

The medical impacts of climate change

Carbon dioxide captured in fossil fuels over some 410 million years has been released in decades, and the earth is warming as a result. This threatens not just our health, but our very survival as a species.

Reports of the earth's warming appearing twenty or so years ago were easy to dismiss. Later claims that climate change was human-driven, and a threat, seemed far-fetched. Surely the earth's climate has always been changing. Didn't the Thames regularly freeze over only a few hundred years ago? Such views were heavily promoted by vested interest and people were (actively) confused (Leggett, 2001). But now we have all moved on: all communities recognize that we are driving climate change.

But still we seek reassurance – that climate change is gentle and easily managed, and that genuine concerns are for governments (not individuals) to address. Such responses are natural: they offer balm for concern and absolution from action. But hiding from the truth cannot alter its reality.

The history of anthropogenic climate change

The earth's atmosphere is very thin: almost half lies within 3 miles of its surface. Together with water vapour, a variety of atmospheric gases (chiefly carbon dioxide, but including methane and fluorocarbons) allow short-wave solar radiation to warm the earth, but prevent long-wave radiant heat escaping. In this way, the earth's temperature is kept 30°C or so higher than would otherwise be the case.

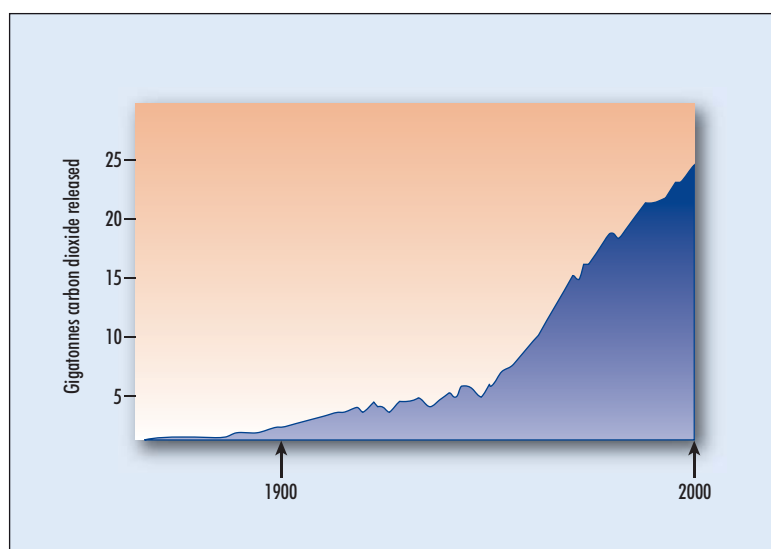
Over a period of some 350–410 million years, vast amounts of carbon dioxide were drawn down from the atmosphere and preserved as fossil fuels. But recent industrialization has seen simply massive carbon dioxide release. The first oil well in North America was 69 feet deep, and was drilled in 1858 – only 150 years ago. In 2006, world oil production exceeded 110 billion litres. One hundred years ago there were only 4000 motor vehicles in North America: there are now more than 600 million worldwide. The first commercial jet ticket was purchased just 50 years ago; we now make more than four billion passenger flights/year. And the small stuff: 'standby' options (not even equipment use) on stereos leads to the release of 1.6 million tonnes of carbon dioxide and on television equipment to the release of 1.54 million tonnes of carbon dioxide annually. We now burn 100 metric tonnes of coal, 155 000 litres of oil, and 3 million litres of gas a second. Meanwhile, the world's forests sequester carbon dioxide, but half were destroyed after 1950, and the area of twenty football pitches destroyed every minute (burned or rotting) releases 2 billion tonnes of carbon dioxide annually. Massive and escalating quantities of

carbon dioxide are thus being released (some 293 Megatonnes each year, *Figure 1*), and atmospheric carbon dioxide concentrations, stable for thousands of years (approximately 280 parts per million), are rising exponentially (perhaps as the soil 'sink' begins to fail), reaching levels now higher than at any time in the last 650 000 years.

