Climate change - the science

The Greenhouse Effect

Heat comes to the Earth from the sun, warms Earth's surface, and makes life possible. Heat also leaves the Earth and goes back out into space. As long as the amount of heat that enters the planet's atmosphere is equal to the amount that leaves, the average temperature of the Earth's surface will remain constant.

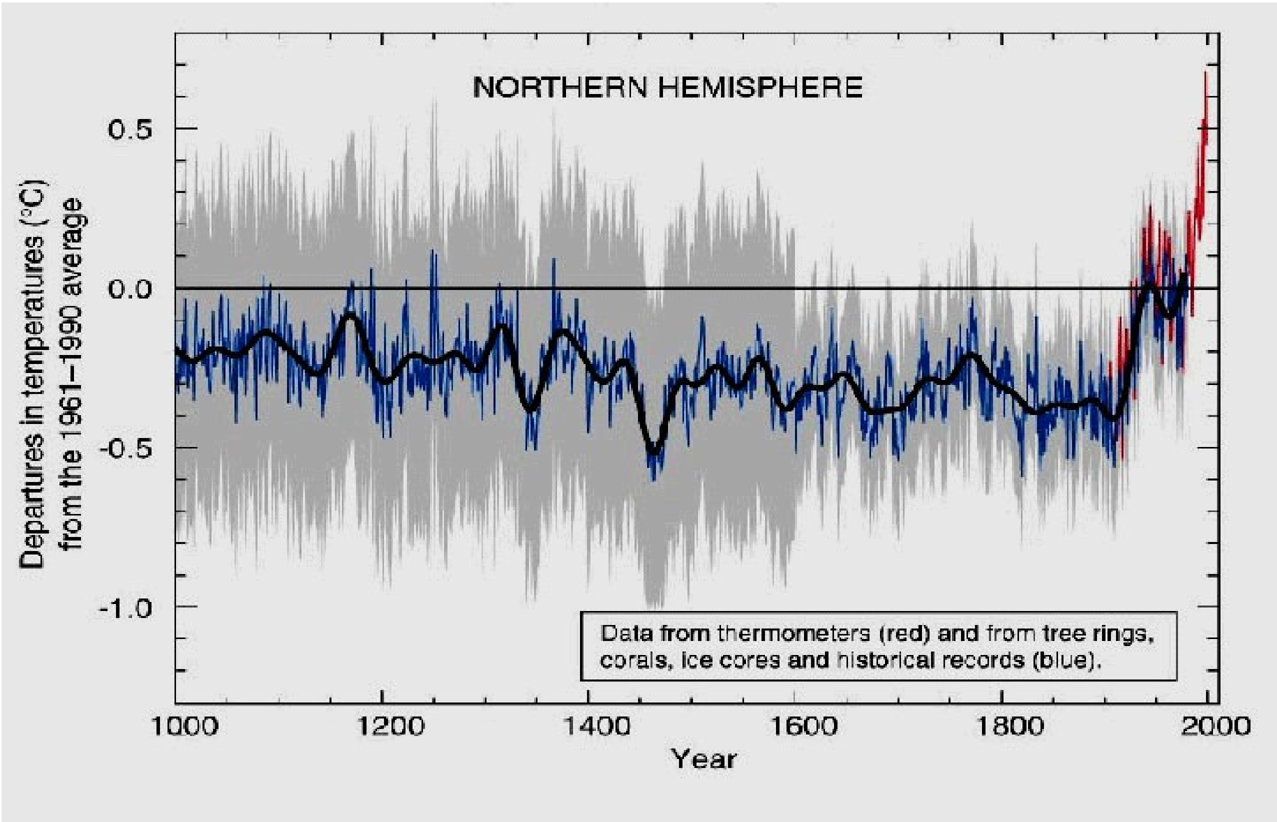
The light that comes to the Earth from the sun is of a shorter wavelength than the heat energy that is radiated from the Earth's atmosphere back out into space. Greenhouse gases, such as carbon dioxide, water vapour, methane, nitrous oxide, ozone, and sulphur hexafluoride, have little effect

on the radiation coming from the sun, but block the longer-wave radiation which is emitted by the planet Earth. Essentially greenhouse gases are transparent to radiation from the sun, but they are opaque to radiation emitted by the Earth.

