Climate Change Discussions in Washington: A Matter of Contending Perspectives

MICHAEL C. MacCRACKEN[1]

Climate Institute
Washington, DC 20036, USA
Email: mmaccrac@comcast.net

ABSTRACT

The scientific evidence and understanding underpinning societal responsibility for the accelerating pace of climate change has become increasingly strong over the past hundred years. Although many nations have begun to take actions that have the potential to eventually slow the pace of change, contention over the issue continues in the United States, particularly in the nation's capital. A major cause appears to arise from different interpretations of the evidence arising from different perspectives on the issue, including those of the scientific, environmental, fossil-fuel generating, technological, economic and ethical communities. In addition, the public encounters a cacophony of intermixed perspectives from the media and elected officials. While each perspective provides some useful insights, each alone contributes to inhibiting development of the national political consensus needed to responsibly address climate change. Without leadership that balances and reconciles competing perspectives, it is unlikely that a sufficient limiting of emissions will be enacted to prevent significant changes in climate that will impose increasing challenges for those in both developing and developed nations.

KEY WORDS

Climate change, climate change policy, global warming, climate impacts, perspectives on climate change, uncertainties and climate change

INTRODUCTION

Over one hundred years ago, Swedish scientist Svante Arrhenius recognised that human activities were increasing the atmospheric carbon dioxide (CO_2) concentration, and that this would cause the world to warm (Arrhenius, 1896). By the 1930s, preliminary measurements by British scientist G.S. Callendar

Environmental Values **15** (2006): 381–95

indicated an increase in both the CO_2 concentration and Northern Hemisphere average temperature (Callendar, 1938). By the late 1950s, American scientist Roger Revelle and Swiss scientist Hans Suess had explained why the growing emissions of CO_2 would not be taken up rapidly by the oceans, making clear that humanity's 'great geophysical experiment' would influence atmospheric composition and the climate for centuries (Revelle and Suess, 1957). In 1965, a distinguished panel of the President's Science Advisory Council (PSAC) summarised the science and reported that climate change was an important emerging issue meriting attention (PSAC, 1965). Although in the 1970s there were over-publicised suggestions that the few-decades cooling of the 1950s and 1960s could intensify into an ice age, the potential warming influence of the increasing CO_2 concentration began receiving more and more scientific attention. By 1978, the US Department of Energy (DOE) had initiated a major research program and, in 1979, the American Association for the Advancement of Science organised a workshop that generated reports describing, to the extent understood, the potential impacts on society and the environment[2] (updated later in NAST, 2000). By the mid 1980s, the National Research Council (NRC) and the DOE had both issued reports that detailed the state of scientific understanding, clearly establishing the significance of human-induced climate change (NRC, 1983; DOE, 1985a, 1985b).

Recognition of the growing prospect of human-induced changes in the climate by the world community emerged in the early 1970s (e.g., SCEP, 1970; SMIC, 1971), and the World Climate Research Programme began in 1979. By 1985, an international meeting in Villach, Austria had called for governments to take the issue seriously (WMO, 1985). Building on the success of the international effort to protect the Earth's stratospheric ozone layer, the UN established the Intergovernmental Panel on Climate Change (IPCC) in the late 1980s and tasked it with preparing comprehensive scientific assessments. Since 1990, IPCC has published three comprehensive assessments (e.g., see IPCC, 2001a, 2001b, 2001c), all *unanimously* accepted by the roughly 180 nations that make up the IPCC. For no other major issue is there such a broad international consensus of scientific understanding and the prospects for future conditions.

With a Herculean effort, the world community of nations has started to respond. At the 1992 Earth summit in Rio de Janeiro, the United Nations Framework Convention on Climate Change (UNFCCC) was negotiated. It called for developed nations to reduce their emissions back to 1990 levels, and set the long-term objective of 'stabilization of the greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system'. They added that '[s]uch a level should be achieved within a time frame sufficient

- to allow ecosystems to adapt naturally to climate change,
- to ensure that food production is not threatened, and

• to enable economic development to proceed in a sustainable manner'.

