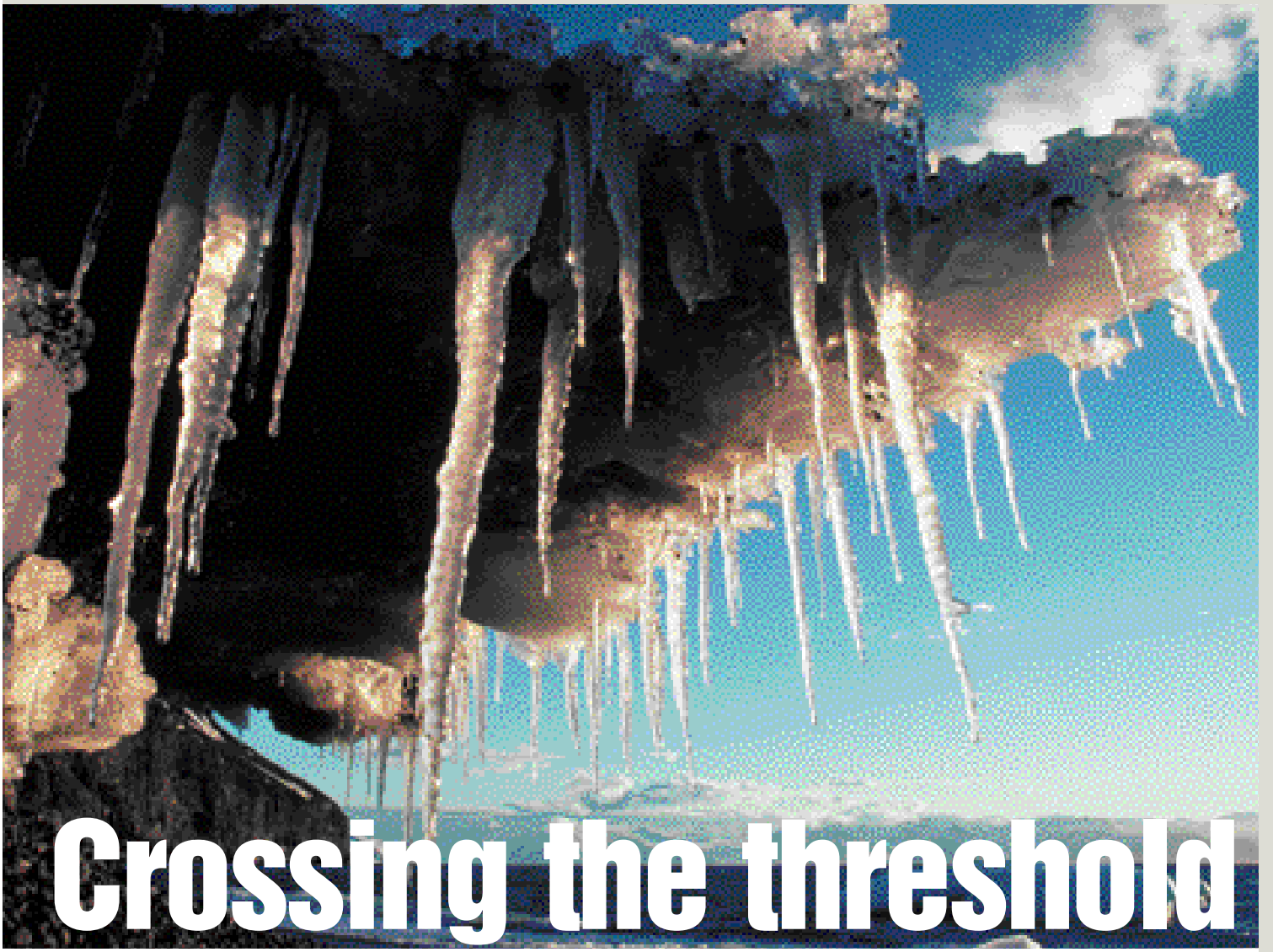


Crossing the threshold

CORBIS

It takes no more than a gentle nudge to push a man over the edge of a cliff, but it is almost impossible to haul him back before he hits the ground. Given that we show no sign of putting a stop to global warming, Peter Bunyard takes a look at what the future might hold

Since 1990 we have experienced the warmest 10 years on record. This has left some parts of the world ravaged by drought and famine, and others suffering freak storms such as those that flooded much of lowland Britain in 2000. France, having experienced a devastatingly hot summer in 2003 then found itself enduring torrential winter rains and unprecedented floods. According to Phil Jones, head of the Climatic Research Unit of the University of East Anglia, the three months of June, July and August 2003 were the warmest ever recorded in western and central Europe. The average temperature for those months was nearly 4° centigrade above the long-term norm and breaking records everywhere – including the UK, where temperatures exceeded the 100° Fahrenheit mark for the first time.