The Earth has had a greenhouse effect for millions of years. Without it the Earth's average temperature would be below freezing, and life would not be possible. The most important naturally occurring greenhouse gases are water vapour and carbon dioxide.

However for the past 200 years or so, since the Industrial Revolution, humans have been adding extra carbon dioxide into the atmosphere, on top of the carbon dioxide that would be there as a result of natural processes. In the past 50-100 years or so the pace at which carbon dioxide

and other greenhouse gases are being added has increased dramatically. This has caused extra heat to be trapped inside the Earth's atmosphere, and thus the Earth has been getting warmer.



Over the past 200 years the concentration of carbon dioxide in the Earth's atmosphere has increased by about 30%, from 270 parts per billion to 370 parts per billion. This is the highest it has been in 150,000 years.

Effects of global warming

As a result of greenhouse gas emissions, the Earth has been getting hotter. Strong global warming has been observed since 1975. Globally 1998 was the hottest year on record. The second hottest was 2005, in which there was a record US hurricane season, and accelerated melting of Arctic sea ice and Siberian permafrost. The third hottest year on record was 2003, in which Europe experienced the hottest summer for at least 500 years, with an estimated 30,000 casualties as a result. Later researchers concluded that this hear wave was the first extreme weather event almost certainly

attributable to climate change caused by human activities. The IPCC (Intergovernmental Panel on Climate Change) has predicted that the temperatures in Europe in the summer of 2003 may be normal by 2040, and cool by 2060.

The sea level is rising both because glaciers are melting, and because warm water takes up more space and is less dense than cold water. Global warmer means that the sea gets warmer just as the Earth's land surface does. It is expected that in the coming century many coastal regions will be flooded due to the sea level rise.

Globally glaciers have retreated. Arctic sea ice has decreased by about 40% in the past thirty years. Biologists predict that polar bears will become extinct due to the loss of sea ice which allows them to hunt for seals. The Greenland ice sheet contains enough water to increase the global sea level

by 7m. It is clear from satellite photos that the surface area of this ice sheet has been reduced significantly in the past ten years. The West Antarctic ice sheet is also melting and could contribute 6m to the global sea level.

Carbon dioxide can stimulate plants to grow more rapidly. Over the past century this enhanced growth has taken place and plants have acted as an important carbon sink. However experts believe that the Earth's forests are now reaching the limit of their ability to absorb carbon dioxide.

Furthermore the world's remaining forests are being destroyed to clear new agricultural lands, and for the timber industry. When an area of forest is cleared the carbon dioxide stored within it, over a period of decades, is released back into the atmosphere. Thus the world's forests, which have up until now acted as an important carbon sink, are on the verge of becoming a source of carbon dioxide.

Most forms of life on Earth are adapted for a particular climatic zone. For instance, palm trees only thrive in tropical climates, while polar bears can only live in an Arctic climate. Climate change will cause climatic zones to shift outward from the equators. So an area of woodland may begin to die off because the local climate is suddenly a degree or two too hot. Some forms of life, such as birds and insects, will simply migrate north to an appropriate climatic zone. But trees migrate very slowly. It would take centuries for seeds carried by birds or by the wind to allow a woodland to shift its location. The pace of climate change is much too fast for trees to keep up with. In addition some species that do manage to migrate may die off anyway because other species which they depend on food food or shelter have failed to migrate. We are already living in a time of mass extinctions and climate change will bring about the loss of many more species.

One category of organisms which does find it easy to migrate quickly is those that cause disease, such as malaria and cholera. The IPCC predicts that in the coming decades tropical diseases will spread to regions where they were previously know, and will cause significant loss of life.

Climate change doesn't just mean a hotter world overall, it means greater extremes of both hot and cold, and more extreme weather such as storms. This is because energy is being added to a complex dynamic system – the global climate system. Some of the negative feedback systems which would

normally have a stabilizing influence on the climate have been disrupted, which means that extreme weather events will become far more frequent and severe in the coming decades.

