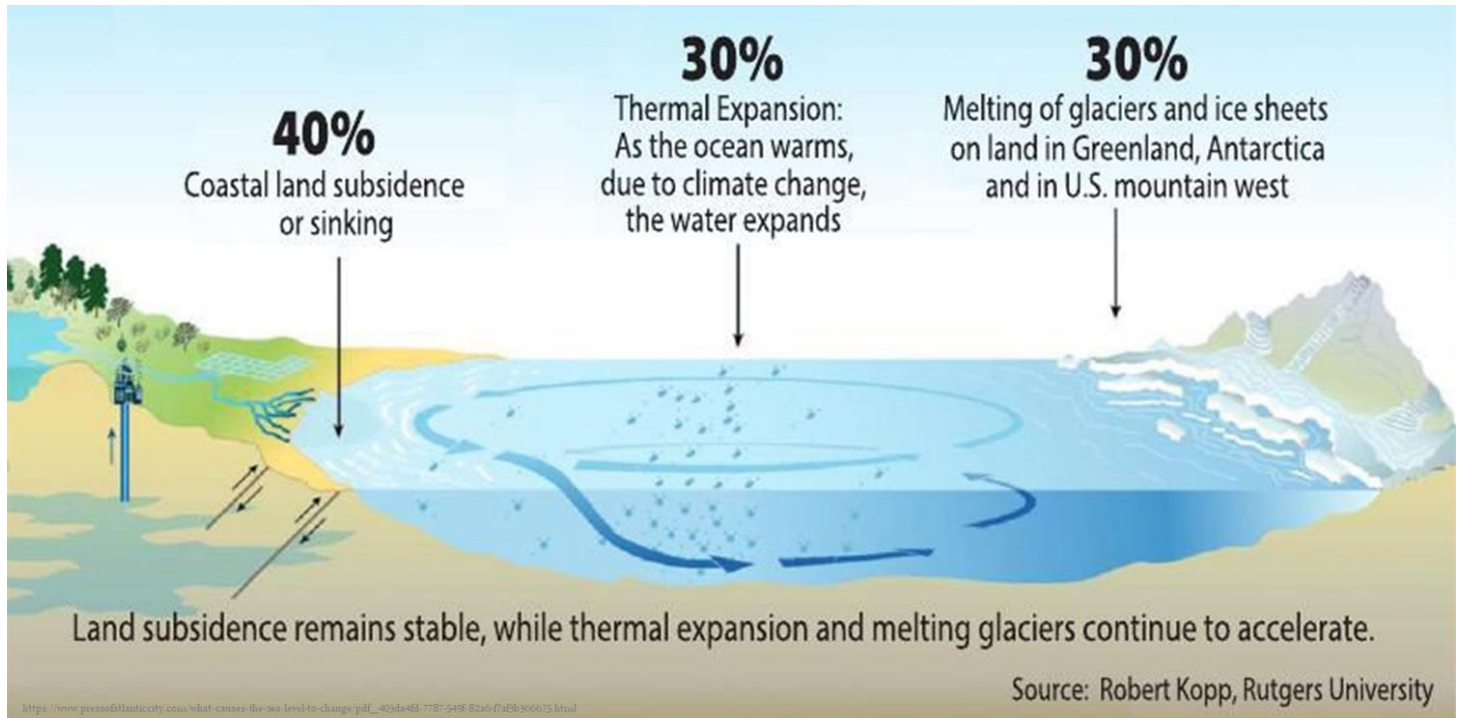
Most of the extra heat created by the additional greenhouse gases is being absorbed by the oceans. The oceans are huge so they are taking a long time to heat, but the extra warmth is causing problems for the living things that call it home, and changing the water moves around

## Where is global warming going?



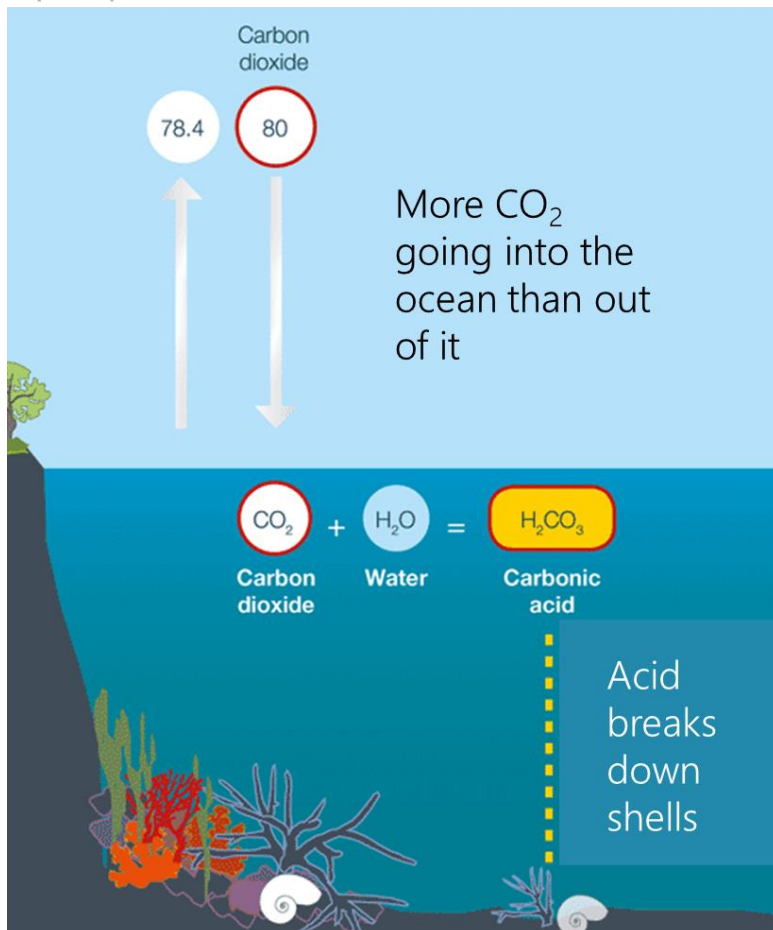
## What else causes the sea level to rise?