The impact of rising carbon dioxide levels on our climate

Dramatic changes in carbon dioxide concentration are having dramatic effects on global temperatures. Although the sea has so far absorbed over 80% of the heat added to the system (warming to a depth of over 3 km), global surface temperatures are rising by 0.1–0.16°C per decade – double the rate at the start of the last century. Eleven of the 12 years to 2006 were the hottest on earth since direct measurements began in 1860. And dramatic temperature rises are having dramatic impacts. In all, 89 000 km³ of Arctic ice have melted in the last 40 years, and summer Arctic sea ice has melted at a rate of 9.8% per decade since 1978 (Levitus et al, 2001). Mountain glaciers have lost 3700 km³ ice in the 30 years to 1993 (Dyuregov and Meier, 2000), since when sea levels have risen by 3.1 mm/year (Intergovernmental Panel on Climate Change, 2007). And climate change drives

Figure 1. Cumulative total of carbon dioxide released from burning fossil fuels in the last 100 years. From World Resources Institute (2007) (www.cait.wri.org/).



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weather change: in 2005 Hurricane Katrina caused \$250 billion-worth of damage – more than 4 years of war in Iraq. The first South Atlantic hurricane ever recorded (Hurricane Gafilo) occurred 3 years ago. The (inflation-adjusted) costs of extreme weather events – some \$10 000 million in 1950 – had risen six-fold by 2000.

And if such effects are alarming, we have seen only the beginning. Global carbon dioxide production is still accelerating wildly. Unchecked, temperatures will follow, rising by more than 1.5°C per decade (6.5°C overall) in the lifetimes of our children (Intergovernmental Panel on Climate Change, 2007), and far more in some regions.

The health implications of climate change

So what does all this mean for humanity?

Direct deaths from heat may initially be mitigated by reduced deaths from cold. However, this balance is unlikely to remain for long, with the Intergovernmental Panel on Climate Change (2007) predicting ‘increased deaths...and injury due to heatwaves, floods, storms, fires and droughts’. Cardiorespiratory disease will be driven by increases in ground level ozone concentrations. Flooding and drought will also impact on human disease: the association with climate cycles such as the El Nino Southern Oscillation are already well recognized. By 2002, the World Health Organization was already ascribing 2.4% of worldwide cases of diarrhoea in some areas to climate change (World Health Organization, 2002). Elsewhere, by 2100, the population exposed to malaria-prone temperature ranges may rise by more than one third.

Water availability will suffer, affecting 250 million people in Africa by 2050. In some areas, yields from rain-fed agriculture will fall by more than 50%. Meanwhile, large areas of Asia depend upon diminishing mountain glacier meltwater supplies meaning that over 1 billion people face water shortages by 2050.

Food availability will suffer. Sustained agriculture will fail regionally, through sustained changes in temperature or rainfall, increased weather instability, altered growing seasons, and ecosystem collapse (below). ‘Increases in malnutrition and consequent disorders, with implications for child growth and development’ will result (Levitus et al, 2001). Hunger may also be driven by economic collapse similar in scale to those associated with world wars (Stern, 2007).

Can we ‘roll with the punch’?

Surely we can ‘adapt’ to these changes?

Seventy thousand years ago, catastrophic climate change (associated with the Sumatran eruption of Toba) left 5000 human females alive. Five thousand years ago, there were 5 million humans worldwide, their small groupings able to move with the weather. Now, there are 7 billion, 3 billion anchored to the complex infrastruc-

ture of cities. Major weather events (Katrina), changing water and food availability, disease, and economic pressure are likely to drive mass migration and war. Indeed, at the 2003 Third World Water Conference, ex-Soviet president Gorbachev ascribed 21 recent armed disputes to (lack of) water availability.

In Bangladesh, over 50% of the population rely on Himalayan glacier melt water, and these glaciers are shrinking. The last time the polar regions were warmer than now for a significant time (about 125 000 years ago), sea levels were 6 m higher: a 1 m sea level rise would flood 17.5% of Bangladesh. Perhaps for these reasons, the Indian government is completing a 4500 km fence along the entire border with Bangladesh. More locally, the Intergovernmental Panel on Climate Change warns that we face the imminent prospect of the whole of north Africa and southern Europe becoming uninhabitable. How will our children survive such changes in climate, ecology, agriculture, economy and water supply? Or deal with millions of refugees moving towards them? Cause for concern? On 24 January 2007, the Royal United Services Institute hosted a meeting entitled ‘Climate Change – the Global Security Impact’ at which the UK Ministry of Defence was represented.

Finally, since multi-celled life first appeared 540 million years ago, six mass-extinction events (generally related to major climate change) have each killed 40–92% of species on the planet. We face just such an event now: ‘mid-range risk’ is of one in three species (and perhaps one in two) committed to extinction in the next 40 years (Thomas et al, 2004). We depend on these ecosystems for the very survival of our species. Human-driven climate change is certainly upon us. Dissent seems limited to a fringe, or misrepresentation of expert testimony (Monbiot, 2007).

