Climate change in earth history: policy implications

Deep time context

As we wait to see how climate will evolve over the next century, we may increasingly draw lessons from the climate of Earth's deep past. Thus, human civilization has been allowed to develop to its present extent because the last ten thousand years – when set against the context of the last million years – have seen unusual stability of climate and sea level. That situation looks set to change.

It is beyond doubt that earth's climate over the last few million years has been controlled by variations in the earth's spin around its own axis and orbit around the sun, operating on cycles tens of thousands of years long. It is also clear that the climate changes have not smoothly followed these cycles, but have shown abrupt (decade-scale) flips from one climate state to the other, and that these have been associated with changes in atmospheric levels of carbon dioxide and methane, as recorded in air fossilized within the icecaps of Greenland and Antarctica. The situation is further complicated by shorter-term (millennial-scale) climate variations, the causes of which remain poorly understood.

The human effect

The contribution of humanity since the Industrial Revolution has been to cause the largest single and most abrupt perturbation to these global geological cycles for several million years. The scale of this change has led some scientists to suggest, with all seriousness, that we have entered a new geological epoch, christened the Anthropocene.

Of all of these man-made changes, the most far-reaching is likely to be the several hundred billions of tons of carbon transferred from terrestrial reservoirs to the atmosphere, over an exceptionally short time: less than 200 years. This release is unprecedented in the context of recent earth history, not least because it is happening during a warm phase of the current Ice Age.

Fossilized global warming events

Recent research has shown, though, that there have been precedents for such carbon releases farther back in earth history. The two best-known episodes occurred some 55 and 180 million years ago respectively, when carbon transfers on a similar scale (probably derived from the decomposition of methane hydrates stored in ocean sediments) were associated with geologically rapid global temperature rises of between 5 and 8 degrees centigrade, that persisted for the order of 100,000 years.

Such temperature increases, if repeated in the near future, would almost certainly lead to melting of a substantial part of the global icecaps, and the subsequent sea level changes of tens of metres, in removing a large fraction of the earth's arable land, would render unsustainable earth's current global population, let alone the extra 2-4 billion people predicted for the coming century. Research published this year has confirmed that the Greenland and Antarctica icecaps are showing considerable overall ice loss – measured in hundreds of cubic kilometres annually. There is now serious concern that such ice loss might accelerate markedly in the future[1].

Policy implications

What are the policy implications? It is clear to us that:

Further research into these and related phenomena are imperative, not to establish their reality (which are beyond reasonable doubt), but to constrain further the exact mechanisms involved and their timing.

The clear dangers of global warming are not currently being matched by adequate funding of either mitigation or adaptation strategies, nor by overall economic strategy. For instance, funding for carbon sequestration is counted in terms of millions of pounds, while funding for (say) identity cards or health service computer systems is counted in billions. This is not to decry the latter, but simply to provide some comparison of perceived relative importance. Similarly, the continued lack of fiscal constraints on aviation sends a strong message to the public that economic growth and cheap air transport are more important than reducing the carbon dioxide emissions from this source.

We note the mismatch between the rigour of the current health and safety regulations that increasingly govern our lives (even where minimal risk is involved) and the apparent negligence of the health and safety of our children and grandchildren, given the probability that the lives of many will be curtailed by lack of nourishment, living space or civil order, brought on by climate change. We urge consideration of, and action on, these matters.

The Stratigraphy Commission of the Geological Society of London

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[1] The March 24th 2006 issue of Science includes several remarkable articles detailing the history and current health of the world's icecaps.