

Understanding climate change and sea level rise

Humans contribute to greenhouse gases... through the burning of fossil fuels and by altering the natural carbon cycle...

Regulating our climate

The Earth has an 'energy budget'. This is the amount of energy coming into the atmosphere (as rays of light from the sun) and the amount of energy being let out (as heat emitted from the Earth's surface). As some areas receive the sun's rays more directly than others, the planet tries to create a balance and distributes the heat energy around the globe.

Two connected systems function as the Earth's heat energy regulators - the climate and the ocean. Through ocean and wind currents, these systems move heat energy from place to place. The climate uses molecules of water in the air to do this.

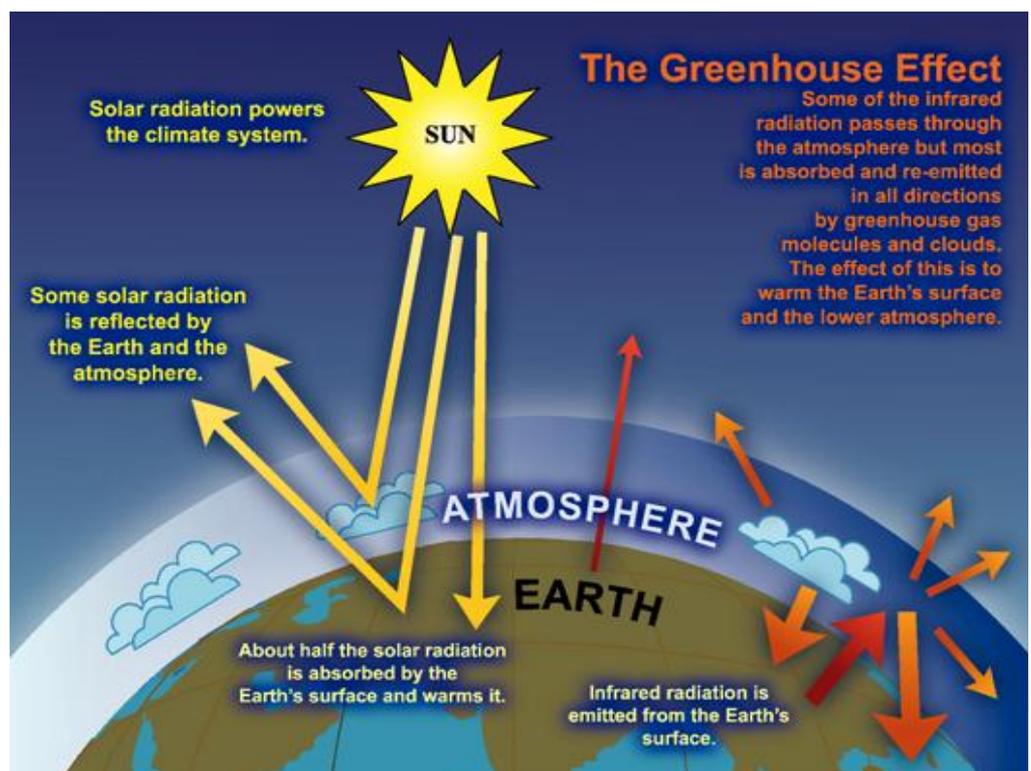
The composition and content of the Earth's atmosphere affects the amount of sun rays reaching its surface, and the amount of heat retained in the atmosphere.

When the temperature of the Earth increases, the regulating systems have to change in order to continue distributing its heat energy.