Satellite data reveals that the planet has lost about 10 per cent of its snow cover since the 1960s, and that lakes and rivers in the high latitudes of the northern hemisphere remain frozen for two weeks less than they did one century ago. Glaciers in non-polar regions are also retreating, while Arctic sea ice has not only thinned by some 40 per cent since the 1950s, the surface area that it covers during the spring and summer is also down by up to 15 per cent.

The financial cost of natural disasters in 1998 amounted to $65.5 billion, and the World Health Organisation estimates that the spread of diseases induced by global warming may have led to 5 million deaths. Given that all this is down to a mere 0.6° centigrade increase in global temperatures, what will the future hold?

The doomsday alternatives

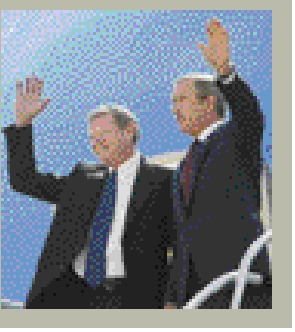
As climatologists are now certain that it is our greenhouse gas emissions that have led to global warming, we urgently need to know what will happen if we fail to

THE KYOTO PROTOCOL

Our concerns about global warming and climate change are largely informed by the work of the Intergovernmental Panel on Climate Change (IPCC), set up by the UN 12 years ago. The formation of the IPCC led to the establishment of the Kyoto Protocol in 1997, and the realisation among most industrialised countries that man-derived greenhouse gas emissions must be drastically reduced if the world is to avoid the dangerous consequences of global warming.

All industrialised countries agreed on the need to ratify the Kyoto Protocol, but the US and, for the time being, Russia have since reneged on that agreement. If either of these countries continues to opt out of the protocol it cannot officially come into force. Nonetheless, the EU remains theoretically committed to cutting its greenhouse emissions by 8 per cent of their 1990 levels. But only two EU member states are on target to achieve that goal: Sweden and the UK. The rest are failing: Spain, for example, by more than 30 per cent; Ireland by 27 per cent; the Netherlands by 12 per cent; Italy by 10 per cent; Austria by 25 per cent; and Denmark by 38 per cent. As for the US, current indications suggest it will be more than 30 per cent off the Kyoto Protocol target for cutting emissions over the next 10 years; given that the US emits 25 per cent of the world's carbon dioxide, such a failure is criminal.

The attitude of the US administration is well represented in the remarks of senator James Inhofe (pictured right with President Bush), its negotiator at a UN conference on climate change in Milan in December (and the chairman of the Senate Environment and Public Works Committee). Inhofe told the conference: 'I'm becoming more and more convinced as time goes by and we look at the research, that global warming is the greatest hoax ever perpetrated on the American people and the world.'



curb our emissions or, worse, continue to add to them. The Intergovernmental Panel on Climate Change (IPCC) has come up with a range of predictions for the next 100 years, all contingent on different scenarios of fossil fuel use.

1 If CO_2 emissions remain the same as they are today – 375 parts per million (ppm) of the atmosphere

The truth is that the emissions of yesterday will have their impact tomorrow, and, whether we like it or not, we are committed to further warming – even if we were 'magically' to level off our greenhouse gas emissions at the level of today: some 375 parts of carbon dioxide per million parts of the atmosphere (375 ppm). According to such a scenario, global temperatures will rise another 1° centigrade on top of what we have already experienced.

Even that 'best' scenario will wreak some havoc. Glaciers and sea ice will in all probability vanish, and the number of extreme climate events, such as floods, landslides, heat waves and violent storms, is bound to increase. Agriculture will be affected, as a lack of rain during the growing season and a spate of heat waves have a catastrophic effect on global food supplies. Worst of it all, as conditions get tougher, we are likely to resort to ever increasing uses of energy, so adding to the potential of global warming in the future.

2 If we curb emissions so they only rise to 550 ppm

If we could stabilise carbon dioxide concentrations in the atmosphere at about double pre-industrial levels (550 ppm, compared to 280 ppm), global temperatures would rise 2° centigrade over the next 100 years, according to the IPCC. With luck, our current climate system could still cope with such a temperature increase without jumping unexpectedly to a very different and hard-to-predict state.

