Understanding and responding to the climate change issue: Towards a whole-of-science research agenda

Charmine EJ Härtel
Department of Management, Faculty of Business and Economics, Monash University, Caulfield East VIC

Graeme I Pearman
Graeme Pearman Consulting Pty Ltd; Monash University, Clayton VIC

PP: 016 - 047

Abstract

Much of human behavior and the very fabric of our economies and culture relate to the nature of our climate, its regularity/variability and severity. Climate change should therefore be a central field of inquiry in the social, behavioral and organizational sciences generally. This is especially so given that much of the observed and current climate change is attributed with a high degree of confidence to human activities and further change is anticipated.

Whilst historically biophysical research has tended to dominate attention to the climate-change issue, there is an emerging literature examining laypeople’s environment-related knowledge structures and the changes in attitudes, beliefs and behaviors required to effectively implement responses to the issues raised by the physical sciences. However, there are limitations in this literature, particularly regarding how scientists themselves engage with and capture emerging knowledge related to the issue. Although there is a broad consensus that the environmental problems we are experiencing are essentially social, organizational and behavioral problems, insufficient attention has been given to the issue of how to cultivate a cross disciplinary approach to address what is a complex and systemic problem (Cash et al., 2006).

This article seeks to bring that issue into focus and offers a whole-of-science agenda for climate-change related research. It is essential that social, behavioral and organizational scientists accept greater responsibility for helping to address and facilitate the social, attitudinal, behavioral and management changes required to ameliorate and respond to the environmental deterioration identified by research in the physical sciences. The need for further and ongoing multi-disciplinary and international research is both necessary and pressing. Moreover, it is an ethical and practical responsibility that individuals of all scientific persuasions cannot afford to shirk.

Keywords

environmental deterioration; anthropogenic interference; climate change research; social, organizational and behavioral science; biophysical science; whole-of-science agenda; attitudinal change

Article Text

Change has a considerable psychological impact on the human mind. To the fearful it is threatening because it means that things may get worse. To the hopeful it is encouraging because things may get better. To the confident it is inspiring because the challenge exists to make things better. - King Whitney Jr.

Introduction

Despite the popularity of such documentaries as Al Gore’s (2006) The Inconvenient Truth, which led to increased public knowledge of the issue of climate change, a great deal of recent semi-popular literature on the topic still endeavors to substantiate the reality of anthropogenic modification of the atmosphere and repudiate the claims of the deniers of Global Warming (Flannery, 2006; Gelbspan, 2004; Lovelock, 2006; Lowe, 2007; Monbiot, 2007; Pearce, 2002). Whilst such attitudinal, political and analytical differences are characteristics of classic scientific discourses in the face of continued uncertainty, resistance to acknowledging that our present environmental practices are unsustainable distracts from the critical work required to address the problems and best manage the environment.

Somewhat independently, biophysical sciences on the one hand and the behavioral, social and organizational sciences on the other have significantly progressed our knowledge of the climate-change issue, yet to a large extent these developments have been independent, reflecting the differences in language, methodological and theoretical approaches, and the sheer difficulty of the integration of these disparate and broad disciplinary areas. Reflecting the urgency of the issue, significant activities around the world are taking place (for example at institutions such as the Tyndall Centre for Climate Change and the Department of Environment, Food and Rural Affairs, in the UK, MIT in the US and international research programs such as the International Human Dimensions Program for Global Change Research). These relate to interacting with and changing behavior through risk communication, public participation/deliberative democracy, energy efficiency, energy policy, technology transfer and transport. Unfortunately, little of this is reflected in the peer-reviewed...
There is a consensus that 'environmental problems basically are social and behavioral problems' (Vlek & Steg, 2007, p.3; cf. DEFRA, 2008; WWF, 2008). Present social structures and institutions supported by social norms, government policy, commercial culture, and capitalist market driven economies contribute to the exploitation rather than protection of the natural environment (Gudmusson & Hojer, 1996; Sanne, 2002; Vlek & Steg, 2007, p.7). Recently, Adger et al. (2009) asked the question, 'Are there social limits to adaptation to climate change?' and concluded that limits to adaptation are endogenous to society and hence contingent on ethics, knowledge, attitudes to risk and culture. In particular, they proposed that there are four limits:

- The ultimate goal is underpinned by diverse values;
- Uncertainty exits about views of future risk;
- Social and individual factors; and
- Systematic undervaluation of the way loss of place and culture disguises real, experience and subjectivity.