The scariest effects of climate change are those we don't know. The climate is a complex system and it is impossible to predict all the effects of global warming. In recent years several climate experts have pointed out that computer-generated models of the climate such as those used by the IPCC are good at predicting slow, gradual shifts, but are not able to predict rapid changes that might take place. Some climatologists believe that a near-total shut-down of the thermohaline circulation could happen within the next 20 years, bringing dramatic changes to the climate of Northern Europe. Other experts claim that this shift, if it happens at all, will be gradual and will not occur within the next 100 years.

It takes time for greenhouse gas emissions into the atmosphere to be translated into changes in the climate. Even if all greenhouse gas emissions ceased today the planet would continue heating up for at least the next 50 years. We have already caused a far greater disruption to the climate than we realise.

Is there any chance left to prevent the Earth from becoming an uninhabitable nightmare world? If we stopped all greenhouse emissions now the global average temperature would continue to rise for several decades to come, and would then stabilize (at a higher temperature than before). Some species would face extinction as a result of these shifts, but most would adapt to the new climate.

Various campaign groups have claimed that we need to cut our present emissions by 70% - 95% within the next couple of decades, in order to avoid a truly catastrophic situation. What is clear is that small cuts to emissions won't have much effect - drastic cuts to our greenhouse emissions are needed now, if we are to have any hope of providing our children and grandchildren with a world they might want to live in.

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Greenhouse gases

Greenhouse gases (GHG) are gaseous components of the atmosphere that contribute to the greenhouse effect. Like greenhouse glass, greenhouse gases are transparent only to some wavelengths of light. When sunlight hits the Earth, some is absorbed and re-emitted at longer wavelengths for which the greenhouse gas is opaque, hindering emission back out into space.

The major natural greenhouse gases are:

water vapour, which causes about 36-70% of the greenhouse effect on Earth (not including clouds), but that can be converted to rain by nature;

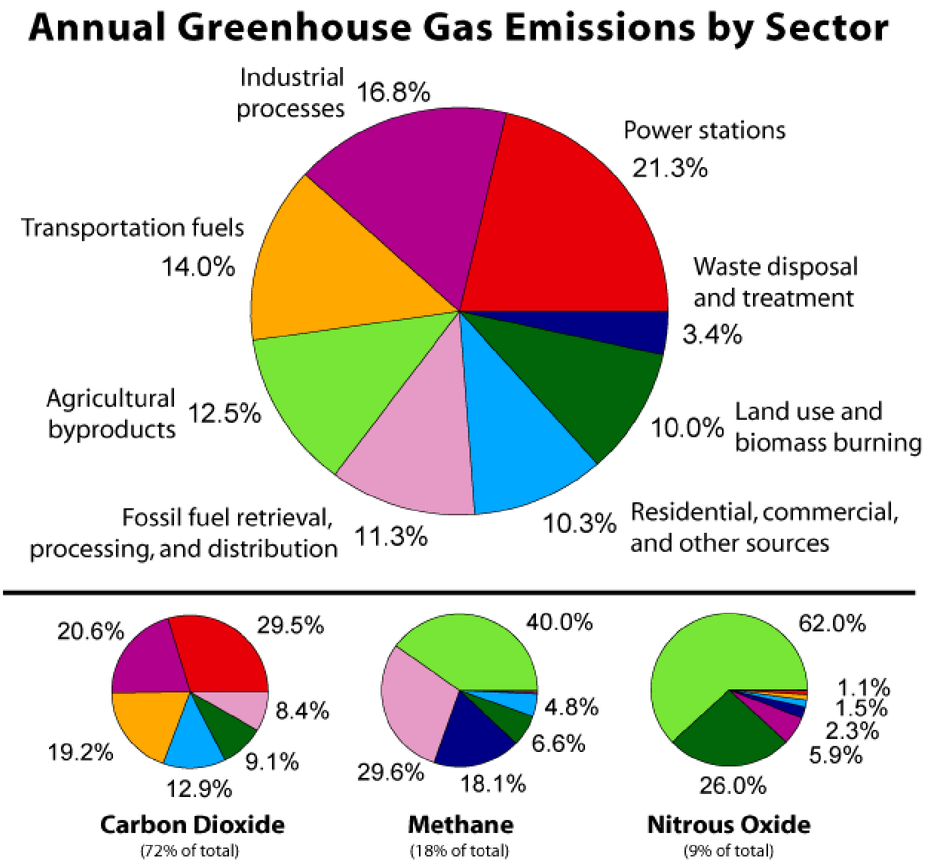
carbon dioxide, which causes between 9-26%;

methane, which causes 4-9%, and ozone, which causes between 3-7%. (note that it is not really possible to assert that such-and-such a gas causes a certain percentage of the greenhouse effect, because the influences of the various gases are not additive.)