Thermal expansion from heating oceans also contributes to sea level rise, as the average temperature of the ocean risen 0.17°C in the past 40 years. The ocean water has a high capacity to absorb energy and, therefore, shows a slower increase in temperature than on land.



## Ocean Acidification

<https://coastadapt.com.au/ocean-acidification-and-its-effects>



CO<sub>2</sub> from human activity, is being dissolved into the ocean carbon sinks, causing *ocean acidification*. The *pH* (measure of acid) of the water is becoming more acid.

Acidification is harmful to many marine organisms, as most function optimally (the best) within a narrow range of pH. Many marine organisms, including shellfish and corals, have shells made of a compound called carbonate. The shells are being *neutralised* (a chemical reaction) by acid, which creates weak or breaking shells.



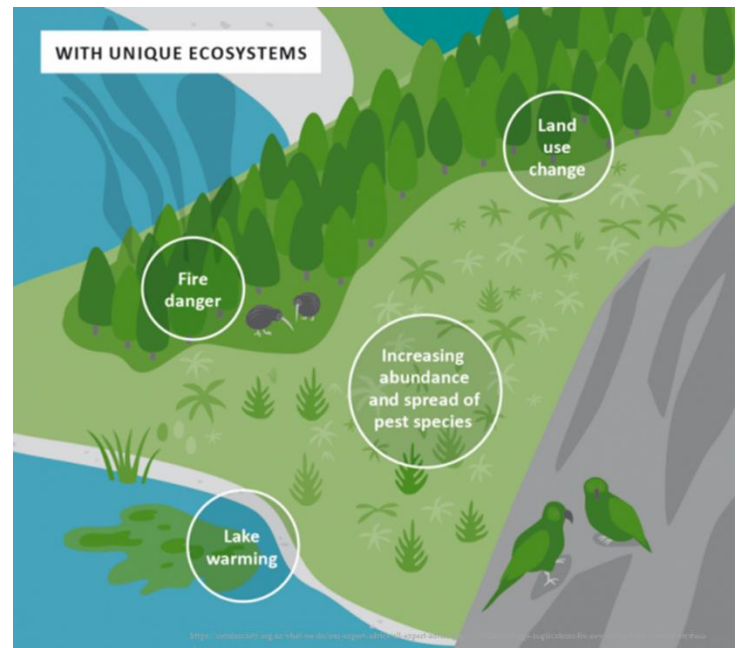
## Climate change effects ecosystems

New Zealand, like the rest of the world, is likely to experience climate shifts, and many endemic (that are not found anywhere else) species, already under threat, may face extinction, as they are unable to adapt to the rapid changes in their habitats.

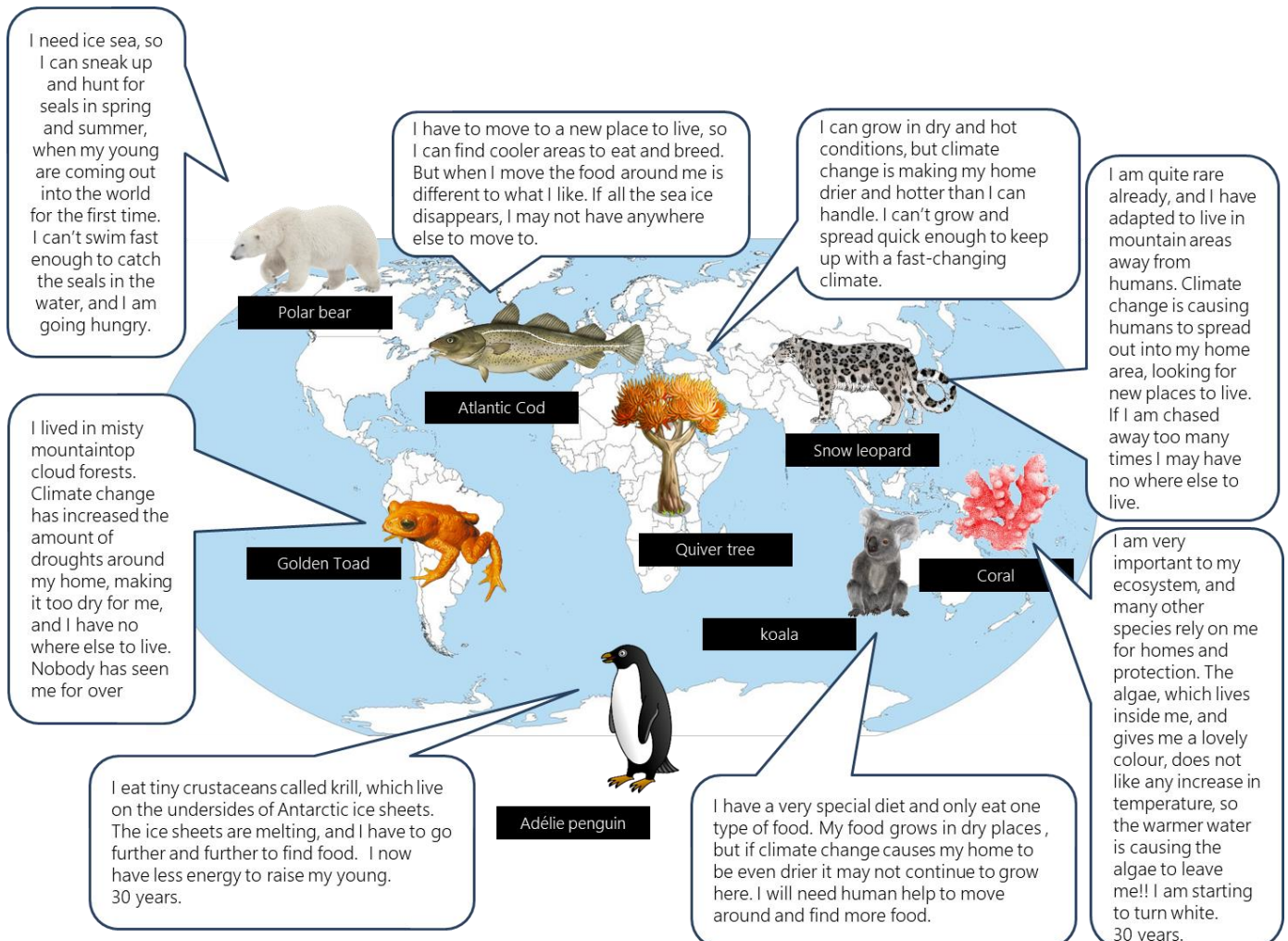
In NZ, we are likely to see ecosystem damage, habitat shifts for plant and animal species, and an earlier start of spring plant growth, migration, and mating events.