Many of these same issues raised by Adger et al. (2009) are raised in this monograph, albeit with a significantly different approach. In particular, we briefly discuss behavioral, social and organizational issues recognizing three levels of interacting characteristics (Figure 1). First, there are the factors that determine the behavior of individuals deriving from both genetic predisposition and framed within cultural, educational and personal experiences. Collectively, and over time, these have instructed the social structures that organize or control communities, such as social institutions, political processes and embedded, widely accepted social norms. The third characteristic is the interface between the first two, the actual individual responses reflecting the personal embedded motivation and beliefs and externally applied norms and institutions of the society. It is impossible to comprehensively review all of the ramifications of these three levels, but we have attempted to highlight many areas. Nonetheless, we note one boundary condition to our discussion in particular, namely that little attention is given to the broader social context including the political framework that generates both sectoral power and community democracy.

In this article we propose a research agenda into climate change for the social, behavioral and organizational sciences. To do this, we begin by providing a brief background on the climate-change issue along with an overview of the evidence provided to date by research undertaken by physical scientists. This is followed by a discussion of the behavioral, social and organizational implications evidenced by the magnitude and urgency of the change required. Next we provide a review of the contributions from behavioral, social and organizational research to the climate change challenge thus far. Following on from this, we introduce a framework highlighting the physical sciences contributions to climate change and the complementary contributions a behavioral, social and organizational sciences agenda needs to make. Finally, we conclude the article with a call to all scientists, with particular emphasis on behavioral, social and organizational scholars, to place an imperative on this critical area.

It is important to note that it is not the purpose of this article to review the huge literature base, which has, by and large, grown out of multidisciplinary research, albeit largely from the physical science community. The purpose rather is to take our current understanding of the physical nature of the climate-change issue and to map onto this the current and potential research in behavioral, social and organizational sciences that could contribute to both our understanding of the climate-change issue and identify ways of coping with it into the future. This is important because, from our perspective, the role of the behavioral, social and organizational sciences in the issue thus far, while not absent, has been limited. The intention is to provide a broad overview of where behavioral scientists might contribute to the discovery and promulgation of solutions to the challenges posed by the climate-change issue.

A Background to Climate Change

The climate of the Earth has always been changing; from year-to-year, century-to-century and millennium-to-millennium (eg, Overpeck, 1995). There are a number of mechanisms involved in these physical changes. Whereas some operate on timescales of millions of years, such as the relative planetary position of the Earth in the solar system, others are on decadal timescales associated with small variations of the energy output from the sun, the degree of volcanic activity, and the internal dynamics of the ocean-atmosphere system and still others occur on intermediate timescales, such as the wobbling of the Earth on its axis that is responsible for successive ice ages through the last million years (Hayes, Imbrie & Shackleton, 1976). General scientific consensus today is that anthropogenic climate changes are now being superimposed on natural cycles.

Extensive physical-science research has revealed the potential impacts on human population as a result of its (too) heavy 'ecological footprint' on the Earth (see, for example, ACIA, 2004; EMA, 2006). Accordingly, the issue of global warming/climate change has entered the contemporary discourse. Greenhouse gases are the naturally occurring gases in the Earth's atmosphere that are responsible for keeping temperatures warmer than they would otherwise be, by about 30°C. It has been known for a long time that they have the particular properties of being transparent to sunlight (solar radiation) but absorbent to heat radiation (Tyndall, 1861) and include, among other gases, water vapor, carbon dioxide, methane and nitrous oxide. Without them, the global environment would be inappropriate for life as we know it.

Given the use of carbon-based energy resources such as coal, oil and natural gas by modern civilization, scientists, in the 20th Century, began suggesting that human activities must be releasing significant amounts of carbon dioxide into the atmosphere. Moreover, by the middle of the century, scientists began asking whether or not this might be a future issue for the climate of the planet (eg, Plass, 1956). As such, they began to conduct observations of these gases in the atmosphere and, as predicted, in the second-half of the
20th Century, it was shown that the concentrations of some of these gases were increasing. Further analyses suggested that this must be causing significant changes to the energy balance of the planet and thus its mean temperature and climatic patterns. Given that these changes were unlikely to be evenly distributed across the planet, it was expected that they would lead to changes to both the way the atmosphere and oceans mix and distribute energy, affecting our weather and climate. In sum, it was revealed that although human societies had always been influenced by climate variations, for the first time they possessed the capacity to affect the climate.