Other greenhouse gases include, but are not limited to: **nitrous oxide**, sulphur **hexafluoride**, hydrofluorocarbons, perfluorocarbons and chlorofluorocarbons.

Human activity raises levels of greenhouse gases primarily by releasing carbon dioxide, but other gases, e.g. methane, are not negligible.

The concentrations of several greenhouse gases have increased over time[4] due to human activities, such as the burning of fossil fuels and deforestation leading to higher carbon dioxide concentrations, livestock and paddy rice farming, land use and wetland changes, pipeline losses, and covered vented landfill emissions leading to higher methane atmospheric concentrations, many of the newer style fully vented septic systems that enhance and target the fermentation process also are major sources of atmospheric methane, and the use of CFCs in refrigeration systems. The use of CFCs and halons in fire suppression systems and various manufacturing processes.



Global greenhouse gas emissions broken down into 8 different sectors for the year 2000.

The role of water vapour

Water vapour is a *natural greenhouse gas* which, of all greenhouse gases, accounts for the largest percentage of the greenhouse effect. Humans do not produce any overall direct change in water vapour levels. However water vapour is involved in a positive feedback mechanism: warm air holds more water vapour than cold air. As the world heats up due to the greenhouse effect, the amount of water vapour in the atmosphere increases, and this in turn causes even greater warming. Changes in the water vapour may also have indirect effects on the climate via cloud formation.

Increase of greenhouse gases

Radiative forcing is a scientific term which means, roughly, the amount of warming produced by a given amount of a greenhouse gas. It is not straightforward to calculate the radiative forcing of a given greenhouse gas (see below).

Since the beginning of the Industrial Revolution, the concentrations of many of the greenhouse gases have increased. Most of the increase in carbon dioxide occurred after 1945. Those with the largest radiative forcing are:

Relevant to radiative forcing

Gas	Current (1998) Amount by volume	Increase over pre-industrial (1750)	Percentage increase	**Radiative forcing (W/m^2)**
Carbon dioxide	365 ppm	87 ppm	31%	1.46
Methane	1,745 ppb	1,045 ppb	150%	0.48
Nitrous oxide	314 ppb	44 ppb	16%	0.15

All of the following have no natural sources and hence zero amounts pre-industrial:

Gas	Current (1998) Amount by volume	**Radiative forcing (W/m^2)**
CFC-11	268 ppt	0.07
CFC-12	533 ppt	0.17
CFC-113	84 ppt	0.03
Carbon tetrachloride	102 ppt	0.01
HCFC-22	69 ppt	0.03

(Source: IPCC radiative forcing report 1994 updated (to 1998) by IPCC TAR table 6.1 [7][8]).

Removal from the atmosphere and global warming potential

The greenhouse gases, once in the atmosphere, do not remain there eternally. They can be removed from the atmosphere:

- as a consequence of a physical change (condensation and precipitation remove water vapour from the atmosphere).
- as a consequence of chemical reactions within the atmosphere. This is the case for methane. It is oxidized by reaction with naturally occurring hydroxyl radical, OH• and degraded to CO_2 and water vapour at the end of a chain of reactions (the contribution of the CO_2 from the oxidation of methane is not included in the methane GWP). This also includes solution and solid phase chemistry occurring in atmospheric aerosols.
- as a consequence of a physical interchange at the interface between the atmosphere and the other compartments of the planet. An example is the mixing of atmospheric gases into the oceans at the boundary layer.
- as a consequence of a chemical change at the interface between the atmosphere and the other compartments of the planet. This is the case for CO_2, which is reduced by photosynthesis of plants, and which, after dissolving in the oceans, reacts to form carbonic acid and bicarbonate and carbonate ions (see ocean acidification,) (CO_2 is chemically stable in the atmosphere).
- as a consequence of a photochemical change driven by sun light. Halocarbons are dissociated by UV light releasing Cl• and F• as free radicals in the stratosphere with harmful effects on ozone (halocarbons are generally too stable to disappear by chemical reaction in the atmosphere).
- as a consequence of dissociative ionization caused by high energy cosmic rays or lightning discharges, which break molecular bonds. For example, lightning forms N atoms from N_2 which then react with O_2 to form NO_2.