Pest species may travel into new areas and threaten our endemic species.

Human populations may have to move into areas that endemic species live.

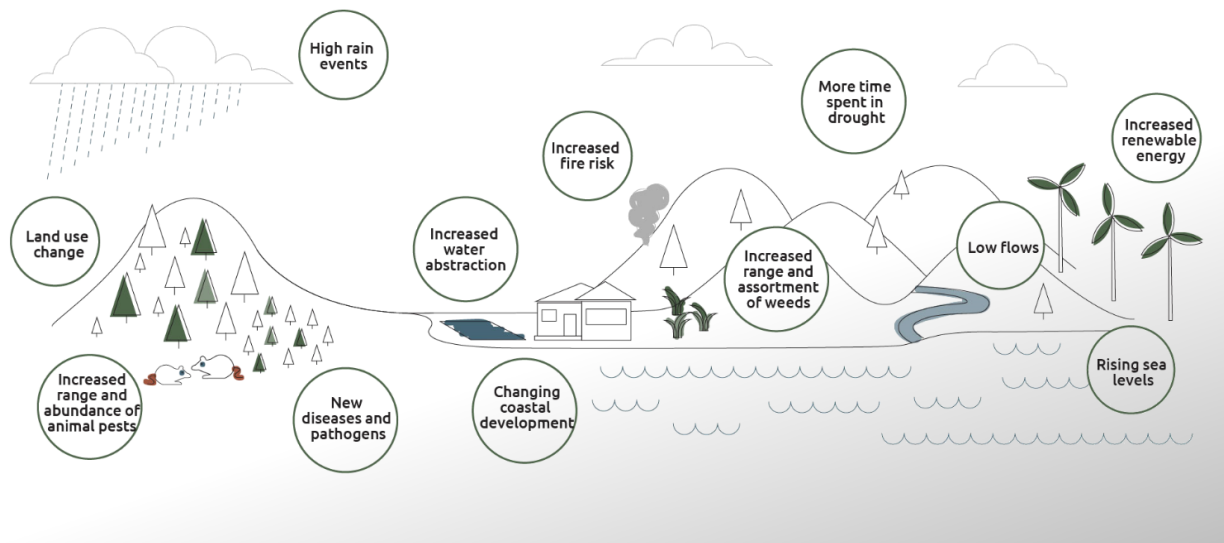


## Our World is changing

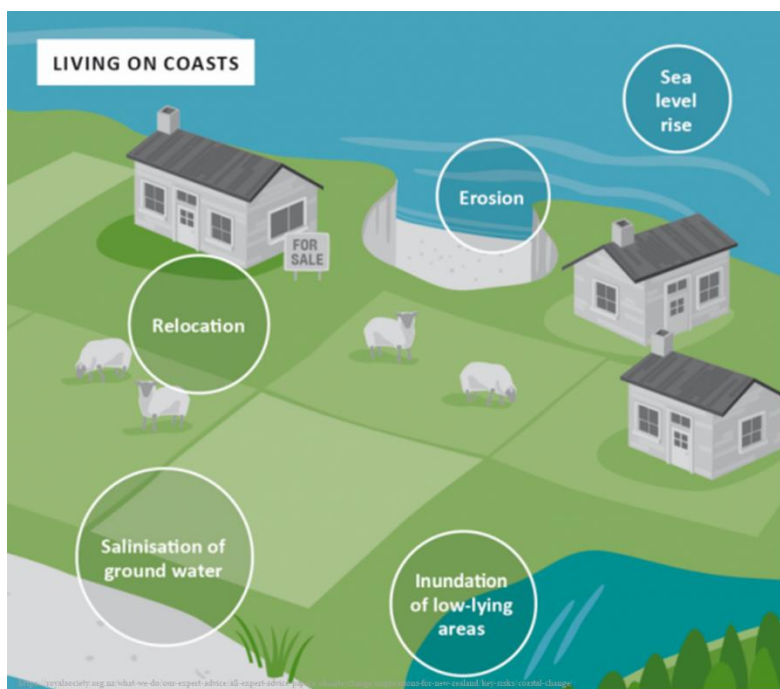


## Climate change effects human communities

Climate change will affect the way we produce our food, manage our land and water resources, as well as have an impact on the infrastructure (buildings and structures built for our use) that we rely on in our rural and urban communities.



