



THE IMPACTS OF CLIMATE CHANGE

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Global warming has already caused our planet to heat up by around 1°C. This warming is causing a huge range of impacts. For example, heat waves are becoming more severe and affecting humans and animals; in some places, rivers are flooding more frequently due to heavy rainfall; droughts in other parts of the world are affecting crops. These changes can have a huge effect on people, making it difficult to grow food, find shelter, and avoid dangerous weather such as storms and heat waves. Many people have needed to leave their homes to search for safer places to live because the climate has changed so much. While all countries are affected by climate change, different countries face different impacts. By understanding these impacts and how vulnerable people are to climate changes, it is much easier to prepare for future changes and protect against them.

WHAT ARE THE IMPACTS OF CLIMATE CHANGE?

Our planet is a very complex place, made up of lots of different systems that all link together. These interrelationships mean that a

CLIMATE SYSTEM

The inter-linked system that affects our climate. This includes the atmosphere, water cycle, ice, rocks, and all living things.

Figure 1

The center of the circle shows the drivers (causes) of climate change. The middle ring illustrates the changes that climate change can have on Earth's climate system. The outer ring shows examples of the impacts these climate changes can cause.

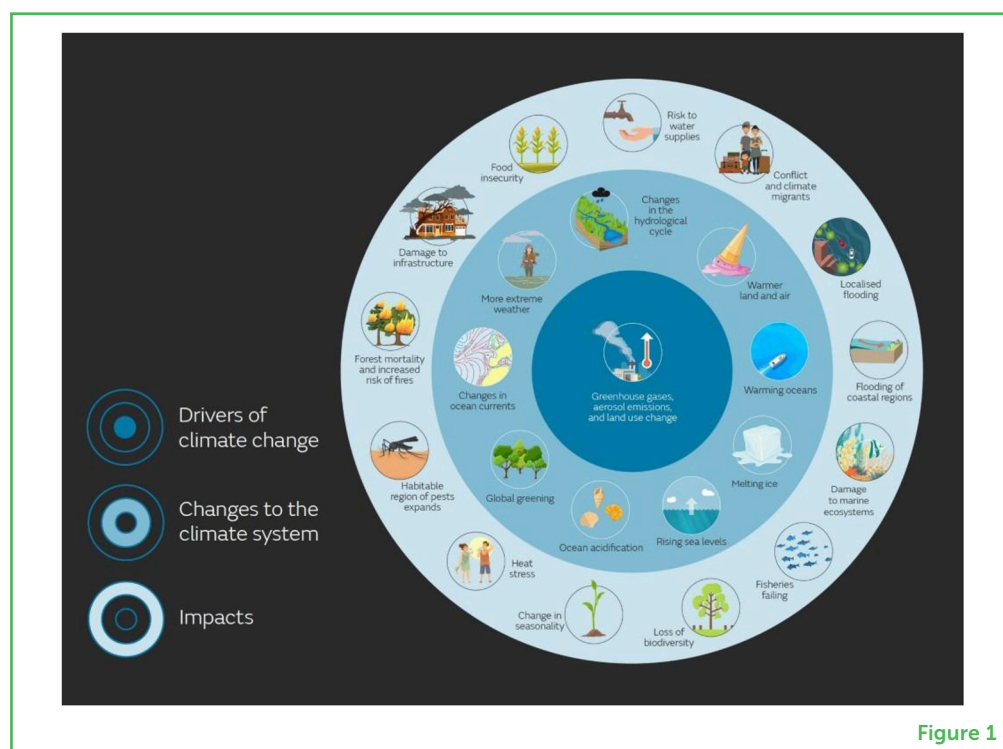


Figure 1

GREENHOUSE GASES

Gases in the atmosphere that trap heat from the sun at the earth's surface. These include carbon dioxide, methane, and nitrous oxide.

HYDROLOGICAL CYCLE

Water evaporates from rivers, lakes, soil and plants into the atmosphere, where it forms clouds, and falls to earth going back into rivers, lakes, and the sea.

When we talk about the impacts of climate change, we are talking about how people's lives and the ecosystems they depend on are affected as the world gets warmer. For example, farmers growing crops depend on the right amount of rain, sunlight, and warm temperatures to produce food. People and animals need clean, fresh drinking water at all times of the year, even during dry spells. Many people must also live through extreme weather events such as heat waves, droughts, **Hydrological cycle** fires, and flooding each year. In the last 30 years, we have seen that climate change has already affected many of these aspects of our lives, sometimes in good ways, but more often in bad ways.

GLOBAL AVERAGE TEMPERATURE

Thermometers around the world are used, on land and sea, to observe the average temperature on a particular day. We even estimate the temperature in places where there are not thermometers.

HEAT STRESS

When it is so hot and humid outside that it causes your body to over-heat. When this happens we need to sit down in the shade and drink water.

HOTTER TEMPERATURES

Although our planet has warmed by about 1°C over the past 100 years [1], this does not tell the full story. Some parts of the world have warmed by much more than this, while others have warmed less. For example, the North and South Poles are the coldest places on Earth, and they are heating much more quickly than the rest of the planet. Since 2000, observations have shown that the Arctic has warmed at double the rate of the **global average temperature**.

Higher temperatures have a range of impacts at the poles. For example, snow and ice normally melt in the summer and then refreeze in the winter. Warmer temperatures are causing ice to melt more quickly and to freeze more slowly, meaning that the total amount of ice in the Arctic is shrinking. Ice shrinkage is leading to even more warming, because darker land and seawater absorb more heat from the sun than the white snow cover does—snow and ice usually reflect sunlight back into space. Water from the melting ice is also flowing into the ocean, adding to sea-level rise.