The lifetime of an individual molecule of gas in the atmosphere is frequently much shorter than the lifetime of a concentration anomaly of that gas. Thus, because of large (balanced) natural fluxes to and from the biosphere and ocean surface layer, an individual CO_2 molecule may last only a few years in the air, on average; however, the calculated lifetime of an increase in atmospheric CO_2 level is hundreds of years.

Aside from water vapour near the surface, which has a residence time of few days, most greenhouse gases take a very long time to leave the atmosphere. It is not easy to know with precision how long, because the atmosphere is a very complex system. However, there are estimates of the duration of stay, i.e. the time which is necessary so that the gas disappears from the atmosphere, for the principal ones.

The global warming potential (GWP) depends on both the efficiency of the molecule as a greenhouse gas and its atmospheric lifetime. GWP is measured relative to the same mass of CO_2 and evaluated for a specific time-scale. Thus, a molecule with a high GWP on a short time scale (say 20 years) but a short lifetime, will have a high GWP on a 20 year scale, but a small one on a 100 year scale. Conversely, if a molecule has a longer atmospheric lifetime than CO_2 its GWP will increase with time.

Examples of the atmospheric lifetime and GWP for several greenhouse gases include:

- **CO_2** has a variable atmospheric lifetime (approximately 200-450 years for small perturbations). Recent work indicates that recovery from a large input of atmospheric CO_2 from burning fossil fuels will result in an effective lifetime of tens of thousands of years.[8][9] Carbon dioxide is defined to have a GWP of 1 over all time periods.
- **Methane** has an atmospheric lifetime of 12 ± 3 years and a GWP of 62 over 20 years, 23 over 100 years and 7 over 500 years. The decrease in GWP associated with longer times is associated with the fact that the methane is degraded to water and CO_2 by chemical reactions in the atmosphere.
- **Nitrous oxide** has an atmospheric lifetime of 120 years and a GWP of 296 over 100 years.
- **CFC-12** has an atmospheric lifetime of 100 years and a GWP(100) of 10600.
- **HCFC-22** has an atmospheric lifetime of 12.1 years and a GWP(100) of 1700.
- **Tetrafluoromethane** has an atmospheric lifetime of 50,000 years and a GWP(100) of 5700.
- **Sulfur hexafluoride** has an atmospheric lifetime of 3,200 years and a GWP(100) of 22000.

Source : IPCC, table 6.7.

Carbon monoxide has an indirect radiative forcing effect by elevating concentrations of methane and tropospheric ozone through chemical reactions with other atmospheric constituents (e.g., the hydroxyl radical, **OH**) that would otherwise destroy them. Carbon monoxide is created when carbon-containing fuels are burned incompletely. Through natural processes in the atmosphere, it is eventually oxidized to carbon dioxide. Carbon monoxide concentrations are both short-lived in the atmosphere and spatially variable.

Another potentially important indirect effect comes from methane, which in addition to its direct radiative impact also contributes to ozone formation. Shindell et al (2005) argue that the contribution to climate change from methane is at least double previous estimates as a result of this effect.

Shadow of Extinction

Only six degrees separate our world from the cataclysmic end of an ancient era

By George Monbiot. Published in the Guardian 1st July 2003

It is old news, I admit. Two hundred and fifty-one million years old, to be precise. But the story of what happened then, which has now been told for the first time, demands our urgent attention. Its implications are more profound than anything taking place in Iraq, or Washington, or even (and I am sorry to burst your bubble) Wimbledon. Unless we understand what happened, and act upon that intelligence, pre-history may very soon repeat itself, not as tragedy, but as catastrophe.

The events which brought the Permian period (between 286 and 251 million years ago) to an end could not be clearly determined until the mapping of the key geological sequences had been completed. Until recently, palaeontologists had assumed that the changes which took place then were gradual and piecemeal. But three years ago a precise date for the end of the period was established, which enabled geologists to draw direct comparisons between the rocks laid down at that time in different parts of the world.