Although the voluntary actions of the developed nations led to only very limited progress during the 1990s, the Kyoto Protocol was negotiated in 1997 (and elaborated upon over the next few years) as the next step in the UNFCCC process. As finally negotiated, the Protocol calls for the major developed nations to reduce their greenhouse gas emissions for the period 2008–12 to, on average, several per cent below their 1990 levels. The Protocol went into effect in early 2005 after it had been ratified by a sufficient number of nations; notably, however, neither the United States nor Australia has ratified the Protocol, and neither has yet taken significant steps to reduce their emissions.

While it may appear that the scientific community and world leaders have come a long way over the past 13 years, there is much further to go to meet the UNFCCC objective and the length of time that it has taken to get to where we are today has made the task ahead very challenging. This paper provides one perspective on the slow progress in the US, suggesting that a major factor is the failure of leadership to reconcile multiple, arguably legitimate but incomplete, viewpoints and perspectives. As a result, the mainstream media are faced with a very wide set of viewpoints and analyses to distil and present, leading to a diffused and confused message, especially as the more polarised views of special interest groups and media were also more widely published and became more available over the Internet.

A SCIENTIFIC PERSPECTIVE

As summarised by the IPCC, there is a well-established scientific consensus that the changes in climate projected to result from scenarios of unconstrained emissions will lead to substantial environmental impacts and societal consequences. Moderating the projected impacts will require very substantial reductions in net CO_2 emissions as well as substantial adaptation to ameliorate the negative consequences of the climate change resulting from past and inevitable future emissions.

Understanding the general outline of the issue, however, has not proven sufficient to generate national action. Because of its perceived responsibility for building a solid 'pyramid of knowledge', the scientific community is doggedly pursuing a full, quantitative explanation of what is happening and why. By tradition, the hypothesis-testing approach that is most often relied upon to evaluate scientific results requires, for example, achieving high statistical significance as a means of minimising the chances that mistaken explanations for various phenomena are adopted.

The Earth system, however, is among the most complex systems being researched by the scientific community. While much can be learned about how the Earth system works from studying its past behaviour, lacking an experimental model and lacking adequate records from analogous times before humans were influencing the climate, computer-based climate models have had to become the primary means for projecting future changes in the climate. Because of limitations in the observations and unknowables in the prediction of future emissions, the resulting projections of climate change are made broad to ensure that virtually all eventualities are encompassed.

Communicating scientific findings to policymakers is proving to be a challenge, requiring careful attention to how confidence and uncertainties are expressed.[3] For example, IPCC Working Group I dealing with the science of climate change utilised a lexicon of familiar terms to convey its view of the relative likelihood of occurrence given current scientific understanding (IPCC, 2001a, p. 2):

>99% chance	*Virtually certain*
90–99% chance	*Very likely*
66–90% chance	*Likely*
33–66% chance	*Medium likelihood*
1–10% chance	*Unlikely*
<1% chance	*Exceptionally unlikely*

Both the supposed precision of the categories and the failure to indicate how much confidence to place in these estimates have been questioned, leading IPCC to propose a two-stream lexicon for its fourth assessment (IPCC, 2004). In addition, the selections invoke the judgment of scientific experts, stretching further what can be rigorously determined and defended. Climate change sceptics have generated some public confusion as a result of these efforts to balance strict adherence to the scientific tradition of hypothesis testing with usefully communicating the most foreseeable outcomes to decision-makers and the public. Despite the remaining limitations in scientific understanding, national academies and major scientific organisations in the US and elsewhere are indicating that climate change is real and these actions should be recognised as an indication of how significant, serious and definitive the evidence and understanding of climate change has become.[4]

A CONSERVATION PERSPECTIVE

For environmental conservationists, the delay resulting from the pursuit of scientific results that can be concluded with high statistical confidence has been, at best, unfortunate because this position often leads to the presentation of overly qualified findings concerning climatic, environmental and societal impacts and risks. Given that there is only one *Spaceship Earth* and no extraterrestrial lifeboat, initiating irreversible change is viewed as obviously dangerous and unacceptable.