Nevertheless, we would definitely be committed to substantial sea rises, perhaps a foot or more, as sea water expanded in volume as it got hotter; this would be exacerbated by the further melting of glaciers and polar ice. Increased rainfall, particularly over Siberia, would also lead to a significant increase in the flow of cold fresh water into the Arctic Circle, which would curb the flow of the Gulf Stream and its vital transport of heat from the tropics to the high northern latitudes. We would be subjected to ever stronger climate events, including storms and sea surges, torrential rains and their deadly counterpart – drought.

3 If energy use continues to grow at the current rate

Our insatiable and growing appetite for fossil fuels means we are heading for a fourfold increase in greenhouse gases compared to pre-industrial times. That being so, the UK Met Office's Hadley Centre for Climate Prediction and Research envisages a catastrophic 8° centigrade rise on today's global average. We would be then in a range of global temperatures not seen since 40 million years ago, when the planet had no permanent polar ice sheets and sea levels were 12 metres higher than today.

We would lose our major capital cities and much of our best farmland, and be subjected to violent weather on account of the much greater energy trapped at the earth's surface. The circulation of air and the movement of oceans would be fundamentally different from what we experience today. Survival under such circumstances would most likely be impossible, especially in those parts of the world where we have already ravaged the environment.

4 If we take into account neglected variables

In its business-as-usual scenario, in which global emissions of greenhouse gases continue to rise uncurbed, the IPCC anticipates that by 2100 the concentration of carbon dioxide in the atmosphere will rise to 700 ppm – double that of today. However, the IPCC's predictions neglect the impact of global warming on soils and vegetation.

Until now most climate models, especially those used by the IPCC, have assumed that carbon dioxide will be drawn down out of the atmosphere at a constant rate; this would offset up to half our current emissions. Such models are inherently deficient and far removed from the real world in which the interchange of gases between the earth's surface and the atmosphere is contingent on living processes such as photosynthesis and respiration.

When there is more photosynthesis than respiration the earth's plant life and soil organisms become a sink for carbon. Such is the situation today. But if respiration exceeds photosynthesis the situation reverses and that store of carbon begins to be consumed; soils and vegetation emit greenhouse gases, and become a source of carbon.

The fact is that the Hadley Centre's climatologists are now finding that the IPCC's climate models (used to inform governments) are far too optimistic in their conclusions. Once different vegetation types (ie, broadleaf trees, tropical forests, savannah and grasslands) are integrated into the dynamic of climate change, there is a very different climate story from that when life is left out of the equation. For instance, those scientists who maintain that increased growth of forests in the northern parts of Siberia and Canada will counteract global warming are found to be fundamentally wrong. Why? Because the boreal forests are quick to shed winter snow on account of their shape, thereby exposing their dark needles to the rays of the spring sun. In contrast to the snow-covered tundra and swamps, boreal forests warm themselves and their surrounding environment when all around is cold. As Hadley Centre climatologist Richard Betts has found, the warming from the dark sun-exposed leaves more than counteracts the cooling that accrues from the growing forest taking up carbon dioxide. Forest growth in the Arctic Circle gives us a warmer, not a cooler, planet.

Our coastlines will be battered by violent sea storms, hurricanes and typhoons, and we will see sea surges on an unprecedented scale

Currently, one half of all global emissions of greenhouse gases are absorbed into soils and oceans during the course of each year. The growth of forests and storage of carbon compounds in soils therefore play an important role in acting as a 'sink' for carbons, thus reducing the overall impact of our emissions. But how permanent is the 'storage' of that carbon? Could it suddenly be released back into the atmosphere and become an additional 'source' of greenhouse gases, just when the heat is on and we least want it?

Most climatologists base their predictions of future climate change on the grounds that the stores of carbon in soils and vegetation will remain intact as if for ever, and that the sinks for our carbon dioxide emissions will continue to operate come what may. Yet when the Hadley Centre climatologists included carbon cycle feedbacks in their climate models they found that disturbing changes would be likely to occur across the planet.

2080 – the nightmare scenario

By 2080 the pattern of rainfall would be fundamentally different, with somewhat greater precipitation over the high latitudes – including the ocean. But across the tropics (except for a region in the Pacific) rainfall would decline by 50 per cent or more over all continents. With far less broadleaf forests in the tropics as a result of declining rainfall, daytime temperatures would be likely to rise by a substantial 10° centigrade. That, and the lack of rain, would be devastating for agriculture right across the planet. It would also be devastating for settlements, cities and industry. The corn-belt of the US would suffer from a 30 per cent decline in rainfall during its critical growing season, quite aside from an increase in

A FALSE SENSE OF SECURITY

We are all aware that the weather is never quite the same from one year to the next. That is all part of the natural variability of climate. It is the task of climatologists to tease out any change to climate, such as global warming, from all that variability.