Having done so, they made a shattering discovery. In China, South Africa, Australia, Greenland, Russia and Spitsbergen, the rocks record an almost identical sequence of events, taking place not gradually, but almost instantaneously. They show that a cataclysm caused by natural processes almost brought life on earth to an end. They also suggest that a set of human activities which threatens to replicate those processes could exert the same effect, within the lifetimes of some of those who are on earth today.

As the professor of palaeontology Michael Benton records in his new book, When Life Nearly Died, the marine sediments deposited at the end of the Permian period record two sudden changes.1 The first is that the red or green or grey rock laid down in the presence of oxygen is suddenly replaced by black muds of the kind deposited when oxygen is absent. At the same time, an instant shift in the ratio of the isotopes (alternative forms) of carbon within the rocks suggests a spectacular change in the concentration of atmospheric gases.

On land, another dramatic transition has been dated to precisely the same time. In Russia and South Africa, gently deposited mudstones and limestones suddenly give way to massive dumps of pebbles and boulders. But the geological changes are minor by comparison to what happened to the animals and plants.

The Permian was one of the most biologically diverse periods in the earth's history. Herbivorous reptiles the size of rhinos were hunted through forests of tree ferns and flowering trees by sabre-toothed predators. At sea, massive coral reefs accumulated, among which lived great sharks, fish of all kinds and hundreds of species of shelly creatures.

Then suddenly there is almost nothing. The fossil record very nearly stops dead. The reefs die instantly, and do not reappear on earth for ten million years. All the large and medium-sized sharks disappear, most of the shelly species, and even the great majority of the toughest and most numerous organisms in the sea, the plankton. Among many classes of marine animals, the only survivors were those adapted to the near-absence of oxygen.

On land, the shift was even more severe. Plant life was almost eliminated from the earth's surface. The four-footed animals, the category to which humans belong, were nearly exterminated: so far only two fossil reptile species have been found anywhere on earth which survived the end of the Permian. The world's surface came to be dominated by just one of these, an animal a bit like a pig. It became ubiquitous because nothing else was left to compete with it or to prey upon it.

Altogether, Benton shows, some 90% of the earth's species appear to have been wiped out: this represents by the far the gravest of the mass extinctions. The world's "productivity" (the total mass of biological matter) collapsed.

Ecosystems recovered very slowly. No coral reefs have been found anywhere on earth in the rocks laid down over the following 10 million years. One hundred and fifty million years elapsed before the world once again became as biodiverse as it appears to have been in the Permian.

So what happened? Some scientists have argued that the mass extinction was caused by a meteorite. But the evidence they put forward has been undermined by further studies. There is a more persuasive case for a different explanation. For many years, geologists have been aware that at some point during or after the Permian there was a series of gigantic volcanic eruptions in Siberia. The lava was dated properly for the first time in the early 1990s. We now know that the principal explosions took place 251 million years ago, precisely at the point at which life was almost extinguished.

The volcanoes produced two gases: sulphur dioxide and carbon dioxide. The sulphur and other effusions caused acid rain, but would have bled from the atmosphere quite quickly. The carbon dioxide, on the other hand, would have persisted. By enhancing the greenhouse effect, it appears to have warmed the world sufficiently to have destabilised the superconcentrated frozen gas called methane hydrate, locked in sediments around the polar seas. The release of methane into the atmosphere explains the sudden shift in carbon isotopes.

Methane is an even more powerful greenhouse gas than carbon dioxide. The result of its release was runaway global warming: a rise in temperature led to changes which raised the temperature further, and so on. The warming appears, alongside the acid rain, to have killed the plants. Starvation then killed the animals.

Global warming also seems to explain the geological changes. If the temperature of the surface waters near the poles increases, the circulation of marine currents slows down, which means that the ocean floor is deprived of oxygen. As the plants on land died, their roots would cease to hold together the soil and loose rock, with the result that erosion rates would have greatly increased.