New Zealand is an Island, and many of our human communities are close to the coast. Those communities are likely to experience multiple effects due to climate change.



Some communities may have to relocate further away from the coast. Barriers may have to be built to keep the water away from the towns.

Farms may have to move away from areas no longer suitable to grow food, and we may have to change the ways that we farm.

## Climate Change Adaptation Strategies

Adaptation helps us respond to future problems created by climate change. Every area, and population will face different changes in temperature, rainfall, sea level rise, and other factors. By starting projects to help solve immediate problems and making plans for possible future predicted issues before they arise, we can help humans and other living things cope better with the changes.

New Zealand has already begun planning for adaptation, that will help us avoid, live with, move away from, and protect against climate change impact.



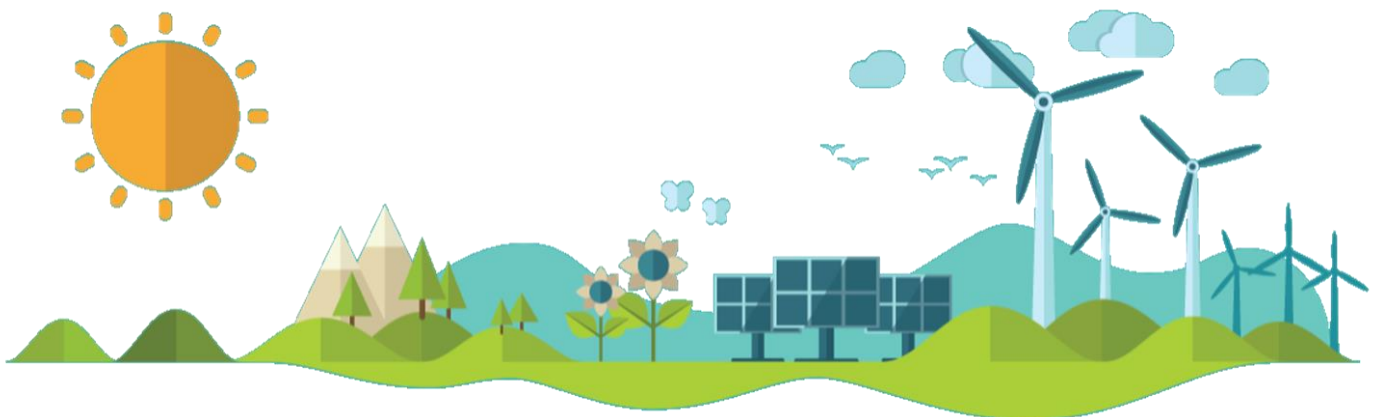
Examples of adaptation strategies include habitat protection, migration corridors between alternative habitats, and coastal planting. Preparation for more frequent extreme weather events could include relocating vital town resources such as power and water supplies to safer sites, building flood barriers, and running drills in response to possible future scenarios. Implementing adaptation strategies in New Zealand will involve working in partnership with iwi / hapū, and making the best use of local knowledge and Mātauranga Māori, to create feasible projects.



## Climate Change Mitigation

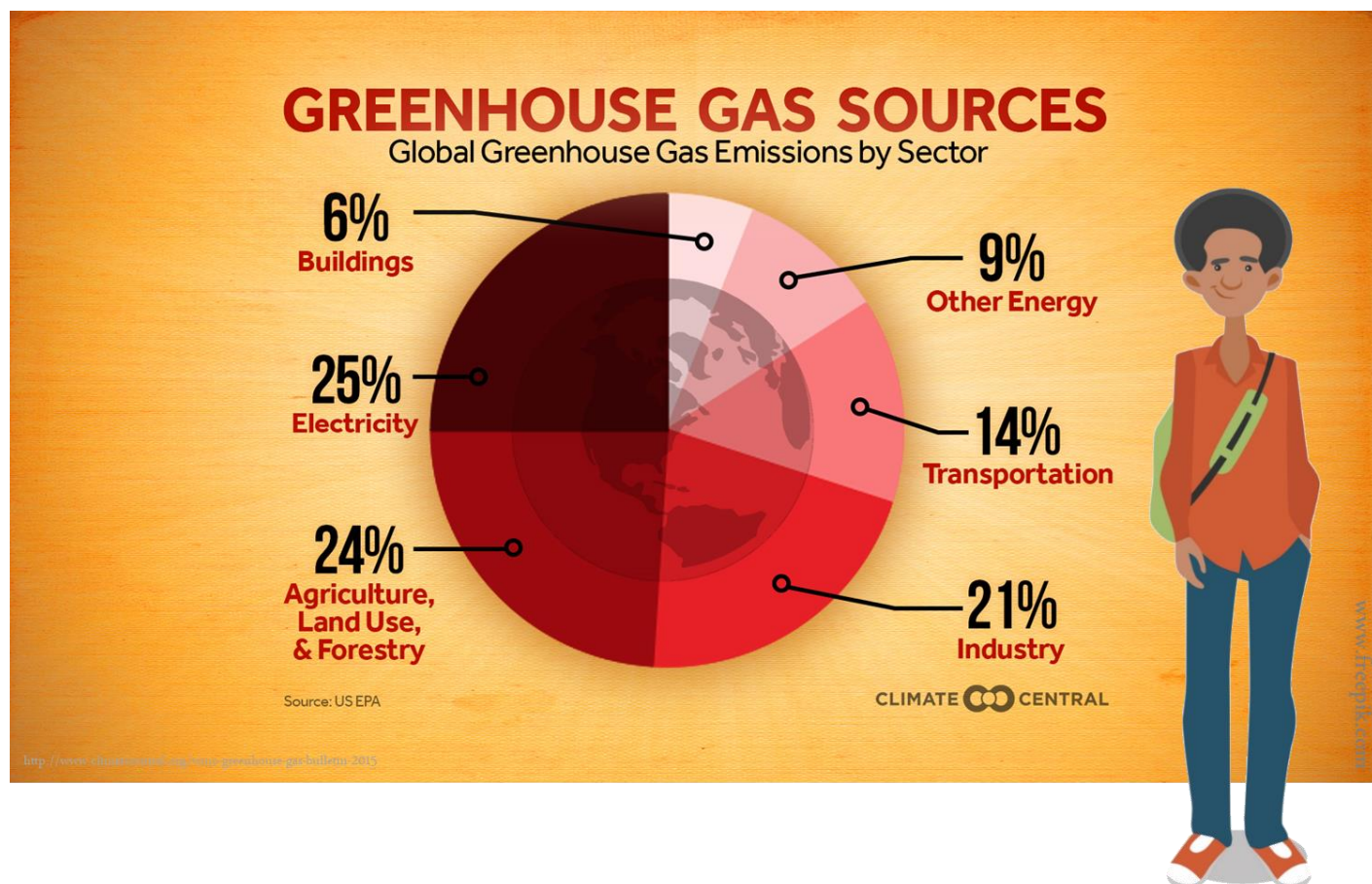
Adaptation can help us adjust better to the negative consequences of climate change, but does not prevent the underlying reasons why climate change is occurring.