Equally certainly, climate change heralds plague, pestilence, war, famine and mass migration on scales never before seen. The middle-aged among us will feel the bite. Our children will be savaged – unless we act now. After 2020 or so, temperatures begin to rise dramatically. The bulk of the climate impact of carbon dioxide emissions is felt some 20 years after their release, meaning that the rate of rise in temperature (and its peak) is substantially affected by what we do in the years leading up to the Olympics.

What can we do?

Perhaps it is only the action of individuals that can make a difference (*Table 1*). While energy-efficient technologies, new energy sources, carbon sequestration, government treaties and tax changes all have their role to play, these take time. Time we do not have. Each of us in the UK is responsible for perhaps 12 tonnes of carbon dioxide per year. Simply switching to a green energy supplier (www.good-energy.co.uk or www.ecotricity.co.uk) can save 4 tonnes/year in one go. Avoiding a car journey

saves 1 kg of carbon dioxide every 3 miles. Travelling from London–Paris by train reduces carbon dioxide release ten-fold compared to flying. Switching off ‘stand-bys’ would save more than 4 million tonnes of carbon dioxide each year. Boiling only the water needed (‘want one cup, measure and boil one cup’) would save enough electricity to power all the UK’s council houses and street lights. Buying local- or UK-produced food would help reduce the 1.8 billion litres of oil used to import food annually. It is argued by some that ‘there is no point in us doing something; pollution from developing economies is dwarfing our efforts’. But these economies pollute because they are doing our manufacturing for us, Europe’s manufacturing industry having declined sharply. If we don’t like the pollution, perhaps we should stop buying the produce?

Conclusions

Climate change is upon us, and is being driven by us. Its impacts will soon be felt and may be devastating. There is little time to act. We all have a practical, as well as a moral imperative to respond now. The implications of failing to do so now dwarf the health impacts of our own beneficent work in health care. We may yet become the only species to have documented its own extinction. **BJHM**

Conflict of interest: none.

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Table 1. Ten easy ways to make a difference

Change your electricity supplier, so that your energy comes from renewable sources. This is easily done online (www.good-energy.co.uk or www.ecotricity.co.uk). It takes 5 minutes, and saves up to 4 metric tonnes of carbon dioxide annually

While on-line, move your money. High-street banks lend vast amounts of your money to the fossil-fuel industry. Move your account to the Co-operative Bank (www.co-operative-bank.co.uk) or ‘Smile’ (www.smile.co.uk/), who do not

Turn things down. Your radiator or thermostat. Reduce the amount of time the heating is on

Be more efficient. Use low-energy lightbulbs – Tesco have slashed prices to help you. Insulate your home – B and Q have also slashed prices on loft insulation (www.diy.com/)

Turn things off. Standby is still on and uses up to 80% of the power. Your phone charger is using energy even if your mobile is not plugged in

Use the train instead of the plane. Taking the Eurostar to Europe (www.eurostar.com) uses ten times less carbon dioxide than taking the plane. The same applies to travel inside the UK, and Virgin Trains (www.VirginTrains.co.uk) put all the profits into climate change technologies

Drive well. An average UK family car releases 1 kg carbon dioxide every 3 miles. So try not to drive – cycle or walk instead – or don’t go! If you must have a car, consider the carbon dioxide-per-mile figure: look at www.greencarsite.co.uk/ The Toyota Prius (www.toyota.co.uk/prius) is very energy efficient about town. Look also at the Honda Civic Hybrid (automobiles.honda.com/civic-hybrid/) and G-Whiz (www.GoinGreen.co.uk)

Think where you shop. Some retailers have really made the difference. Marks and Spencers (www.marksandspencer.com) are the first major retailer to go carbon neutral. Sky (www.sky.com) have also gone carbon neutral – so think of them if you want satellite TV. British Telecom have also made huge efforts – www.bt.com. Support them!

Think what you buy. A punnet of Californian strawberries carries a carbon dioxide-cost of >20 kg from growing, washing and flying. Are the apples from Chile or Argentina? The string beans from Kenya? Then don’t buy them

Spread the word. We haven’t got long

KEY POINTS

- Rapid changes in the Earth’s climate are occurring, and are unequivocally the result of human production of ‘greenhouse gases’.
- Unless very rapid reductions in such emissions are made – within a few years – we face global temperature rises of 6.5°C.
- These changes would have devastating effects on the health and survival of the human species.
- Individuals have an imperative to act at once, while encouraging politicians and businesses to do likewise.

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