A changing climate

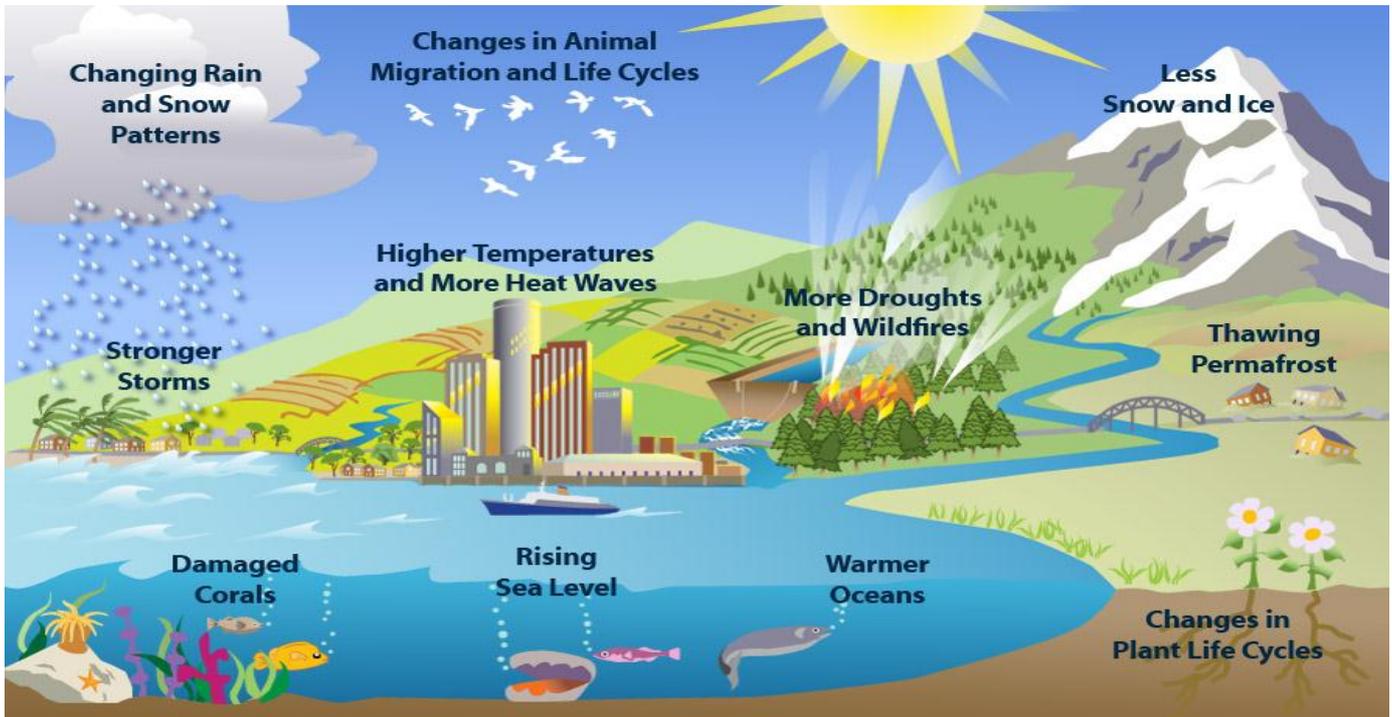
Throughout the Earth's lifetime, climate (average weather over a period of years) has varied considerably, from warmer periods to ice ages lasting thousands of years. We know this through analysis of climatic indicators found in fossils, coral, gas bubbles trapped in ice caps and tree rings.

Various factors can affect climate, including the sun's rays and the Earth's rotation and movement in the solar system. These factors are thought to have caused the long-term changes in climate. However, there are so many variations within these changes that there must also be other factors affecting climate over time.



A simplified model of the greenhouse effect

Source: AR4 IPCC



Climate change is already affecting many ecosystems around the globe
Source: www.epa.gov

The greenhouse effect

Greenhouse gases - Methane, water vapour, Oxygen, Carbon Dioxide (CO₂) and Nitrous Oxide - compose the Earth's atmosphere in the level closest to its surface. They all have their own global cycles and all absorb heat. When solar rays hit the Earth's surface, some are absorbed into the land and water. The rest are reflected back into space by surfaces like clouds and ice.

Like any object that sits in the sun, the Earth becomes warm and gives off heat. These heat waves are absorbed by the greenhouse gases in the atmosphere. This is called the 'greenhouse effect', and it allows all life to exist on Earth. However, if the proportion of greenhouse gases increases, more heat is absorbed and the atmosphere's temperature therefore increases.

A certain amount of each greenhouse gas exists in the Earth's atmosphere at a given time. The gas that absorbs the most heat is water vapour, but CO₂ remains in the atmosphere for much longer.

CO₂ is a combination of Carbon and Oxygen, and is absorbed and exhaled by living things. Carbon is reused and recycled naturally through the Carbon cycle, and life on earth is dependent on it.

Carbon that existed thousands of years ago in plants and animals is now stored in fossil Carbon. Technology has allowed us to dig up this fossil Carbon and burn it as fuel (oil, coal and gas). This process emits Carbon Dioxide, amongst other pollutants.

Humans are therefore contributing to the concentrations of greenhouse gases by releasing additional Carbon through the burning of fossil fuels. We also alter the natural Carbon cycle by removing natural resources that absorb or store Carbon, such as forests and peat soils.

The effects of a changing climate

Although the Earth's climate has always gone through changes, the rate of change is now more rapid than it has ever been – up to 10 times faster than in any period in the last 65 million years.

These rapid changes are creating an imbalance in the global systems. Changes in weather patterns – such as warmer, wetter winters and more frequent extreme events like storms and heavy rainfall - are a signal of this imbalance.

While the causes of this rapid change remain uncertain, strong evidence points towards a direct link between the high increases in greenhouse gases (especially CO₂) and the increase in global average temperatures.

Sea level rise

As global temperatures rise, the sea absorbs more heat from the atmosphere, causing thermal expansion and rising sea levels. Additional water from melting polar ice caps, ice sheets and glaciers also has an impact. Satellite measurements for the past ten years show that sea levels are rising by around 3mm a year.

In the UK, sea level rise goes hand in hand with rebalancing vertical land movement, particularly in easterly coastal lowland areas. These factors, combined with the impacts of climate change, will increase the risk of coastal erosion and flooding.

Future change

Climate science has been evolving for decades, studying evidence from the past and using complex computer modeling to simulate the Earth's climate system and create likely future scenarios. This information will help society to make behavioural changes to minimize future adverse impacts, and to adapt to the inevitable changes that will occur.

Useful websites:

<http://www.cru.uea.ac.uk/information-sheets>
http://ipcc.ch/publications_and_data/ar4/syr/en/mains2-2.html
<http://www.metoffice.gov.uk/climate-change/guide/science/explained>