*Mitigation* focuses on limiting or controlling the factors contributing to climate change. Mitigation projects can be started by countries, businesses, and individuals. These actions can reduce or prevent carbon dioxide emissions, the main cause of climate change, and this can include limiting energy use, developing alternative low carbon fuel, or sequestering (storing away) CO<sub>2</sub>, either natural methods or designing new technology.



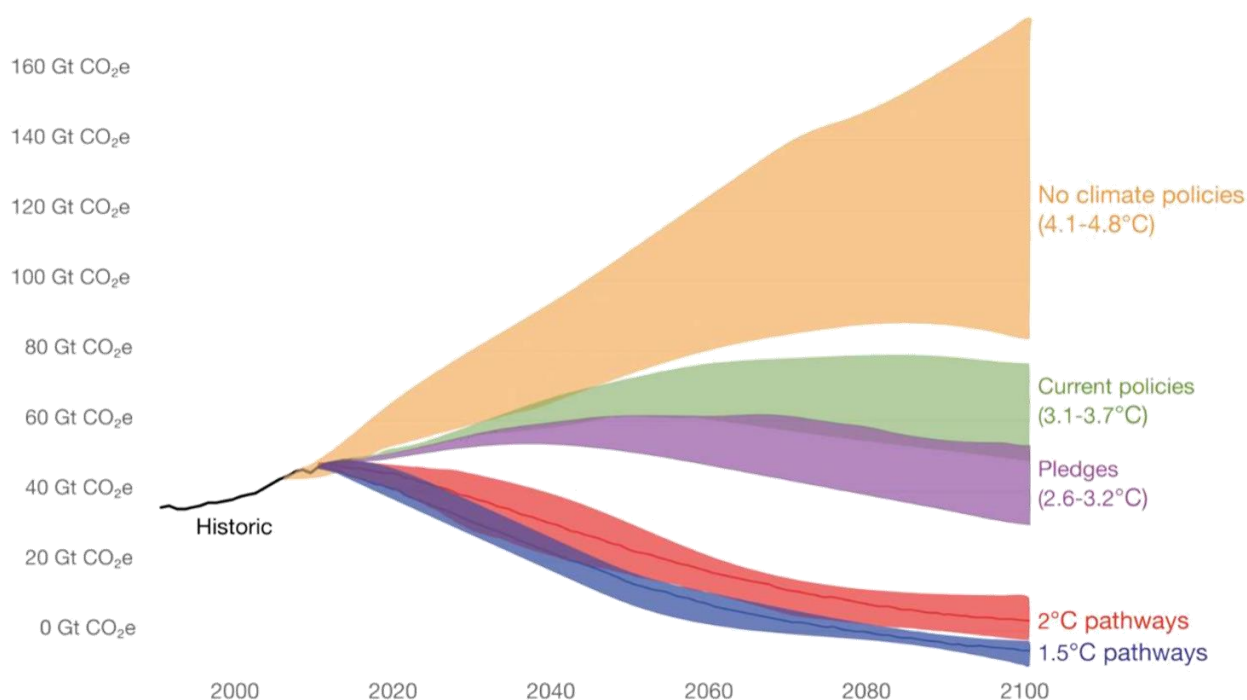


Who produces the CO<sub>2</sub> anyway?



## Possible Emissions in the future

The amount of carbon dioxide released in the future, and the resulting global temperature increase, is based on what mitigation steps we take in the very near future. To keep the temperature rise under 2°C, we will need to develop technology to remove CO<sub>2</sub> from the atmosphere



Based on data from the Climate Action Tracker (CAT).

The data visualization is available at OurWorldinData.org. There you find research and more visualizations on this topic.

