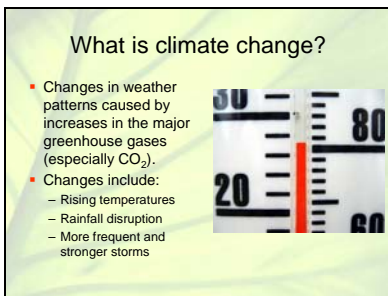


Plants and climate change – an introduction



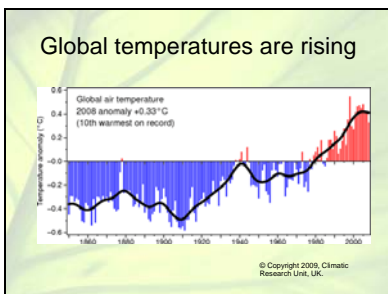
Slide 1



Slide 2

Climate change is happening because the quantity of so called ‘greenhouse gases’ in our atmosphere is increasing every day. While this cocktail of gases includes water vapour, methane, nitrous oxide and ozone, the most important of them is carbon dioxide, CO₂. The evidence that human activity is responsible, directly or otherwise, for these emissions is overwhelming.

Although the terms are often seen as interchangeable, it’s more accurate to talk about **climate change** rather than **global warming** because, while it’s true that global temperatures are rising, their rate of increase is not the same everywhere on Earth. Climate change embraces events like changes in cloud cover, rainfall, drought, storms and temperature variations. It describes phenomena such as the increased frequency and intensity of tropical storms or the emergence of new weather patterns around the world.



Slide 3

Global temperatures are rising because of the ‘greenhouse effect’, which locks in the heat from our planet and prevents it escaping into Space.

The Earth operates a natural temperature control system that protects it from the worst effects of the Sun’s, or solar, radiation. About a third of the solar radiation that hits the Earth is reflected back to Space. The rest is largely absorbed by land and the oceans. As the Earth heats up, it emits infrared radiation that is prevented from escaping by greenhouse gases, leading to increased atmospheric temperatures.

Our graph shows the combined global land and marine surface temperature record from 1850 to 2008. The year 2008 was tenth warmest on record, exceeded by 1998, 2005, 2003, 2002, 2004, 2006, 2001, 2007 and 1997. This time series is being compiled jointly by the Climatic Research Unit and the UK Met. Office Hadley Centre.

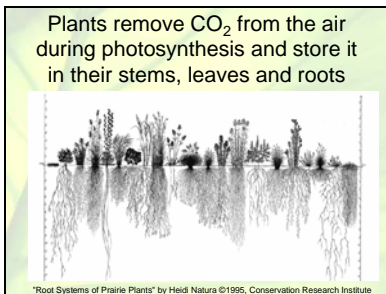
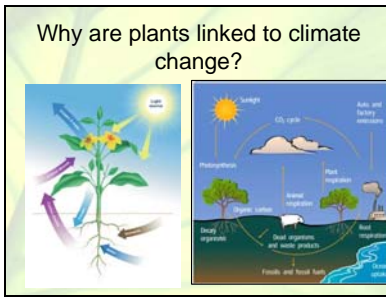
Slide 4

While plant life cycles are linked to all the major greenhouse gasses, we're going to focus here on probably the most important – carbon dioxide.

The picture on the left shows how photosynthesis works, while the picture on the right describes the wider carbon cycle.

Plants extract CO₂ from the air by way of a process called photosynthesis and, using sunlight and water, they convert it into carbohydrates. This is the foundation of the food chains that enable all living things to exist and grow.

Our diagram shows how photosynthesis is the only biological process for **removing** carbon dioxide from the atmosphere. However, many processes **add** CO₂ to the atmosphere – from factory emissions and the decay of plants and animals to fundamental biological activities like human, plant and animal respiration.