Rather than a primary focus on achieving the high statistical confidence characteristic of the scientific community, those focused primarily on conservation of existing environmental resources generally favour basing decision making on the 'precautionary principle'. Applying this perspective and seeking to minimise risk often leads to a focus on pointing out how much climate change is possible, so attention to the upper limits of the scientific results,[5] including especially the potential for amplification of global average changes at high latitudes. The search for assuredly safe scenarios has also been complicated because it has proven difficult to project the impacts of climate change on the environment and society (e.g., see IPCC, 2001b) and, to date, not possible to objectively constrain the upper bound of what could occur.

With significant environmental changes already occurring, especially in high latitudes (ACIA, 2004), and with much more change being inevitable as the climate system continues to try to catch up with past emissions, preventing as much change as possible becomes the central goal. Urgency in reducing emissions is also viewed as critical to ensure that climate thresholds are not crossed. Hesitation, according to this view (and that of many of those living in the Arctic), has put environmental, and even cultural, existence and *Spaceship Earth* at substantial and unacceptable risk.

Focus on the worst possible cases, however, has opened environmentalists to the charge of being alarmists, a perspective that, it has been suggested, has led to the death of environmentalism because the upper bound outcomes have not always resulted.[6] By the scientific community broadening their estimates of the range of possible outcomes to ensure that they will not be wrong and the pyramid of knowledge will not be compromised, a situation has been created where the care and caution of the scientific community has contributed to undermining the credibility of those whose primary focus is on the great value to society of the environment and essential ecological services.

A FOSSIL-FUEL INDUSTRY PERSPECTIVE

Burning coal, oil and natural gas provides roughly 80 per cent of the world's energy. Without such energy and related services, the global economy could not sustain the world's 6.5 billion people. Fossil fuels are the source of this energy because they are the most available and least expensive, given the present energy infrastructure. When most convincingly making their case for delays in limiting emissions, the industry's leaders argue that sequestration or switching to renewables would divert money from other important societal needs.[7] Because this would create hardship (or foregone benefits), they argue that society should only respond to 'sound science', which is interpreted to mean having a very high level of confidence that the specified changes will occur. Looking at the status of current scientific understanding, this perspective leads to a focus on the lower bounds of the scientific estimates of climate and environmental change and how well these bounds can be defended.

Were only the fossil-fuel energy providers making this case, their perspective could be balanced with the other perspectives. Unfortunately, a few energy companies are supporting a very vocal, but small number of contrarian scientists and 'think' tanks that are quoted by the media in opposition to the scientists presenting the IPCC consensus, often presenting the two sides as equal and seeming to give no deference to the credibility of the IPCC view created by its very careful and intensively reviewed summarisation of scientific understanding.[8] This effort has been particularly effective in the US because these scientists are often portrayed in the media as simply being sceptical, a trait instilled in all scientists, rather than as being highly selective interpreters of the literature.

AN ECONOMIC PERSPECTIVE

The assertion by the energy industry that restricting fossil fuel combustion will surely increase the cost of energy has led to attempts to actually estimate the costs of switching from the fossil fuel energy path to other, less climatically disruptive paths (e.g., IPCC, 2001c). Progress on cost-benefit analyses is being made, but there have been many complications along the way, and many still remain.

To estimate the cost side, a base case must be developed – what would the costs be were climate change not an issue? In making the estimates, assumptions must be made about the quantities and prices of fossil fuel resources, the pace of development and prices of renewable technologies, the growth in population and energy demand, the improvement in labour productivity, the nature of the products and services, the functioning of world markets, and the occurrence of disruptive events – all subject to ranges and uncertainties. Then an estimate must be made assuming that controls on CO_2 emissions are instituted, requiring assumptions about how and when this is done, how revenues from any taxes or permits are recycled, how much research in alternative technologies can be stimulated, how energy demand and efficiency will change, how much change will occur in countries around the world and how prices and the market will adjust. As an anecdotal indication of the range of estimates that emerge, an industry presentation on costs at a 1997 meeting of the Virginia Coal Council put the cost at $200 per ton of CO_2 emissions reduced, whereas a utility CEO said his company was sequestering carbon by planting trees in South America at $2 per ton. Even though such uncertainties appear to dwarf uncertainties in projections of climate change, the President, in withdrawing the US from the Kyoto Protocol, cited the large uncertainties in climate science and selectively drew results from an industry-sponsored economics model to justify the conclusion that regulating carbon emissions would seriously impact the economy and employment.[9]