So how much warming took place? A sharp change in the ratio of the isotopes of oxygen permits us to reply with some precision: six degrees centigrade. Benton does not make the obvious point, but another author, the climate change specialist Mark Lynas, does.2 Six degrees is the upper estimate produced by the UN's scientific body, the Intergovernmental Panel on Climate Change, for global warming by 2100.3 A conference of some of the world's leading atmospheric scientists in Berlin last month concluded that the IPCC's model may have underestimated the problem: the upper limit, they now suggest, should range between 7 and 10 degrees.4 Neither model takes into account the possibility of a partial melting of the methane hydrate still present in vast quantities around the fringes of the polar seas.

Suddenly, the events of a quarter of a billion years ago begin to look very topical indeed. One of the possible endings of the human story has already been told. Our principal political effort must now be to ensure that it does not become set in stone.

www.monbiot.com

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NO STABLE CLIMATE WITHOUT RAINFOREST PROTECTION: WHY WE MUST DEFEND ANCIENT FORESTS

We all know that billions of people and countless other species will face death unless we reduce fossil fuel burning by a large margin, and fast. The same fate awaits us if we allow the rampant destruction of ancient forests and peat lands to continue – yet protecting the Earth's carbon sinks is not even on the agenda of many organisations fighting climate change, nor is it part of the Kyoto Agreement.

How much carbon is released from deforestation?

Since the industrial revolution, humans have added between 345 and 465 billion tons of carbon to the oceans and the atmosphere. Fossil fuel burning releases around 6.3 billion tons a year. Throughout most of the 1990s, between one fifth and one quarter of the total emissions came from deforestation, mostly in the tropics. Then, in 1997/98, an unprecedented disaster happened on Borneo: That year, up to 2.5 billion tons of carbon went up in smoke during massive forest and peat fires – probably more than all the carbon dioxide emissions from the United States. Similar, though slightly smaller fires raged in 2002, 2003 and 2005 and another record drought is likely in the near future and could cause worse fires than ever.

Suddenly, deforestation and peat drainage might account for as much as 40% of human emissions.

Why is carbon dioxide in the atmosphere rising faster than ever?

Between 1750 and around 2000, carbon dioxide has been going up largely in line with fossil fuel burning. In some years, including 1998, those levels rose faster than in other years. Then, in 2002, levels began to rise faster than before – and much faster than can be explained by the gradual growth in fossil fuel use. This means that the planet will be warming even faster.

To understand what is happening, we need to think where all that carbon which our power stations and cars emit ends up: Less than half of it goes into the atmosphere to cause global warming. A large part is absorbed by the ocean, which is turning more and more acidic, threatening the survival of marine life. And the remainder is taken up by plants on land. If, suddenly, more carbon ends up in the atmosphere, it means that less is being absorbed either by the ocean, or, more likely, by plants.

Ice core records prove that global warming always leads to more carbon dioxide being released, leads to more warming. This feed-back cycle may be kicking in. There is, however, strong evidence that much of the additional carbon dioxide comes from forest and peat fires, which are directly linked to logging and peat drainage – with Borneo's fires as a major source of emissions.

What does that mean for the world's climate?

Destroying ancient forests and peat swamps is a double whammy for the climate: It releases billion of tons on carbon, and it forces more and more of the carbon from fossil fuel burning into the atmosphere and the oceans, where the real harm is caused. Cutting our emissions by 60-90% is possible, if tough. It won't stabilise the climate, though, unless there are strong carbon sinks to absorb what humans will still be emitting – and certainly not if tropical rainforests go up in flames and put their billions of tons of carbon into the air.

Here are some figures from Fred Pearce's climate science book, "The Last Generation": Since the industrial revolution, carbon in the atmosphere has gone up from 600 to 800 billion tons. Another 50 billion tons, and there is a real danger that global warming will exceed 2 degrees C. Once the atmosphere holds over a trillion tons of carbon, the odds of avoiding those 2 degrees C are against us. How bad are 2 degrees C? As James Hansen, chief climate scientist at NASA, says, we would be looking at 'essentially a different planet' – one far less hospitable to humans and millions of other species.

'Business as usual' on Borneo, Sumatra and West Papua is likely to release another 50 billion tons of carbon now stored in ancient peat. Tropical deforestation, meanwhile, is expected to release another 85-130 billion tons of carbon this century. And that might be optimistic, ignoring the growing evidence that the Amazon and other rainforests will die back and dry up completely beyond an unknown threshold of logging. Nor do those figures suggest the massive changes in rainfall patterns which would result from the loss of the Amazon, and which would probably be enough to wipe out much of the world's food production on their own.