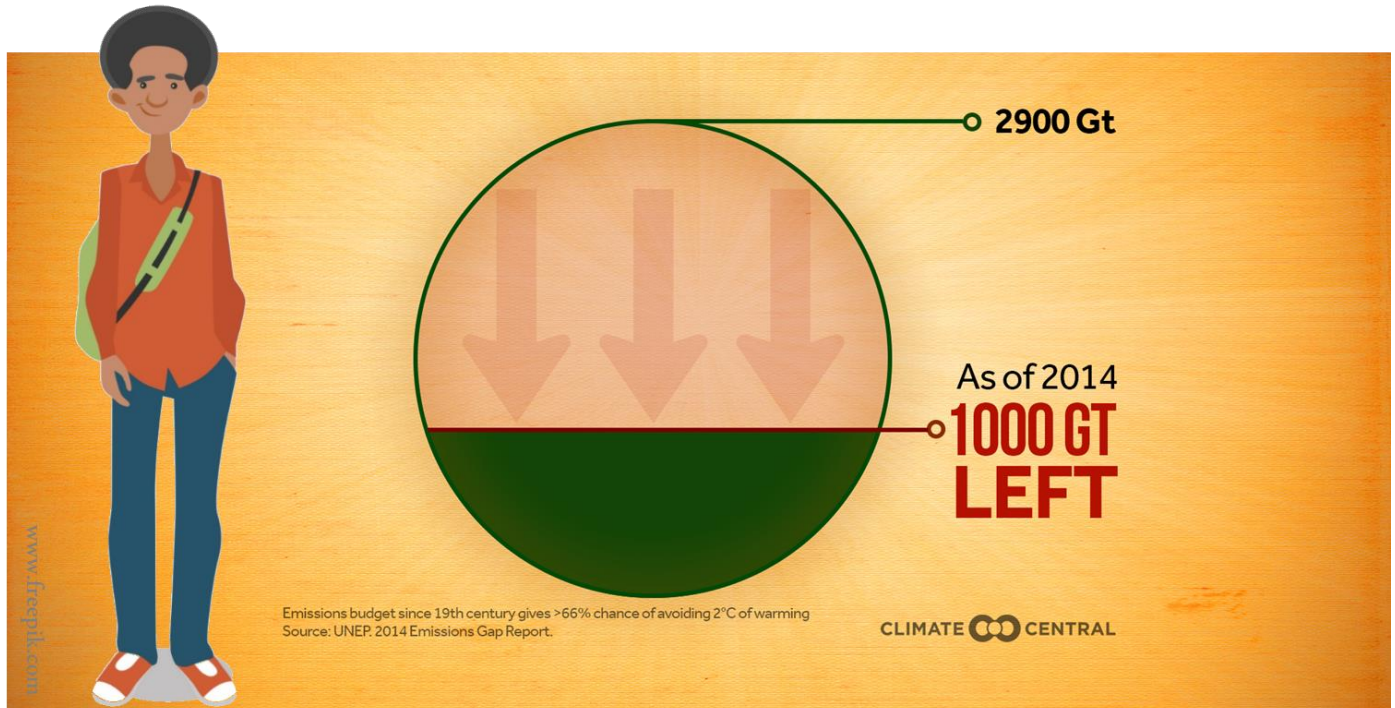
<https://ourplanet.com/global-warming-future-greenhouse-gas-emission-scenarios/global-future-greenhouse-gas-emission-scenarios/>

Licensed under CC-BY-SA by the authors Hannah Ritchie and Max Roser.

## What is the World doing about Climate change?

In 1997, most of the World's governments met together to agree on *the Kyoto Protocol* in 1997, and to reduce the amount of greenhouse gases they released by at least 5% by 2012.

In 2015 most governments (194 countries, including new Zealand) signed the *Paris Climate Agreement*, to reduce their greenhouse gases released so that the global temperature would remain below 2°C rise (above pre-industrial levels)



## What are carbon credits?

Carbon credits are given to 'developed' countries when they reduce their greenhouse gases (GHG). They are 'traded' away if they produce more GHG than agreed. They can be earned if they reduce GHG, or pay for a project in a 'developing' country to reduce their GHG, called 'carbon-offset programmes'