The physical sciences community has been aware of the threat of these anthropogenic modifications of the global climate for over two decades, as illustrated by the 1985 conclusion of the atmospheric scientific community (WMO, 1986). Internationally a Framework Convention on Climate Change entered into force in 1994 with the objective to 'prevent dangerous anthropogenic interference with the climate system' (http://unfccc.int/2860.php). The Intergovernmental Panel on Climate Change (IPCC; http://www.ipcc.ch/) was established in 1988 as a mechanism for the regular assessment of all peer-reviewed published literature on the climate-change issue for use by public and private sector policymakers. The most recent of these assessments, the IPCC Fourth Assessment Report, was published in 2007 (IPCC 2007a-d).

Climate Change: Evidence and Projections Regarding its Future Impact

As indicated above, the understanding of the climate and how the oceans and atmosphere respond to changing levels of energy input and greenhouse gases has improved significantly in recent decades. This has come about via much improved observations of the climate using such things as satellites, balloons and deep-sea probes so that we have a much clearer picture of what is happening to the Earth’s climate. The observed changes to the climate over the past century as assessed by IPCC (2007a) are summarized as:

- Global temperatures have risen by 0.74 ± 0.18°C.
- Northern hemisphere warmth of the last half century is likely the highest in at least the past 1300 years.
- Globally, 11 of the last 12 years rank in the 12 warmest years in modern records.
- Snow cover has decreased in most regions, especially in spring and summer.
- The summer period has extended by 12.3 days, averaged over the entire northern hemisphere.
- The areal extent of Arctic sea-ice has declined by 2.7 ± 0.6% per decade.
- Sea levels have risen by 1.9 ± 0.5 mm per year between 1961-2003.
- With the uptake of carbon dioxide, the surface of the global oceans has acidified by 0.1 pH units.

The reports released by the IPCC in 2007 referred to above highlighted relatively new knowledge about how both the physical climate and the biological systems dependent on that climate are changing. To prevent what might be regarded as potentially ‘dangerous’ (the term used in the International Framework Convention) change, a global average warming of about 2°C, the emissions of greenhouse gases into the atmosphere would need to peak in the very near future and start decreasing substantially through the first half of this century. Clearly, this poses huge challenges to human society: adjusting the way it sources and uses energy and coping with the impacts of climate changes that are now unavoidable. The physical consequences of climate change are also reported by the IPCC process and have highlighted the vulnerability of both human and natural systems to changes in sea level, extreme events of temperature and rainfall and the consequences of changed levels of storminess and other characteristics of the climate system.

Furthermore, throughout the last 12 months, new scientific evidence of change has increased the level of concern about climate change and the urgency for adequate responses to it (see for example Hansen et al. 2007; Rahmstorf et al. 2007). Such responses need to be both adaptive, that is how we and natural ecosystems respond to climate change into the future, and mitigative, how the growth of emissions of greenhouse gases can be curtailed and reversed so as to avoid otherwise more serious changes in the future.

Projecting forward as to what may happen to the global climate into the future is extremely uncertain and demanding. In the first instance, despite the improved knowledge and degree of confidence in physical understanding of the climate system and the representation of this in very complex computer models of the climate, differences and issues remain between research groups in terms of how well some physical features of the system are represented in these models. Perhaps of even greater importance is the fact that changes to the future climate will also affect the level of greenhouse gases in the atmosphere. This depends first on how such gases, when released into the atmosphere, get absorbed by the oceans or the vegetation on the Earth’s surface. We have reasonable understanding of these issues (eg, Raupach, Canadell & Le Quéré, 2008). Second, it is difficult to anticipate exactly what humans will do in regards to this issue; how will they mitigate against future climate change, how will they change their energy systems, what new technologies will emerge through innovation, what will be the population growth and per capita demands for energy, and what will be the social and political issues that determine the future? The international discussions in preparation for the Copenhagen 15th Conference of the Parties to the United Nations Framework Convention on Climate Change in December 2009 (http://en.op15.dk/), attempted at top-down implementation of global actions to achieve emissions reductions through the rest of this century commensurate with perceived shared risk and capacities. But of course, final decisions will be strongly influenced by national political license and ultimately the views of individuals within those nations.

The way the science community has dealt with the uncertainty of future emissions has been to develop a number of scenarios, building upon different views of how these things may unfold (IPCC, 2000). These
scenarios are not exhaustive and although the likelihood of any one of these scenarios coming to fruition varies, these futures are generally treated as equally likely and regarded as a projection rather than a prediction. (It will be argued later in this article that in this regard there is significant opportunity for improvement in developing such scenarios and their relative probabilities through further application of social and economic skills.) Projections of future climate change are usually presented as ranges meant to incorporate uncertainty related to both the science of the climate system and future human behavior. Table 1 summarizes future changes to the global climate as assessed by IPCC (2007a) in its consideration of over 6000 peer-reviewed and published scientific papers. Table 2 provides a broad perspective on the nature of potential vulnerability across the Earth to climate change for different levels of annual mean temperature change. Several recent publications mentioned above suggest that these Tables may be conservative given that the rate of response of the climate to greenhouse gas emissions appears to be at the high-end of earlier estimates as is the rate of increase of carbon dioxide in the atmosphere.

A further uncertainty relates to the translation of these global changes into regional and local changes which are, of course, what everyone really wishes to know in order to assess their respective exposures and vulnerabilities. Undoubtedly, projection becomes less confidently believable at the regional level where the complexity of the general dynamics (the mixing of the oceans and the atmosphere) may dominate more general global effects. Some features of the climate system are more amenable to accurate projection (eg, mean temperature) than others (eg, seasonal rainfall) simply because of the complexity of the physical processes involved. The way this has been approached in Australia has been to take the Australian regional projections of climate change from 23 global climate models built by research groups around the world and used in the IPCC (2007a) assessment (CSIRO & BoM, 2007). A summary of the key climate projections for Australia is given in Table 3. Much of human behavior and the very fabric of our economies and culture relate to the nature of our climate, its regularity/variability and severity. Temperature determines the rate of chemical reactions and this is as real for biological systems as it is for physical processes. Growth and biological production rates and the development and behavior (flowering, migration, mating, etc) of all species of plants and animals are influenced by temperature both on average and in their extremes. Further, water is the essence of life and, for terrestrial organisms at least, is derived either directly or indirectly from rainfall delivered through the climate system. It is surprising therefore that most of us have only a relatively weak understanding of just how sensitive these systems may be to ‘small’ changes in climatic conditions. This may influence the degree of disconnect that exists between projections of temperature and rainfall changes and anticipation of impacts to be felt by members of the community. In part this is because scientists speak mostly about changes in large-scale averages that are not interpreted equivalently by laypeople, whose mental models of the climate are informed by the experience of hour-to-hour and day-to-day changes in temperature of 10°C or more. In the context of these natural variations in temperature at the scale observable by the individual, the prospect and consequences of the world warming by one or two degrees are unlikely to be interpreted as cause for concern. In part, it is because the potential impacts perceived by scientists seem remote and, until there are significant consequences, this disconnect will continue, at least for some.

The IPCC (2007b) identified a range of impacts in Australia and New Zealand that are already observed and attributable to climatic change thus far, that include impacts on:

- **Ecosystems**: Semi arid woodlands, Eucalypt savannas, rain forest/woodland, sub-alpine, mangroves, coral reefs.
- **Genera**: Birds, Antarctic beech, mammals, insects (including genetic changes), sea urchins, marine mammals, fish, invasive species.
- **Behavior**: Flowering phenology, earlier migration and egg-laying, seed production.

Some of the key ecosystems in Australia that are regarded as vulnerable are summarized in Table 4. Furthermore, Pearman (2008) indicates that the key vulnerabilities for Australia appear to be related to:

- **Water availability**: The most probable outcome for Australian rainfall is a decline by about 5% by 2050 and by more in the southwest. Evaporation is expected to increase by 3% by 2050. Both influence the net available water in soils, streams, and catchments.
- **Natural ecosystems**: The IPCC (2007b) attributes a 50% probability of the loss of between 20 and 30% of all species with a temperature change of 1.5-2.5°C. This would involve the total realignment of ecosystems across Australia. The impact of such changes may manifest through impacts on the services they deliver including tourism opportunities.
- **Coastal communities**: Sea level is expected to rise by at least 43 cm by 2100 with additional increases through the following century. Very recent work is suggesting that this increase may be closer to 100 cm. This may result in frequent or permanent coastal inundation and erosion for parts of the Australian coastline.
- **Agriculture**: High likelihood of restructuring of the rural sector through relocation, land abandonment and changed production methods and crop types.
- **Human health**: Significant risk to human life associated with extreme events of fire, flooding, heat waves and new geographical ranges for disease-bearing vectors.
- **Major infrastructure**: Storminess will likely increase substantially across the nation with effects on the delivery of rain and consequences for flooding, soil and river erosion, siting of reservoirs and the destruction of infrastructure and the loss of livestock, crops and human life.
International pressure: Warming through this century could lead to almost half of the world's population at risk of water shortage, as many as a quarter of a billion exposed to potential health problems associated with the warming, and hundreds of millions facing food shortages and coastal inundation issues (see Parry et al. 2001). This is a world in which a sense of international cooperation and security would be potentially jeopardized and in which the potential for militancy and conflict over resources substantially increases (see for example Dupont & Pearman, 2006; Pearman, 2009).

Stern (2006) in his seminal study provided an economic assessment of the costs of climate change without mitigative action, and the costs of mitigative action. This was a daunting task, but showed a clear advantage economically for mitigative rather than adaptive responses especially when that action is taken early. In Australia, during 2008, Professor Ross Garnaut completed a review of the climate-change issue on behalf of the State, Territories and Federal Governments (Garnaut, 2008). Together with analyses by the Federal Treasury (Treasury, 2008), this report contributed to the information base for debate in the Federal Parliament in 2009 concerning national action particularly around the introduction of a carbon-trading scheme (Carbon Pollution Reduction Scheme; CPRS, 2008). This scheme is designed to internalize the costs of environmental consequences of the burning of fossil carbon-based fuels, thus allowing market forces to drive innovation and change to reduce emissions to targeted levels. Such an emissions reduction scheme will only be part of a portfolio of actions to be taken by governments to change the way energy is sourced and used into the future. We suggest, however, for the change to be effective there must be a fundamental shift in the way that we as a society behave. This demands that the wider community understand both what climate change means for them and the options they have for behavioral change as part of the solution - to achieve this requires the coordinated input of the behavioral, social and organizational sciences. As such, in the next Section, we outline some of the social and behavioral issues associated with climate change.

... continues ...

Conclusion

This article has shown that the climate change issue abounds with uncertainties related both to the way the physical climate will change under the influence of changing levels of greenhouse gases in the atmosphere, the way natural and human systems will respond to that change, and the way human institutions will manage the issue through both mitigated and adaptive responses. The levels of uncertainty and complexity require ongoing reductionist and disciplinary-based research in the physical, biological, behavioral, social and organizational sciences. But simultaneously efforts are needed to enjoin these disciplines to form a more holistic view of what is happening, of what is possible, and how best to manage the risk. The climate change issue highlights the need for different models of scientific engagement with issues that by nature are complex and holistic. We have argued that the current state of the scientific literature indicates a lack of engagement with the issue of climate change in a range of areas, with particular note of the behavioral, social and organizational sciences, and the need for a whole-of-science agenda for climate-change related research. The framework we present illustrates the need and implementation of such an approach, where the full range of scientific disciplines come together to address the multiple facets and holistic nature of the problem. We now place the urgent call for scholars across the physical, behavioral, social and organizational sciences to place an imperative on engaging as a community with the most critical challenge humankind faces today.

Acknowledgements

The challenging breadth of the issues covered in this paper has required the authors to seek advice from a number of colleagues, whom we thank: Peta Ashworth, John Fien, Ralph Horne, Anna Littleboy, Jeff McLean, Janet Stanley, Jodi-Anne M Smith, Samuel Wilson, and the two anonymous reviewers. GIP acknowledges financial support to complete this work from the Faculty of Business and Economics and the Monash Sustainability Institute and CEJH acknowledges the support of the Social & Economic Interface Research Network (SEIRnet), all of Monash University.
Selected Articles

Contracting out Information Technology in Public Sector Contexts
Leslie P Willcocks, Wendy L Currie

Salient stakeholder voices
Yi-Chun Huang, Hung-Bin Ding, Ming-Rea Kao

Aggression at the Service Delivery Interface
Loraleigh Keashly, Joel H Neuman

Governance and management
John Paynter

The decision to outsource
James D Hunter, Ray W Cooksey

Research on corporate divestures
Caterina Moschieri, Johanna Mair

Sign Me Up

Search

Translate

Web Feed

Call for Papers

Educating for Sustainability and CSR: What is the role of business schools?
Volume 17/3
Deadline: 30th Jun 2010

Special Issues

Stability and Change: Managing the Tensions
Volume 17/1
Summary

Social responsibility, philanthropy and entrepreneurship in the sports industry
Volume 16/4
Summary | Contents
Related Publications from eContent Management

Lifelong Learning and the Democratic Imagination: Revisioning Justice, Freedom and Community
By Peter Willis, Pam Carden

ÆSOP Leadership for Exceptional Educational Outcomes
By Steve Dinham
Research in Mental Computation: Multiple Perspectives
By Rosemary A Callingham, Jane M Watson

The Process of Participation and Phased Retirement: Evidence from Mature Aged Workers in Australia
By Jacqueline M Drew, Michael E Drew

Journal of Management & Organization
ISSN 1833-3672
©2010 eContent Management
Advertise With Us | Privacy Policy

Published by eContent Management Pty Ltd
Email: info@e-contentmanagement.com
PO Box 1027 Maleny
Queensland 4552 Australia
Phone: +61-7-5435-2900
Fax: +61-7-5435-2911