Estimating the benefits of reduced emissions is also problematic. Not only is there the challenge of determining how the environment and society will be impacted (IPCC, 2001b, NAST, 2000), but also the problem of assigning value to the impacts, and to impacts in one societal context versus another (an equity problem). For example, the cost of losing maple trees in New England, of flooding coral atolls and relocating their residents, of sustaining tropical forests, and of the likelihood of prospective irreversible change in the future must be estimated and compared to the cost, for example, of switching to wind power.

Finally, how the results have been presented has coloured the discussion. The cost of a global transition from fossil fuels to renewables is estimated to be a few tens of trillions of dollars – roughly one year's global economic output. However, the economic impact can alternatively be expressed as slowing the twenty-first century average growth rate of global GDP by a few tenths of a per cent,[10] or as giving out annual raises every 53 weeks instead of every 52 weeks – all in exchange for taking sufficient action to halt human-induced climate change.

AN ENERGY TECHNOLOGY PERSPECTIVE

The global energy system currently generates about 12 terawatts of energy – roughly 2 kilowatts per capita, with over 80 per cent coming from combustion of coal, oil and natural gas (Hoffert et al., 2002); US per capita usage is about 5 times this average value. The development of the technologies to accomplish this has been a remarkable achievement; there is no way that the energy system of a hundred years ago could have sustained the population and standard of living of today. But the developments of this past century have been mainly ones of scale – we have many more power plants, many more buildings and many, many more automobiles and trucks. Certainly the devices are more efficient, but the proportional reliance on fossil fuels remains about the same.

During the twenty-first century, the international population is projected to increase by roughly 50 per cent. To meet global needs, overall energy supply must increase by several hundred per cent. At the same time, production of conventionally derived oil is likely to peak over the next few decades, with a significant decline in production occurring even as prices rise substantially. As a result, coal, oil shale and tar sands are likely to be the most affordable and technologically accessible energy resources to meet the needs of the growing population. Even accounting for conservation and efficiency gains, the projected combustion of fossil fuels will lead to very significant changes in climate unless most of the carbon is sequestered (i.e., injected deep underground or possibly deep in the oceans). To limit climatic effects, there is no choice but to be optimistic that the needed technologies will be developed, for, if they are not, future generations will be living in a very different world.

Unfortunately, however, the current level of investment in long-term energy R&D has generally been stagnant or decreasing just as the long-term problem facing the world is becoming bigger and clearer.[11] Few politicians are addressing the long-term energy situation, being drowned out by special interests and short-term responses.

A NATIONAL SECURITY PERSPECTIVE

The well-being of every country depends on a robust economy, and this requires having a long-term, reliable and increasing source of energy. With petroleum powering the global transportation system, with the supply tightening as international demand grows, with the political instability in the source region, and with the massive amounts of money for petroleum going mainly to a few countries (and some apparently going on to terrorist organisations), there has been serious national concern about the significant US reliance on petroleum.

As a result, some argue that top priority should be ensuring that US energy supplies are more secure. Rather than focus on the need for all nations to have sufficient and reliable energy, this perspective is focused on meeting US needs independent of the consequences for the climate. Thus, the Bush Administration's national energy plan called for building up to 1800 new, coal-fired power plants.

Economically, addressing problems piecemeal is least efficient. The world is now intimately tied together through trade, shared international resources, health, and family and ethnic ties. While an isolationist approach to meeting US needs might serve national interests over the short-term, leaving others to fend for themselves, and especially to try to deal with the disruptive consequences of climate change, seems very likely to severely damage the long-term interests of both the US and other countries. What seems most important is to be taking a very broad view of what influences 'national security'.