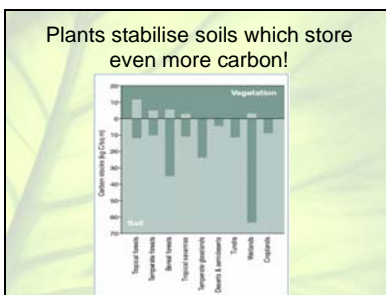
Slide 5

Photosynthesis enables plants to convert atmospheric carbon dioxide into solid carbon-based products, such as leaves, stems and roots, which in turn provide the food and raw materials essential to our survival.



Slide 6

Enormous quantities of carbon are stored in tropical forests, forming some of the world's most important carbon 'sinks'. Cutting down these forests not only destroys the potential of their trees to absorb more carbon dioxide, but also releases the carbon stored in leaves, trunks and roots to return to the atmosphere as carbon dioxide, pushing greenhouse gas emissions even higher.



Slide 7

The highest levels of carbon are actually contained in wetland soils, especially peatlands, which alone are estimated to store twice the carbon present in the forest biomass of the world. Moreover, unlike forests, their carbon storage or sequestration is very long term. Boreal (northern) forests and temperate grasslands also store significant quantities of carbon.

Plants are important:

- They provide food for us

Slide 8

Here we see a woman harvesting rice in India, vegetables on display in the UK and typical processed foods, pizza and tinned baked-beans, that derive directly from plants. Over 30,000 plant species worldwide are edible.

Plants are important:

- They provide food and shelter for animals

Slide 9

In order to protect rare and endangered species such as this tiger, their habitats must be protected from human interference and destruction.

Plants are important:

- They provide medicines and healthcare

Slide 10

Native to Africa, Aloe is remarkably versatile, providing skin and burn treatment and also acting as an effective skin moisturiser. It's estimated that 80% of people in the developing world rely on traditional medicine for their healthcare. Much of this medicine comes from plants. Many modern prescription drugs also originate from plants. Aspirin, for example, was originally derived from the willow tree. And the world's most popular cancer drug, taxol, has been manufactured from the highly poisonous yew tree.

Plants are important:


- They provide wood for building and fibre for clothes

Slide 11

Without cotton and timber, our world would be a very different place! Cotton is still the world's most commonly used fibre. Just think about what you're wearing now. The chances are that cotton is involved somewhere. Timber is among humankind's most ancient and useful natural materials, still used widely for building and industry

Climate change threatens plants

- In order to grow, plants need:
 - Water
 - Carbon dioxide
 - Sunlight
 - Nutrients
 - The right temperature
- All these will change with climate change




Slide 12

While plants can help to reduce the effects of climate change by absorbing carbon dioxide, the survival of many is also threatened by the consequences of climate change.

Plants need the correct growing conditions in order to survive and flourish. Climate change is putting these at risk.

In response to climate change, plants can:


- Move – to where the climate is suitable
- Adapt – to the new climate
- Become extinct



Slide 13

As global temperatures rise, plants may try to move to cooler areas (**migrate**), or they alter their behaviour to cope with the new climate conditions (**adapt**). If they are unable to do either, they will ultimately die out and become extinct

Move



Slide 14

Where will plants move to?

As temperatures get warmer, plants can:

Move higher up mountains

Move away from the equator (move north in the northern hemisphere)

It has already been observed that the Arctic treeline in Alaska is moving northwards – this is attributed to rising air temperatures, which are higher than elsewhere

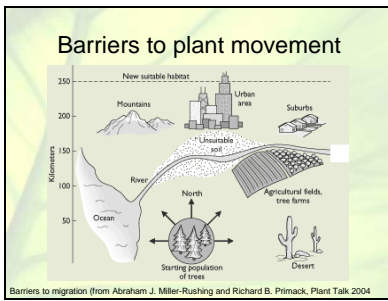
How can plants move?

- Seed dispersal (wind and animals)
- Human movement



Slide 15

Some plants may be dispersed over large distances by animals and by the wind, but it is pure chance if they find a suitable place to grow. Many plants cannot, or do not, move in this way.