There is simply no chance of stopping catastrophic global warming unless we can stop rainforest destruction and protect and restore peat swamps.

And who is responsible?

There are different reasons for rainforest destruction: Logging (much of it illegal), agricultural expansion, often for the global market in animal feeds and vegetable oils, environmental degradation forcing poor farmers into forests, lack of government regulation and policing, mining, oil and gas drilling, hydro-dams.

The main reason, however, is that we, via the global market, pay poor countries to destroy their natural resources. The World Bank and other international organisations lend extra money for the destruction. And there is very little money available for protecting rainforests. Governments of the South are forced to choose between protecting the forests on which we all depend for our survival – or raising much needed revenue.

The EU is helping to speed to rainforest destruction: Imports of timber felled illegally are still perfectly lawful. And the EU Biofuel Directive is creating a massive new and unregulated market for palm oil, sugar cane and soya, vastly speeding up the destruction of south-east Asia's forests and the Amazon. Local people in the rainforest nations are all too often the victims of logging and plantations. Many of them come from communities which have been living in harmony with the forest for thousands of years.

The Kyoto Agreement, meantime, sets out to protect the forests of the richest nations only – giving them every incentive to destroy those in the tropics.

What must be done?

If we want to stop catastrophic global warming, we must end ancient forest logging and protect and restore tropical peat swamps. Scientists have shown that it is quite possible to restore Borneo's peat swamps – all that is lacking are the political will and the money. An urgent programme to protect and restore south-east Asia's peat must be implemented.

The global market in products linked to rainforest destruction must be curtailed and regulated. We need import bans on illegal timber, biofuels linked to deforestation and other environmental destruction, and other agricultural products grown at the expense of forests. Voluntary labelling and certification have been tried and have failed. Raising revenues for forests through eco-tourism, pharmaceuticals, selling Brazil nuts, etc. can never compete with the much larger and stronger palm oil and soya markets on a large scale.

Rainforest nations must be able to raise money for protecting their forests and for restoring peat swamps and degraded ecosystems. Many of them have formed a Coalition of Rainforest Nations and are demanding an urgent amendment of the Kyoto Protocol: They want carbon credits to be paid to countries for protecting rainforests, rather than to companies which now get credits for planting tree monocultures in the South, often to the detriment of local people and the environment. Such an amendment to the Kyoto Protocol would transfer billion of dollars into rainforest protection. It is the only international proposal which could stem deforestation between now and 2012.

Sustainable logging of rainforests has been tried and funded for years, and has, on the whole, been a spectacular failure. Granting land rights and protection to indigenous communities is far more likely to preserve rainforests.

What can we do?

As climate change activists, we must recognise that rainforest protection and the restoration of south-east Asia's peat swamps as one of our top priorities if we are to avoid catastrophic global warming.

Of course, fossil fuel burning is destroying the planet as we know if – but so are illegal timber imports, biodiesel made from palm oil and soya linked to deforestation, cattle or chicken fed on soya from the Amazon, or gold or copper mined in rainforests.

We need to demand that the UK and the EU ban illegal timber imports, and imports of agricultural goods linked to deforestation, including many biofuel sources.

'Development' and other international funding (e.g. by the World Bank) linked to rainforest destruction must stop.

The Kyoto Agreement is far from ideal, but it will be in force until 2012, so we must support those proposals by the Coalition of Rainforest Nations to amend it now, in order to protect rainforests and restore peat swamps – rather than continuing to pay polluters to plant eucalyptus in Brazil!

And we must actively support those communities in Rainforest Nations which are struggling to protect their forests and their sustainable ways of life.

Useful websites:
Rainforest Portal: http://www.rainforestportal.org/
Coalition of Rainforest Nations: http://www.rainforestcoalition.org/eng/
Biofuelwatch: http://www.biofuelwatch.org.uk/
Greenpeace UK Forest Campaign: http://www.greenpeace.org.uk/forests/
World Rainforest Movement: http://www.wrm.org.uy/