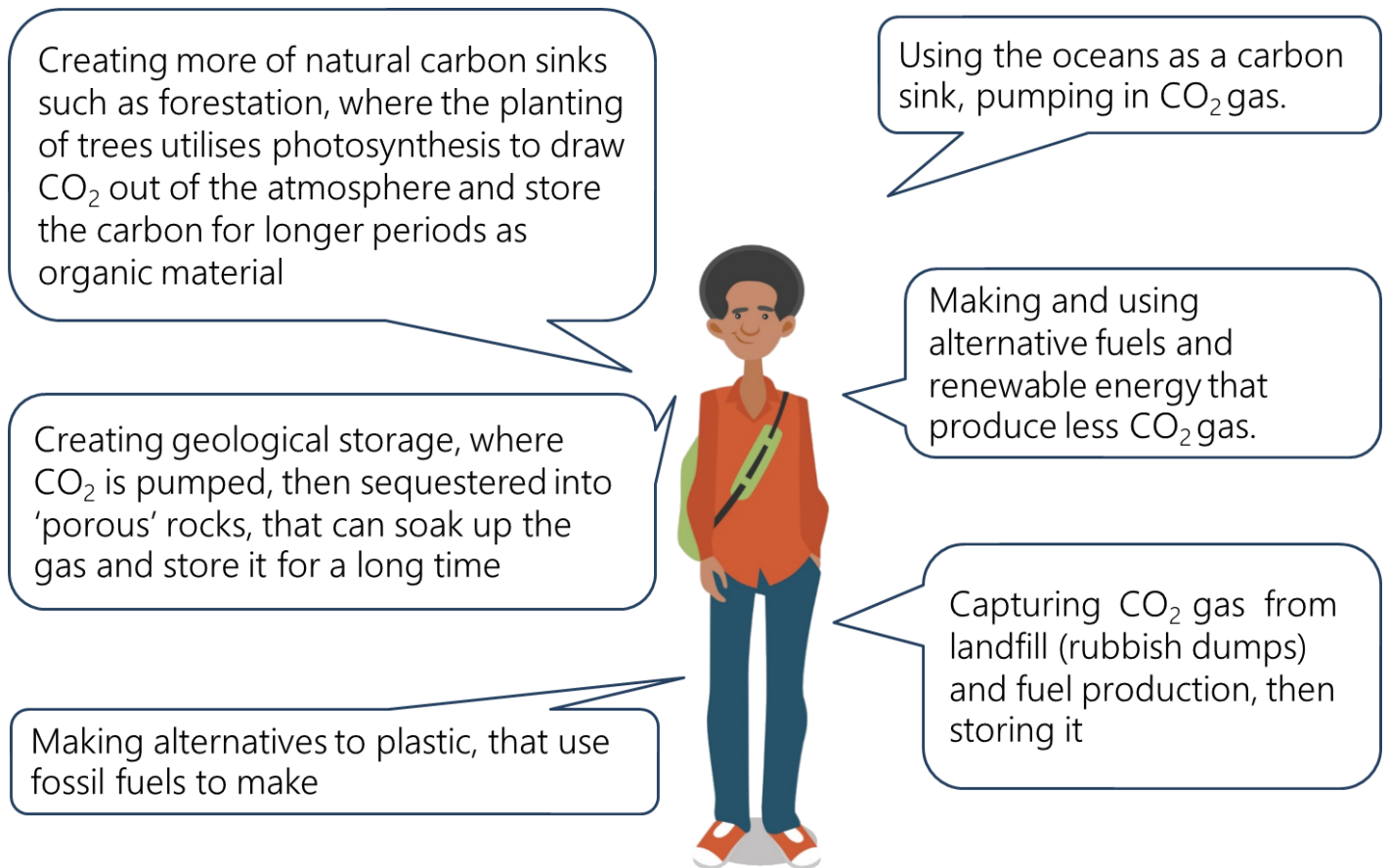
### How a Carbon Offset works.

1 CO<sub>2</sub> Offset = 1 Metric Ton of Carbon Dioxide Reductions



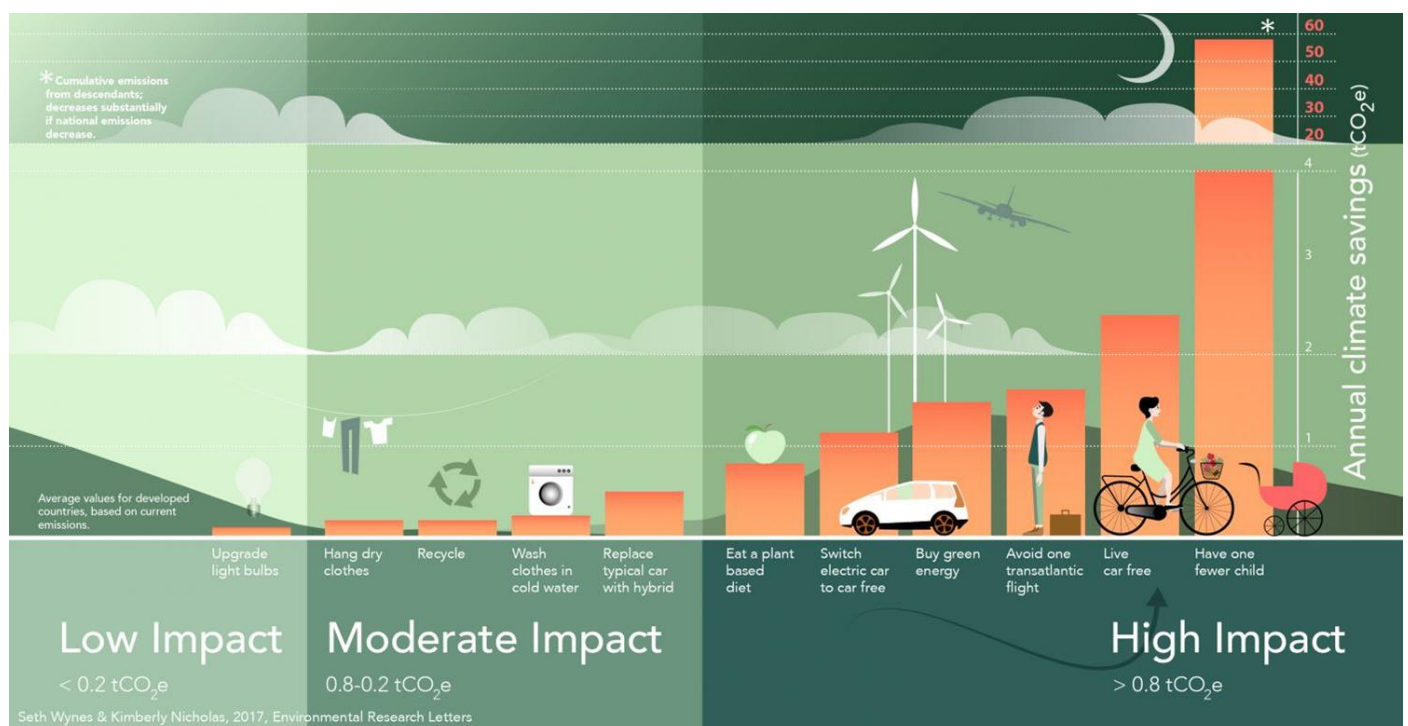


## Mitigation to reduce greenhouse gases



## What is a carbon footprint?

Industry and individuals have a role to play in mitigation by reducing their *carbon footprint*, the amount of CO<sub>2</sub> emitted each year during production or daily life. Individuals can contribute by reducing their own carbon footprint, in small ways such as tree planting, reducing the energy used in their homes, switching to alternative fuels in their vehicles, or becoming involved in community projects. All of these small ways add up to a big help!