AN ETHICAL PERSPECTIVE

In 1998, the Committee for a Dialogue between Science and Religion of the American Association for the Advancement of Science (AAAS) sponsored a climate change symposium that brought a number of scientists together with representatives of major US religious traditions, each of whom explained their religion's perspective on the environment and human actions and responsibility.[12] Since that event, a number of religious groups have taken stands on climate change. For example, in 2001, the US Catholic Bishops approved a very thoughtful statement.[13] Acknowledging that they would not be recognised as experts in the science, economics, technology or politics of climate change, their statement focused on the ethical and moral aspects. They called for public discussion to focus on issues of distributional, international and intergenerational equity, and on responsible stewardship of God's creation. Recently, the evangelical Christian community has begun to raise similar concerns.[14]

How consideration of equity and stewardship would be accounted for is not completely obvious. With not all energy being from carbon, with different needs for energy, and with different locales providing different opportunities for non-carbon energy, the difficulties of an equity-based accounting scheme could become insurmountable. In addition, basic economic theory teaches that arbitrary and inflexible distributions of responsibility (e.g., requiring every nation to have the same per capita emissions) would tend to raise costs and create inefficiencies, only some of which could likely be overcome with an international permit system. Because fairness is, for many, a moral requirement, however, it will be important to understand the degree to which pursuit of equity will tend to raise overall costs, including for the poor and disenfranchised.

AN INDIGENOUS PERSPECTIVE

The homelands of indigenous peoples have, to a large extent, been established on special tracts or on marginal lands, creating boundaries that limit relocation, which has been their traditional adaptive response to environmental stress. Experience is indicating that the climatic conditions in these marginal lands, for example in the Arctic, are changing more rapidly than elsewhere, and the resulting impacts are becoming evident sooner and more deeply affecting their cultures and communities. For example, those living in many coastal regions will need to be moved inland to escape shoreline erosion that is amplified by meltback of the sea ice (GAO, 2004), forcing significant changes in their subsistence traditions and cultural identity (ACIA, 2004).

For many of these peoples, the preferred course of action would be to halt the warming and sea level rise, but that is no longer possible given the ongoing climatic adjustments to past emissions. Because of the threatened extent of these consequences, indigenous peoples are increasingly voicing their concerns about the imperative of limiting climate change.

A MEDIA PERSPECTIVE

Having such a range of perspectives, each interpreting the scientific results in ways most supportive of its position, has led to a very disjointed media perspective.[15] Seemingly trained to always present two sides of an issue, that there are many more defensible perspectives has tended to generate a jumble of views as different reporters in different regions end up talking with different people, each with their own particular perspective. The media's handling (or mishandling) of reporting the science has become so contentious that an academic study of the situation suggested that it was becoming irresponsible for reporters to be presenting contrarian scientific views (Boykoff and Boykoff, 2004). But, is censoring (even self-censoring) scientific or public debate the best, or only, way to build public consensus?

The real need is for a more nuanced presentation, with articles explaining the perspectives and terminology being used in evaluations and differing views being weighted by the rigour of the arguments and the review processes that underpin them. The public debate is suffering, at least in part, because reporters must often deal with so many stories at once[16] and because limitations of time and space seem to preclude providing needed nuance and detail.

A further complication is that the US is geographically so large. The European community of nations is about the size of a climate anomaly, so the very hot summer of 2003 in much of Europe was widely experienced. As a result, scientific findings indicating that this type of event is being made more likely as a result of climate change are being accepted and acted upon. The US, however, is roughly the size of two climate anomalies; when the West is having a hot, dry summer, the East is having a cool, moist one. The focus in most media discussion on the change in the global average temperature gives the impression that this is the amount of change the average person will experience, whereas when indications are given that the changes will vary by location, the climate sceptics assert that the differing conditions are an indication of a natural fluctuation rather than global warming. With at least some reporters asking if each unusual event (e.g., Hurricane Katrina, or even the very active 2005 hurricane season in the Atlantic) is due to global warming or not, the explanation that what climate change will do is to slowly change the likelihood of unusual and extreme events, in some cases by strengthening a wave pattern that intensifies opposing conditions across the US, is too subtle and complicated to be easily communicated. Nor is the fact that effects can seem to be quite perverse helpful in building a public consensus.