Rising temperatures can also affect wildlife. Global warming means that habitats for species such as polar bears, reindeer, and caribou are changing—often making it harder for them to find food [2]. As the world gets warmer, many species may have to move to find food, or otherwise adapt to changes in the seasons. For some species, adapting to climate changes might not be a problem, but other species are expected to struggle to find new places to live. Hotter temperatures also affect people around the world—through heat waves, for example. Hot days are getting hotter and more frequent, and cold days are becoming less common. Heat waves can cause some people, particularly those who have other health issues, to suffer from **heat stress**, which means their bodies overheat and they feel ill [3]. High humidity, high night-time temperatures, and poor air quality can also cause health problems during heat waves. Heat waves do not affect everybody in the same way though. For example, people who work outdoors, those who have breathing problems, and the elderly may suffer the worst impacts of heat stress.

FIRE AND DROUGHT

Many parts of the world naturally experience dry seasons when little to no rain falls for many months or even years. During these periods, grass, shrubs, and trees can become very dry. When this happens, it may take just a small spark to cause a big fire that stretches for many kilometers. Hotter temperatures mean that water evaporates faster, causing vegetation to dry out more quickly and making dry seasons even drier. On top of this, higher levels of carbon dioxide in the air help plants to grow, which creates more vegetation to burn when there is a fire.

Higher temperatures and changing rainfall patterns mean that dry seasons in some parts of the world, like North America, Europe, West and Southern Africa, and Australia, are expected to become longer and even hotter. This means that, in these areas, there is a greater chance of damaging wildfires like the ones seen in Australia in 2019–20, and California in 2020.

FOOD AND WATER

As climate change causes the air temperature to increase, the air can hold more water. This means that when it rains, the rainfall is much heavier! However, in some places, it also means that rainfall is happening less often, making dry spells longer. Lack of rain puts dry places at risk of not having enough freshwater available for drinking. In these situations, the ground can dry out, crops may not get enough water to grow well, and people may need to limit their water use. When it finally does rain, the dry ground is often too hard to soak up the water easily, which can cause flooding. Flooding also damages crops.

All people depend on growing or buying enough food to survive. This is called **food security** [4]. Climate change can affect food security in lots of ways. For example, warmer temperatures, more rainfall, and more carbon dioxide in the atmosphere are generally better conditions for plants to grow in. In areas where these changes happens, crops may produce *more* food which can either be eaten by the people living in those regions, or can be sent to places where it is needed. While the entire Earth will see increases in temperatures and carbon dioxide, it is more difficult to say which areas will see an increase in rainfall.

Livestock, such as cows, pigs, and chickens, can also be affected by hotter heat waves the same way that humans are. Crops can die during heat waves, leaving some people without any food. Some farmers might be able to plant more heat-resistant types of crops or build shelters to protect their animals. However, farmers need money to do these things, and so those in poorer areas may find it more difficult to protect their crops and animals.

CONCLUSION

In summary, climate change can affect people either directly, through more intense heat waves, more frequent and intense fires or long periods of drought, but also indirectly by affecting the ecosystems that provide us with food and water. This is important because as the climate continues to change in the future, many people, especially those in poor countries, are likely to experience the worst effects of climate change. In order to help these countries reduce poverty and reduce the impacts of climate change, all the countries in the United Nations' have agreed to follow Sustainable Development Goals which

FOOD SECURITY

A way of describing how certain you are that there will always be food available to eat.

aim to make sure that everybody will have access to clean water, zero hunger and sustainable use of land in the future. By following these goals, and by taking action on climate change, countries hope to be able to end global poverty, become more sustainable, and limit the impacts of climate change.

REFERENCES

1. Morice, C. P., Kennady, J. J., Rayner, N. A., Winn, J. P., Hogan, E., Killick, R. E., et al. 2021. An updated assessment of near-surface temperature change from 1850: the HadCRUT5 data set. *J. Geophys. Res. Atmos.* 126:e2019JD032361. doi: 10.1029/2019JD032361
2. Pagano, A. M., and Williams, T. M. 2021. Physiological consequences of Arctic sea ice loss on large marine carnivores: unique responses by polar bears and narwhals. *J. Exp. Biol.* 224:jeb.228049. doi: 10.1242/jeb.228049
3. Matthews, T. K. R., Wilby, R. L., and Murphy, C. 2017. Communicating the deadly consequences of global warming for human heat stress. *Proc. Natl. Acad. Sci. U. S. A.* 114:3861–6. doi: 10.1073/pnas.1617526114
4. Richardson, K. J., Lewis, K. H., Krishnamurthy, P. K., Kent, C., Wiltshire, A. J., and Hanlon, H. M. 2018. Food security outcomes under a changing climate: impacts of mitigation and adaptation on vulnerability to food insecurity. *Clim. Change* 147:327–41. doi: 10.1007/s10584-018-2137-y

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YOUNG REVIEWER



ALMA, AGE: 13

My name is Alma. I am 13 years old and I have three sisters and a brother. We also have six hens and one cat. In my sparetime I spend a lot of time playing handball. My favorite subject in school is mathematics.

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I am a weather and climate scientist currently working on improving our understanding of the impacts of climate change on people and ecosystems. I am especially interested in using satellite observations to evaluate and improve our models, particularly in developing countries. *andrew.hartley@metoffice.gov.uk



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I am the climate science journalist at a company called "Carbon Brief." Most days, I read scientific papers and talk to climate experts, so I can write interesting articles about climate change. This is a great job for me, because I love learning about exciting new science and sharing important information with other people! I also spent 2 years working at the UK Met Office as a "climate science communicator." In my free time, I like dancing, yoga, and reading.

