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What is This?
Geographies of health and climate change

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Abstract
Climate change presents significant challenges for human health and well-being and geography is contributing a growing field of knowledge relating to these processes. We outline here key dimensions of the debate, pointing to areas where human geographers can make a particularly strong contribution. These include: issues of adaptation and resilience; sustainability; environmental justice and socially unequal impacts of climate change; and psychological as well as physical impacts of environment on health. Key themes in the emerging research agenda include the significance of affect and emotion for the perception and communication of hazard and risk associated with the health impacts of climate change. Also, understanding exposure to health risks of climate change requires knowledge of complex and individually variable daily action spaces and residential mobility over the lifecourse. We argue for research that considers complex processes operating at various geographical scales, linking arguments about ‘global health’ with the more local and individual processes that contribute to health determinants. Much of the literature on health impacts of climate change demonstrates socially and geographically unequal effects, which often exacerbate existing health disparities. This highlights the links between this field of health geography and other geographical research concerned with sustainability and environmental justice.

Keywords
climate change, environmental justice, geography, health and well-being, sustainability

I Introduction
One of the most pressing issues for societies globally today relates to climate change and its significance for human health and well-being (Confalonieri et al., 2007; Costello et al., 2009; Frumkin et al., 2008; Haines et al., 2006; McMichael et al., 2003; Martens and McMichael, 2002). Research often aims to inform social and political, as well as medical and environmental, strategies relating to health and climate change. The potential role for researchers in human geography is clear, given our central concern with the social and behavioural processes that influence interactions between people and their environment. As Lane et al. (2011) have argued with respect to research on general flood risk management, this requires innovative approaches that bring together and exchange different types and sources of knowledge, and blend ideas from different fields of science and humanities research.
Researchers in the geographies of health and related fields in public health and social epidemiology, as well as disciplines such as anthropology and sociology, have traditionally been adept at this kind of thinking, incorporating strong emphasis on social as well as physical environmental processes that help to explain the associations between the health of individuals and local populations and the social and physical conditions in place and space (Curtis, 2004, 2010; Gatrell and Elliott, 2009; Jones and Moon, 1987; Meade and Erickson, 2000). The view of human health adopted in these research fields is not defined solely in terms of medically diagnosed disease, but in much broader terms, as ‘a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity’ (WHO, 1946: 2).

We consider below examples of recent research on climate change and human health from the standpoint of human geography and allied disciplines and outline directions for a future research agenda. We argue that a research agenda may be informed, as illustrated in Figure 1, by theoretical frameworks that draw on both ‘structuralist’ and ‘poststructuralist’ approaches to health geography and hazards research (see, for example, Gatrell and Elliott, 2009; Wisner, 2006; Wisner et al., 2004). Structuralist theories of social inequality and injustice in environmental exposure and vulnerability to material risks to health (see, for example, Bullard, 1990; Mitchell et al., 1999) help to identify the groups vulnerable to climate change and the broader social context giving rise to their vulnerability. ‘Poststructuralist’ perspectives on personal geographical experience and geographies of emotion (Dorn and Laws, 1994; Kearns, 1993) provide insights into the human understandings of, and responses to, climate change. Geographical discussion of climate change and health also reflects the broader interest among health geographers and other public health specialists in debates concerning global health (Brown, 2011), and accounts offered by political ecology of the complex and emergent relationships between political, social and environmental processes at different scales are crucial to varying human experiences of environmental factors important for human health (Collins, 2002; King, 2010; Mayer, 1996; Richmond et al., 2005).

II Key dimensions of health and climate change for human geographers

We first outline some key dimensions of the debate, which exemplify fields where human geographers are likely to make a particularly strong contribution. These include: issues of adaptation and resilience; sustainability; environmental justice and socially unequal impacts of climate change; psychological as well as physical impacts of environment on health.

**Figure 1.** A conceptual framework for research on climate change and health
The discussion here is situated in a discourse which pays growing attention to questions of adaptation and resilience (Adger, 2000, 2006; Manyena, 2006). This emphasizes that the risk presented to human health by climate change is a product of the human dimensions of vulnerability to change, as well as the hazards presented by global climatic change and the physical environmental consequences (Cutter, 1996; Wisner et al., 2004). While efforts continue, globally and locally, to curb the consequences of human actions contributing to climate change and limit the associated hazards, it is increasingly acknowledged that the agenda needs to include urgent consideration of strategies for human adjustment to future changes that seem at this stage to be irreversible (Adger et al., 2003; IPCC, forthcoming). Thus it is important to understand the social processes influencing human knowledge, perceptions and behaviours at the individual and collective levels, which may contribute to vulnerability or resilience.

Geographical work on health and climate change also needs to be viewed within a wider body of research on sustainability (Adams, 2002; Bigg, 2004; Drummond and Marsden, 1999; Eden, 2000; Kates et al., 2001; Kirkby et al., 1995; Leach et al., 2010). While there is not space here to elaborate on the whole of this literature, one key point for what follows relates to a fundamental principle of sustainability that leads us to be concerned with ensuring that human activity creates conditions which influencing human knowledge, perceptions and behaviours at the individual and collective levels, which may contribute to vulnerability or resilience.