Thus, the media is hindered both by its approach to reporting the news, and by the complications and slow onset of the climatic changes themselves. If the media focus on extreme events, they are accused of fear mongering, but if they don't, they are accused of underplaying the issue. Achieving balance and explaining the long-term nature of climate change at the same time that so many other long-term issues are being ignored pose both an important, yet complicated, challenge and obligation for journalists.

A POLITICAL PERSPECTIVE

Ideally, elected leaders should be reconciling the various perspectives and proposing an approach that responsibly addresses the issue and can be supported by a large majority. This was the case early in the 1970s when a number of far-reaching pollution laws were passed with bipartisan support. Even if this were still the case, however, the many contending and defensible perspectives would make this difficult.

That most of the developed nations ratified and are implementing the Kyoto Protocol has been particularly impressive, although the commitments made, even if fully met by all the developed nations (so also by the US and Australia which have not yet ratified the Protocol and say they will not) and maintained through the twenty-first century, would only reduce emissions by roughly 10–15 per cent compared to what is needed for stabilisation. Finding a solution that neither interferes with the development aspirations of those in the developing world nor significantly erodes the standard of living of those in the developed world remains an important challenge.

President Bush has taken a national and worldwide pummelling for pulling the US out of the Kyoto Protocol in 2001. In doing so, his reasoning alienated many sectors of the international community, including the scientific community by saying the results were too uncertain, developing nations by failing to recognise all that they are doing and insisting that they formally agree to do even more, and the parties to the Kyoto Protocol by pulling out, offering a virtually do-nothing approach, and indicating that he would not support sacrifice of even one US job to protect the global environment.

However, the US did really face a very large challenge if it was going to meet the Protocol's requirements, especially because efforts were not able to get started in 1997 because of continuing negotiations and Congressional proscriptions. In addition, unlike Europe, whose population is starting to decline, the US population is increasing by roughly one per cent per year. As a result, on a per capita basis, the European signatories need to cut their carbon emissions by only a few per cent, whereas the US would need to reduce per capita emissions by over 30 per cent – and do so in less than a decade. While the Europeans close an inefficient plant when they open a new one, the US must keep the old plant open to avoid power failures as the standard of living of immigrants is raised to the national average. This is no excuse for the US not doing more than it is, but there was no feasible way for the US to meet its Kyoto commitment.

The Administration approach currently focuses on the ratio of GDP output to carbon emissions rather than on total emissions, seeking to ultimately reduce emissions by increasing the rate of improvement of this relative measure. With the increasing US population (and it would seem unlikely, uncharacteristic and arguably inequitable, for the US to further restrict immigration), a relative measure is attractive. However, with voluntary measures inadequate to reduce

2000 emissions to their 1990 levels as agreed to in the UNFCCC, President Bush proposed even fewer voluntary measures for the period out to 2012 than had previously been in place, allowing total emissions to continue to rise significantly (USG, 2002). While additional technological and scientific research efforts are a necessary step (and remain underfunded), new technologies in the absence of legislated constraints will not soon slow the pace of US emissions.

MOVING FORWARD

In early 2002, the EPA sponsored an effort by the non-partisan Jefferson Institute to convene a 'Citizens' Jury' on climate change. A representative set of 18 citizens was convened to hear three days of 'testimony' by representatives of the scientific, environmental, fossil fuel, technological and other communities, and then to deliberate about what they had heard and recommend how to move forward. The participants agreed that a great deal more needs to be done than is being done.[17] In contrast to the Citizen Jury's recommendations, however, the US Administration continues to assert that the scientific projections remain very uncertain (CCSP, 2003) and that no action is appropriate until the uncertainties are resolved, something that science is unlikely to ever fully accomplish.

While the increased activity of cities, states and other nations is encouraging, making really significant progress will require a much more encompassing set of actions, starting aggressively and building steadily over time, thereby benefiting from a compounding of the actions. With so many perspectives and aspects contending (some merely with information, and some with more tangible resources), with so much riding on what is decided and with no preferred strategy, that the American people and Congress are having difficulty agreeing on a way forward is perhaps understandable, even if unacceptable environmentally.

What is most needed now in the US is national leadership and national action, and initiatives are starting to emerge from members of Congress. In that there will not be a 'silver bullet' that will simply replace all fossil fuels, a broadly based, portfolio approach involving many different steps will be required. Among the most important steps that are needed are to: greatly increase the energy efficiency of buildings, appliances, lighting and vehicles; expand development of and energy supplies from non-fossil sources of energy, including especially renewables and recapture and use of methane; and initiate a tax or permit system that will create a predictable trajectory of continuously increasing costs for emission of greenhouse gases, particularly from use of fossil fuels. Unless an aggressive effort is begun in the near term, there will be a deteriorating legacy for future generations.

NOTES

[1] The views presented in this article are those of the author, and not necessarily of any of the organisations with which he is or has been affiliated.

[2] The results of this workshop are available through the archives program of the AAAS; see http://archives.aaas.org/aids/Climate.php.

[3] There is an entire literature on this topic. For an overview, see, for example, Hass, P. M., 2003: 'When does power listen to truth?' Keynote address to Workshop on Sustainability Impact Assessment of Trade Agreements and New Approaches to Governance, 28 March 2003, Geneva (see http://biogov.cpdr.ucl.ac.be/sustra/haas.pdf). Others focusing on the issue of effectively communicating science for policy include Sylvia Jasanoff and Silvio Funtowicz.

[4] For example, see http://nationalacademies.org/onpi/06072005.pdf.

[5] That this was the case was made most clear following publication of the IPCC's Third Assessment Report, when much of the reporting about this report focused on the upper end of the change in global average surface temperature being 5.8ºC (over 10ºF).

[6] See 'The death of environmentalism: Global warming politics in a post-environmental world', an essay by Michael Shellenberger and Ted Nordhaus, http://www.grist.org/news/maindish/2005/01/13/doe-reprint/.

[7] For example, see speech by Lee Raymond, CEO of ExxonMobil at the time, at http://www2.exxonmobil.com/corporate/Newsroom/SpchsIntvws/Corp_NR_SpchIntrvw_KLSpeech_100602.asp.

[8] See, for example, 'As the world burns' by B. McKibben, C. Mooney and R. Gelbspan, and 'Climate of denial' by B. McKibben in *Mother Jones*, May/June 2005 (http://www.motherjones.com/toc/2005/05/index.html). See also 'Climate change research distorted and suppressed', Union of Concerned Scientists, at http://www.ucsusa.org/scientific_integrity/interference/climate-change.html.

[9] See http://www.whitehouse.gov/news/releases/2001/06/20010611-2.html and http://www.whitehouse.gov/news/releases/2002/02/20020214-5.html.

[10] For example, see 'Climate gas cuts "are affordable"', describing analyses of John Schellnhuber at http://news.bbc.co.uk/1/hi/sci/tech/3975325.stm.

[11] For example, see http://www.globalchange.umd.edu/?energytrends.

[12] See http://www.aaas.org/spp/dser/02_Events/Conferences/CF_1998_100102_Climate.sh tml.

[13] 'Global climate change: A plea for dialogue, prudence, and the common good', downloadable from: http://www.usccb.org/sdwp/international/globalclimate.htm.

[14] See http://www.christiansandclimate.org/statement.

[15] See, for example, 'Blinded by science: How "balanced" coverage lets the scientific fringe hijack reality' by Chris Mooney, viewable at http://www.cjr.org/issues/2004/6/mooney-science.asp.

[16] Across the mainstream media in the US, only Andy Revkin of *The New York Times* is devoted full time to global environmental change. In addition, there are a few independent journalists devoting most of their time to this issue.

[17] The report 'Citizens jury: Global climate change' is downloadable from http://www.jefferson-center.org under 'Past projects'. Politically imposed limitations prevented EPA from posting the report on its Website.

REFERENCES

Arctic Climate Impact Assessment (ACIA). 2004. *Impacts of a Warming Arctic: Arctic Climate Impact Assessment*. Cambridge: Cambridge University Press.

Arrhenius, S. 1896. 'On the influence of carbonic acid in the air upon the temperature of the ground', *Philosophical Magazine* **41**: 237–76.

Boykoff, M. and J. Boykoff. 2004. 'Bias as balance: Global warming and the U.S. prestige press', *Global Environmental Change* **14**: 125–36.