## Summing up Climate Change

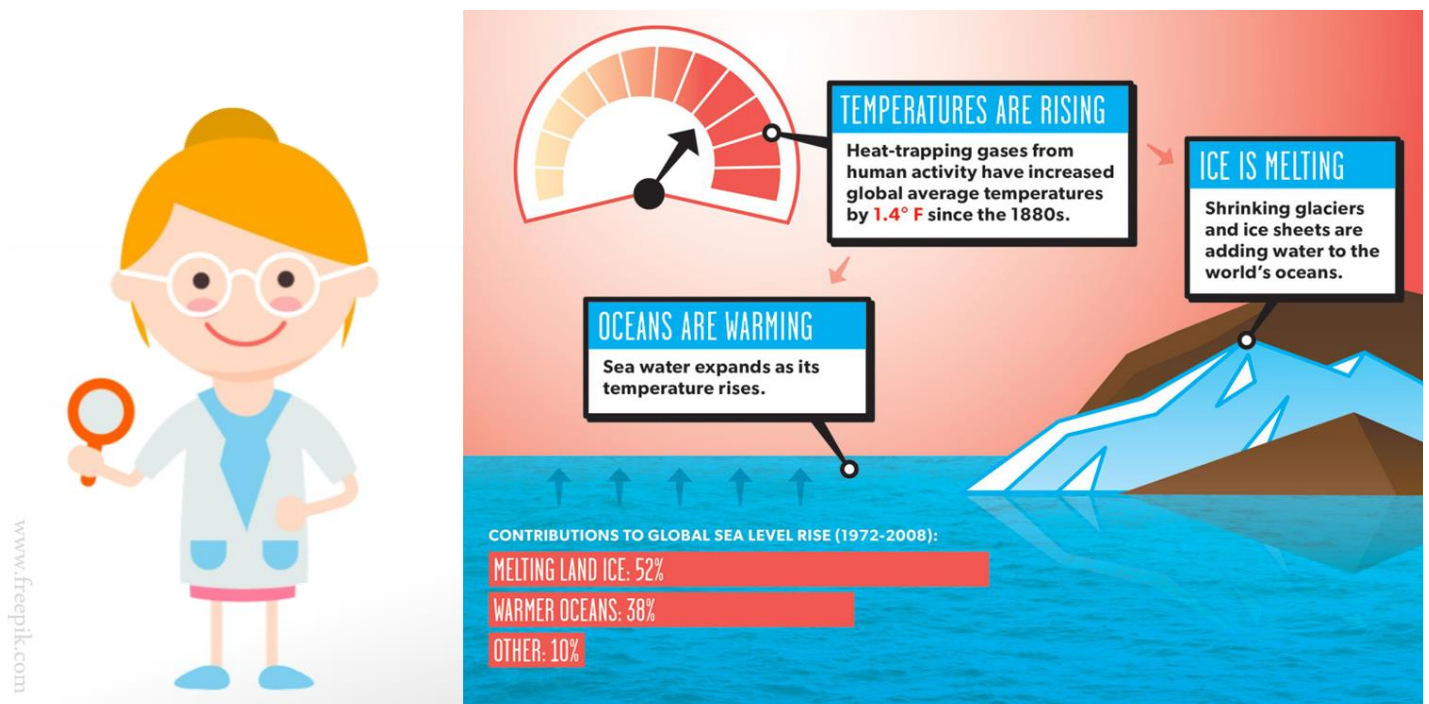
Almost all scientists now agree that human activity, producing CO<sub>2</sub> and other greenhouse gases, have changed the energy balance of the Earth, increasing the average temperature of the Earth, and this is permanently altering the climate around the globe. There is more carbon moving from other reservoirs of the carbon cycle into the atmosphere, than out of it, increasing the CO<sub>2</sub> concentration.

Observations, data and computer now predict more accurately that temperature rise, sea level rise, and an increase of extreme weather events are due to climate change.



The main reason for increasing CO<sub>2</sub> in the atmosphere is the combustion (burning) of fossil fuels for industry, transportation, and energy (electricity mainly) generation.

The greenhouse effect, due from CO<sub>2</sub> and other greenhouse gases, traps heat energy (originally light energy from the Sun), leading to a temperature increase on the Earth's surface. Increasing temperature is accelerating the melting of the cryosphere (frozen water on the Earth), causing the global sea level to rise.



The average temperature in the polar regions is rising quicker than the rest of the planet, partly due to *albedo* reduction, as darker ground under the ice becomes exposed by the melting snow and ice.

In addition, oceans are acting as a major sink of anthropogenic (human-made) CO<sub>2</sub>, and becoming acidified.

Governments, industry, and individuals are planning and initiating climate change *adaptation* projects to reduce projected harm to humans and ecosystems. Like many countries, New Zealand is also likely to experience a many consequences, and we must work with our communities to find the most appropriate solutions



Because current levels of human-made CO<sub>2</sub> will continue to cause a rise in global temperature, mitigation effects are required to reduce greenhouse gas emissions, Guidelines have been signed by many countries to help reduce greenhouse gas emissions, and therefore temperature increases.