Sociogeographical approach to human health and climate change also draws upon related arguments and evidence about environmental justice (Bush et al., 2001; Buzzelli et al., 2003; Cutter, 1995a; Fisher et al., 2006; Maantay, 2007; Maantay and McLafferty, 2011; McMichael et al., 2008; Patz et al., 2007; Pearce et al., 2006a; Walker and Bulkeley, 2006) and emphasizes the geographically and socially uneven impacts of climate change on population health and the potential for climate change effects to be most damaging for groups of people whose health is already likely to be compromised (Jerrett et al., 2010: 423–429). For example, at the global scale, certain countries are particularly prone to climate change impacts, especially some small island states that are relatively weak in the global political economy (Ebi et al., 2006; Pelling and Uitto, 2001; Schwarz et al., 2011; Tang et al., 2009; UNDP, 2007). Also, within larger and more wealthy countries, localities vary in terms of the pace and severity of expected climate change that may be relevant for health (Hess et al., 2008).

Within societies or regions, health impacts of extreme weather events are often reported to be variable for different demographic groups. For example, Balbus and Malina (2009), Cutter (1995b), Enarson and Fordham (2001), Peek (2008) and Sheffield and Landrigan (2011) highlight the particular risks for subpopulations with greater vulnerability to the health effects of disasters and climate change, such as older people, women and children. Groups suffering socioeconomic deprivation and lacking material resources are also often the most vulnerable to financial indicators. Recent debates on ‘well-being’ and how to measure it are a further example of research in which aspects of the human condition aside from economic wealth are considered (see, for example, Gough and McGregor, 2007; Searle, 2008; White, 2010). Thus, as discussed below, ideas and principles of sustainability often inspire and inform geographies of health and climate change.
disasters and climate change effects (Curtis et al., 2007; Fothergill and Peek, 2004). Compared to wealthy groups, poorer people may be less able to pay for protection against or restitution after such disasters. Poorer people are also often economically more dependent on sectors that are most susceptible to climate change, such as agriculture. This may compound existing health disadvantages experienced by these groups, associated with a range of social and physical environmental factors that are referred to in public health discourse as the ‘wider (social) determinants of health’ (i.e. involving factors other than medical care and ‘wider’ than individual genetic and behavioural risks) (e.g. Exworthy et al., 2003; Marmot, 2009). For example, Balbus and Malina (2009) show that impoverished populations, and people with existing health problems or learning disabilities (all of whom typically have relatively poor health for other reasons), are also at greater risk of negative health effects due to climate, either because the settings where they live and work are more likely to be exposed to the hazards presented by extreme weather events or because they are more physically or psychologically susceptible to harm. Similarly, Ginexi et al. (2000) reported that those from low-income households (and those already in poor health) were most at risk of mental illness consequent upon the Midwest floods in 1993. Rey et al. (2009) report that during the 2003 heat wave deaths were highest among the older age groups and were especially concentrated in the poorest areas in Paris, France. Similar patterns were observed by Browning et al. (2006) during the 1995 Chicago heat wave. As noted by Browning et al. (2006), more economically deprived individuals may be less able to protect themselves from intense heat through access to healthcare and air-conditioning, while macro-level economic disadvantage may compromise the effectiveness of neighbourhood institutions including social services, local voluntary organizations, and more informal social networks (Wilson, 1987).

Olago et al. (2007) reported that vulnerability to climate-induced cholera in the Lake Victoria basin, East Africa is strongly associated with low socio-economic status, which can be seen to reduce the adaptive capacity of individuals. Research has also highlighted the vulnerability of rural populations and some indigenous groups, who are particularly reliant on exploiting natural resources or agricultural sectors of the economy for their livelihood; e.g. Hanna et al. (2011), Paavola (2008) and Thomas and Twyman (2005).

A further consideration for our discussion below is that climate change is important in terms of risks for mental as well as for physical health. (It is increasingly being recognized that psychological damage figures importantly in the long term, as well as short-term health impacts of weather-related events associated with climate change (Ahern and Kovats, 2006; Ahern et al., 2005; Berry et al., 2011; Curtis, 2010; Neria et al., 2008).

III Global perspectives on climate change and health

Figure 1 incorporates ideas from these various streams of thought, and stresses the interactions between processes operating globally and locally. The geographical literature on health and climate change underlines the significance of global processes for human health (e.g. Asthana et al., 2002) and the need to engage with the agendas outlined by Brown (2011) who stressed the significance for health geography of discourses concerning ‘global health’ and risks for health. Theories about global health (Ingram, 2005; King, 2002; McMichael and Beaglehole, 2000; Sparke, 2009; WHO, 2007) and the conceptual frameworks envisaged by political ecology perspectives (Collins, 2001; King, 2010), underline the complex connections between climate change and sociopolitical processes at the international scale.
These global processes are illustrated, for example, in research on vulnerability of human populations to climate change, which has explored how changes in the geographical extent of hazards such as floods and droughts, particularly in low-income countries, combined with underlying social, political and economic conditions, are driving processes of national and international migration of human populations in response to these hazards (Myers, 2002; Warner, 2010; Warner et al., 2010; Wisner et al., 2004).

The recent experience of famine in Somalia is a case in point. Geographers such as Moseley (2011) have highlighted the social, economic and political factors behind this disaster which elsewhere has been attributed largely to climate change and the worst droughts since the 1950s. