IRREVERSIBLE CLIMATE CHANGE WILL ALSO CHANGE ENVIRONMENTAL ASSESSMENT AND MANAGEMENT

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Environmental and management methods and procedures developed for the planet's present climate will not be effective after irreversible climate change occurs. To quote Rubin (2009, p 17) ''Suddenly the text books seem to be describing some other world than the one we live in.'' Because the results of climate change cannot be known until they do occur, the focus of new environmental and management methods and procedures is unknown at present, but professionals should be prepared to act when they are known. Anthropogenic greenhouse gas emissions are still rising, and reaching zero discharge of carbon dioxide is not probable as long as fossil fuels (petroleum, coal, natural gas) are a major source of energy. As a consequence, environmental changes that have already occurred are not likely to be reversed. ''The severity of damaging human-induced climate change depends not only on the magnitude of the change but also on the potential for irreversibility . . . the climate change that takes place due to increases in carbon dioxide concentration is largely irreversible for 1,000 years after emissions stop'' (Solomon et al. 2009, p 1704). ''Global average temperatures increase while CO2 is increasing and then remain approximately constant (within __ 0.58C) until the end of the millennium despite zero further emissions . . . '' (Solomon et al. 2009, p 1705).

Therefore, humankind is likely to experience climate change for 1000 years after anthropogenic carbon dioxide emissions cease. Nonanthropogenic carbon is in the atmosphere—e.g., drying wetlands, thawing permafrost—and these positive feedback loops are likely to accelerate. Rapid climate change may soon become the norm, and all humankind must adjust to it effectively. Obviously, global problems require global collaborations from the world's nations. Failure to do so effectively will ensure that climate change continues.

The encouraging aspect of collaboration and improvisation is that ''carbon dioxide is the only greenhouse gas whose falloff displays multiple rather than single time constraints . . . Current emissions of major non-CO2 greenhouse gases such as methane or nitrous oxide are significant for climate change in the next few decades or century, but these gases do not persist over time in the same way as carbon dioxide'' (Solomon et al. 2009, p 1705).

Reasons for Concern

Reasons for concern about stabilizing greenhouse gases in the atmosphere that impact climate change are identified in the Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) (Smith et al. 2009). The risks after 1990 for each increase in temperature from 0 to 5 8C in global mean temperature are substantial: 1) risk to unique and threatened systems, 2) risk of extreme weather events, 3) distribution of impacts, 4) aggregate damages, and (5) risks of large-scale discontinuities (e.g., tipping points). Article 2 of the United Nations Framework Convention on Climate Change (UNFCCC) commits signatory nations to stabilizing greenhouse gas concentrations in the atmosphere at a level that ''would prevent dangerous anthropogenic interference (DAI) with the climate system'' (United Nations 1992; http://unfcc.int/resource/docs/convkp/convegn.pdf). ''The UNFCCC also highlights 3 broad metrics with which decision-makers are to assess the pace of progress toward this goal: allow 'ecosystems to adapt naturally to climate change,' ensure that 'food production is not threatened,' and enable 'economic development to proceed in a sustainable manner'' (Smith et al. 2009, p 4133).

The above metrics are very difficult assessment and management goals, especially because the present reasons for concern indicate that the perceived risks are significantly greater than they were in 2001. The changed perception of risks is quite understandable because much more data were available in 2009 than in 2001, but the methods and procedures for assessing risks during rapid climate change are, at best, in the early formative stages.

''As was true in the TAR (Third Assessment Report of the IPCC), the aggregation of risk across many different sectors, regions, or populations under a particular reason for concern is subjective and thereby introduces another source of uncertainty'' (Smith et al. 2009, p 4135). However, anthropogenic greenhouse gas emissions are still increasing substantially, and, as global mean temperature increases, carbon emissions in positive feedback loops from stored carbon (e.g., wetlands and tundra) are likely to increase as well, further exacerbating the problem.

Natural Capital and Ecosystem Services

Although the three broad metrics highlighted by the UNFCCC are persuasive, none will be achieved if the biospheric life support system fails. As a consequence, this potential failure dramatically increases the risks to which humankind may well be exposed in the near future. Little has been done to protect either natural capital or ecosystem services in comparatively robust economic times, so the prospects of any significant actions during a global financial meltdown seem dim. However, humankind is totally dependent on natural capital and the ecosystem services it provides, and, because Solomon et al. (2009) make a persuasive case for climate change being irreversible, substantive measures are required immediately to protect and nurture them. The consequences of small global temperature increases discussed by Smith et al. (2009) are not attractive at best and appalling at worst. Clearly, anthropogenic carbon dioxide emissions into the atmosphere must be reduced by 80% now because climate changes are already having very serious deleterious impacts in some parts of the world (e.g.,

Australia's ecological footprint is not changing, but its biocapacity is plummeting from the results of environmental changes [http://www.footprintnet-work.org/en/index..php/GFN/page/trends/australia/]). The required changes in lifestyle are distasteful, but the consequences of ''business as usual'' are unacceptable.

Ethical Considerations

Climate changes that have already occurred pose serious threats to future generations. Altered temperatures, rainfall patterns, and water shortages have already adversely affected agricultural productivity worldwide and, with 215,000 new mouths to feed daily (plus the approximately 1 billion people who go to bed hungry each night), further strains on the agricultural systems must be avoided. Finally, these changes are adversely affecting the millions of species with which humans share the planet, which, in the aggregate, constitute the biospheric life support system. Both environmental assessment and management will be more difficult due to irreversible climate change, but they must continue.

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