One way to do that is to average out temperature or precipitation data during the previous 30 years; there must be clear evidence of change over time, and not just a flash-in-the-pan aberration caused by natural variability. Clearly, it is no good taking one warm year in isolation as evidence of global warming. But, while statistically correct, using a 30-year average to track trends may lead us into missing a sudden transition when some threshold, unbeknown to us, has been crossed. We could then find ourselves irrevocably committed to a new climate regime.

heat waves. And, with more energy retained within the tropics (especially in the oceans), our coastlines would be battered by violent sea storms, including hurricanes and typhoons, as well as sea surges on a scale we have never seen before. With raised sea levels, the damage inflicted by such storms on vulnerable coastlines, such as along the Ganges Delta or in Indonesia and in Europe, would be unimaginable. Such climatic horrors would trigger a flood of refugees that would make today's numbers appear a trickle.

Switching off the Gulf Stream

One probable consequence of wetter, warmer conditions in the northern hemisphere is that the Gulf Stream would judder to a halt, or at least shift much further south – taking its warmth with it. Just imagine the consequences of Labrador-like winters over northern France, all of the UK and Scandinavia: an ice sheet would develop, spreading over northern Europe and certainly covering much of Britain, as happened in the last Ice Age of 100,000 years' ago.

The Gulf Stream works the way it does because of the saltiness and low temperature of the surface waters in the higher latitudes. The cold, salty water becomes denser than the waters beneath and sinks to the bottom. From there it flows back to the equator and south towards Antarctica. That conveyor belt circulation picks up nutrients on its long passage at the bottom of the Atlantic, and when those same waters, some thousand years' hence, rise back to the surface to become the Gulf Stream, they are rich in essential elements for the growth of plankton. That's why the northern Atlantic provides one of the richest fishing grounds in the world.

But global warming is causing glaciers to melt in Greenland and Canada; it is also causing a substantial increase in rainfall over Siberia. Consequently, the flow of fresh water into the Arctic Circle is diluting the saltiness of the northern waters of the Gulf Stream. At some critical level the surface waters will neither be cool nor salty enough to sink, and a log jam of warm water pushing up from behind will cause the system to stall. Climate records gleaned from ice-core samples and from the ocean bottom show that a similar stalling has occurred in the past.

What has surprised geologists and climatologists is the suddenness with which the flowing Gulf Stream can stall and the temperature can change over northern Europe: it can all happen in a matter of years, not centuries or millennia. Marine scientists from Scotland and the US have found a 20 per cent drop in the temperature of the deep-bottom flow of the 'overturned' waters from the Gulf Stream close to the Faroe Islands. Again feedbacks are involved. Less Arctic sea ice means that less light is reflected away during the spring, summer and autumn and more is absorbed into an ice-free sea. That will prevent the Gulf Stream waters cooling sufficiently, let alone retaining sufficient saltiness for sinking to occur.

No one knows precisely the critical turning point at which the system will flip. Could we be on the very edge of it now?

If the Gulf Stream were turned off, an ice sheet would spread over northern Europe and much of Britain, as happened in the last Ice Age 100,000 years ago

The methane time bomb

Currently, several hundred million tonnes of methane leak into the atmosphere every year; most of which comes from poorly maintained gas pipelines, rice paddies, cattle farming, the draining of wetlands and the destruction of forests. Over the past 250 years, largely because of human activities, methane concentration in the atmosphere has more than doubled to 1.72 ppm. It is now accumulating in the atmosphere at the rate of around an extra 1 per cent per year. Weight per weight, this potent greenhouse gas is 20 times more powerful over a 100-year time span than carbon dioxide.

Fortunately for our climate, most of the methane produced remains trapped a few hundred metres down in the sea as methane hydrate – an ice-like water-methane compound. Methane's majority ingredient is carbon, and the total methane store could constitute as much as 10,000 billion tonnes of carbon – more than 10 times the carbon now found in the atmosphere. The release of just one 10th of that methane store would not only double atmospheric carbon; its impact on global warming would be more than 10 times greater than an equivalent quantity of carbon dioxide.

The methane store is a bombshell waiting to go off. Methane levels in the atmosphere have not been so high since 160,000 years ago, when the earth was undergoing rapid global warming. Could global warming, combined with sea-level rise, suddenly trigger the release of enough methane to raise temperatures far higher than those projected by the IPCC? Most disturbingly, once global warming gets underway more and more methane will vent into the atmosphere. Global warming will beget more global warming.

ACTION NEEDED

In 1990 the Intergovernmental Panel on Climate Change estimated that global emissions must immediately be reduced by over 60 per cent in order to stabilise carbon dioxide in the atmosphere at a reasonably 'safe' level. Since 1990, however, global emissions have risen by 10 per cent. Unless immediate and dramatic action is taken to massively reduce our greenhouse gas emissions, the world will not be habitable for our children – let alone our grandchildren.

1 RATIFY AND IMPLEMENT THE KYOTO PROTOCOL

All national governments should ratify and implement the Kyoto Protocol immediately. Currently, the US, which produces around a quarter of the world's emissions, and Russia, which produces about 6 per cent, are refusing to sign. It's true that Kyoto only mandates a tiny cut in emissions, at a time when massive cuts are needed. But its real value perhaps lies in the fact that it represents a long-term process for bringing all the world's nations together.

2 KICK THE FOSSIL FUEL HABIT

a) Governments should stop giving the $300 billion they pay worldwide in subsidies each year for the exploration and development of new oil, coal and gas projects. In addition, an end should be put to the public financing of fossil fuel projects through export credit agencies and multilateral development banks. World Bank fossil fuel projects from 1992 onwards will eventually contribute 38 billion tonnes of carbon dioxide to the earth's atmosphere; that's equal to 1.7 times the total emitted by all the world's countries in 1996.

See www.seen.org, www.bankwatch.org, and www.eca-watch.org

b) Governments should immediately start phasing out the use of coal-fired power stations. Together, electricity and heat production constitute the world's single largest source of carbon emissions (39 per cent). Coal-fired power stations supply most of the world's electricity (34 per cent). Coal has the highest carbon content of the fossil fuels, and coal-fired power stations emit up to three times as much carbon dioxide per unit of output as the most modern gas-fired plants.

See Friends of the Earth's report Carbon Dinosaurs at www.foe.co.uk/resource/reports/carbon_dinosaurs.pdf

c) Governments should rapidly phase in clean, renewable energy sources such as wind, solar, wave, tidal, geothermal, hydro and biomass. According to Greenpeace, wind farms off Britain's coasts alone could supply our current electricity needs three times over.

To find out about Greenpeace's renewable energy campaign, go to: www.greenpeace.org.uk/redirect2.cfm?PageParam=%20gp_wind_solar

3 TAKE PERSONAL ACTION TO REDUCE EMISSIONS

While it is completely justified to blame Bush and the oil companies for causing and perpetuating climate change, we all have a role to play in reducing emissions.

a) Cut space heating, which consumes half of domestic energy use. Make homes and offices energy-efficient: insulate walls, double-glaze windows, replace old boilers, use solar water heaters and buy energy-efficient appliances. Governments should play a role in this by providing investment, grants and tax breaks for the development and purchase of energy-saving devices.

To see what you can do today, visit the Energy Savings Trust website at www.est.org.uk

b) Switch to green electricity. Use market forces to help expand the renewable energy sector at little more than a flick of a switch.

Visit the website of renewable electricity supplier unit[e] at www.unit-e.co.uk/switch

c) Travel lightly. Transport is the fastest growing contributor to global warming, and the second largest source of carbon dioxide emissions (24 per cent). Wherever possible, reduce car use, walk or cycle for shorter journeys, and use buses and trains for longer ones. Governments should ban four-by-fours (or station wagons), which emit up to three times more carbon dioxide as other cars, subsidise green fuels, tax aviation fuel and actively discourage short-haul flights.

d) Buy locally grown organic food from small, local shops. The tonnage of food shipped between countries has grown four-fold over the last 40 years. With a typical meal using local ingredients up to 17 times less petroleum is used in transport than with the same meal bought from a supermarket. And if food is organic, it hasn't been coated in petroleum-based pesticides or grown using petroleum-based fertilisers.

e) Invest carefully. The world's 10 largest investment funds are responsible for investing an estimated $11 trillion. If the 30 largest funds were to divert 1 per cent of their investments away from carbon-based industries it would represent $100 billion not going into climate-changing businesses.

4 IT'S CLIMATE CHANGE, STUPID!

Don't leave climate change to the experts. It is a simple issue, it affects us all, and it's only because of our silence that the carbon economy remains so powerful. So, don't leave it to someone else: speak out about climate change. Grassroots, public pressure could be our only chance of saving this planet.