Callendar, G.S. 1938. 'The artificial production of carbon dioxide and its influence on temperature', *Quarterly Journal of the Royal Meteorological Society* **64**: 223–40.

Climate Change Science Program (CCSP). 2003. 'Strategic Plan for the U.S. Climate Change Science Program, Subcommittee on Global Change Research'. Washington, DC (see http://www.climatescience.gov/Library/stratplan2003/final/default.htm).

Department of Energy (DOE). 1985a. *Projecting the Climatic Effects of Increasing Carbon Dioxide*, ed. M.C. MacCracken and F.M. Luther, DOE/ER-0237. Washington, DC: US Department of Energy.

Department of Energy (DOE). 1985b. *Detecting the Climatic Effects of Increasing Carbon Dioxide*, ed. M.C. MacCracken and F.M. Luther, DOE/ER-0235. Washington, DC: US Department of Energy..

Government Accounting Office (GAO). 2004. *Alaska Native Villages: Villages Affected by Flooding and Erosion Have Difficulty Qualifying for Federal Assistance*, GAO-04–895T. Washington, DC.

Hoffert, M.I., et al. 2002. 'Advanced technology paths to global climate stability: Energy for a greenhouse planet', *Science* **298**: 981–7.

Intergovernmental Panel on Climate Change (IPCC). 2001a. *Climate Change 2001: Synthesis Report; Climate Change 2001: The Scientific Basis, ed. J. Houghton et al*. Cambridge: Cambridge University Press (available at http://www.grida.no/climate/ipcc_tar/wg1/index.htm).

Intergovernmental Panel on Climate Change (IPCC). 2001b. *Climate Change 2001: Impacts, Adaptation and Vulnerability*, ed. J. McCarthy et al. Cambridge: Cambridge University Press (available at http://www.grida.no/climate/ipcc_tar/wg2/).

Intergovernmental Panel on Climate Change (IPCC). 2001c. *Climate Change 2001: Mitigation*, ed. B. Metz et al. Cambridge: Cambridge University Press (available at http://www.grida.no/climate/ipcc_tar/wg3/index.htm).

Intergovernmental Panel on Climate Change (IPCC). 2004. Report of the Workshop on Describing Scientific Uncertainties in Climate Change to Support Analysis of Risk and of Options, Maynooth, Ireland, 11–13 May 2004, ed. M. Manning et al. Geneva: IPCC, WMO (available at http://www.ipcc.ch/pub/support.htm).

National Assessment Synthesis Team (NAST). 2000. *Climate Change Impacts on the United States: The Potential Consequences of Climate Variability and Change*.

Overview Report, *U. S. Global Change Research Program*. Cambridge: Cambridge University Press.

National Research Council (NRC). 1983. *Changing Climate*, Report of the Carbon Dioxide Assessment Committee. Washington, DC: National Academy Press.

President's Science Advisory Committee (PSAC). 1965. *Restoring the Quality of our Environment*, Report of the Environmental Pollution Panel. Washington, DC: The White House, November 1965.

Revelle, R. and H.E. Suess. 1957. 'Carbon dioxide exchange between atmosphere and ocean and the question of an increase of atmospheric CO_2 during the past decades', *Tellus* **9**: 18–27.

Study of Critical Environmental Problems (SCEP). 1970. *Man's Impact on the Global Environment: Assessment and Recommendations for Action*. Cambridge, Massachusetts: MIT Press.

Study of Man's Impact on Climate (SMIC). 1971. *Inadvertent Climate Modification: Report of the Study of Man's Impact on Climate (SMIC)*. Cambridge, Massachusetts: MIT Press.

US Government (USG), 2002: *U. S. Climate Action Report – 2002, Third National Communication of the United States of America under the United Nations Framework Convention on Climate Change*. Washington, DC: US Government Printing Office.

World Meteorological Organization (WMO). 1985. *Report of the International Conference on the Assessment of the Role of Carbon Dioxide and of Other Greenhouse Gases in Climate Variations and Associated Impacts*, World Meteorological Organization Publication #661. Geneva: WMO.