Slide 16

Even if plants and seeds are dispersed, finding suitable habitats remain an immense challenge for them, as is graphically illustrated in this slide. Barriers to successful dispersal include: oceans and seas, agricultural land, towns and cities, mountain regions and other areas unsuitable for plants life. In the UK, for example, spreading urban development and intensive agriculture make it increasingly difficult for wild plants to move from one area to another.



Slide 17

Mountain-top and island species are most at risk from climate change because, ultimately, they will have nowhere else to go. Other 'at risk' species include plants with narrow or highly specialised habitats, as well as those that depend closely on another species, which may move or adapt to change at a different rate.



Slide 18

How can plants adapt to climate change?

The picture shows some examples where earlier flowering has been observed in response to climate change. In Japan, cherry trees are now flowering earlier than ever recorded while, closer to home, British spring flowers such as snowdrops, daffodils and crocuses are consistently flowering earlier.



Slide 19

Climate change impacts are affecting us already, sometimes in ways that we don't at first realise. Take the blackcurrant, which needs a frost to ensure that its berries ripen properly. These days there are fewer frosts and this has led to a big decline in blackcurrant harvests. The manufacturers of Ribena have spent millions of pounds and many years developing new varieties of blackcurrant that do not need a frost.

But...

- Not all species will adapt to climate change at the same rate
- Plants that flower too early may 'miss' their pollinators
- Migrating birds might not have a food supply where they expect it

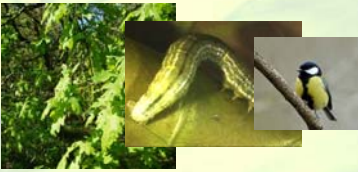


Slide 20

Plants are the foundation of habitats and the base of food chains and ecosystems. So if plants are being forced to adapt, then the insects and animals that rely on them have to change too. But will they, or can they, respond in the same way and at the same time, so that food chains remain intact and habitats for animals survive?

If species that traditionally rely on each other (**co-exist**) no longer occur in the same place or time, both may be driven to extinction.

Foodchain disruption



Slide 21

Take the oak tree, which is at the beginning of a food chain. It comes into leaf in response to temperature and light levels. At the same time, the winter moth caterpillars emerge and eat the young oak leaves. The Great Tit's eggs hatch to coincide with the supply of caterpillars. The chicks have about two weeks to eat as many as they can after hatching and they need to consume about 70 caterpillars a day.

A long-term study has shown that all three species are now mismatched: the oak is leafing too early, so that when the caterpillars emerge there is not enough for them to eat and Great Tit chicks are facing a caterpillar shortage.

All of life based on these chains and interactions – and climate change is starting to disrupt them.

Become extinct



Slide 22

The third option for plants is extinction.

There are around 350,000 known plant species in the world. By the end of this century, half of all these species may become extinct.

And once a species is extinct it is lost forever.

This is what happened to the dodo, a flightless bird from Mauritius that probably vanished before 1700 and exists now only in drawings, some written accounts and museum exhibits.

These plants are almost extinct



Slide 23

These plants are no longer found growing wild, but are not extinct only because they grow in botanic gardens.

A significant number of plant species are 'extinct in the wild', but quite common in cultivation. Because they are maintained in places like botanic gardens, it is possible that they can one day be returned to the wild.



Slide 24

By conserving plants:

- We help to reduce the impact of climate change
- We help to secure our food supply for the future
- We help to provide a secure home for many animals



Slide 25

We are able to store plant seeds in seedbanks to ensure they're available to future generations.

We can take action to protect surviving forests and also plant new forests where they have been cut down.

We can reduce our carbon footprint by changing our lifestyles, especially reducing our energy consumption and making it more sustainable. We can also cut down on the amount of waste we create. Reduce, Renew, Recycle And we can help to raise awareness about how important plants are, as well as growing our local wild plants in our gardens to protect them.



Slide 26

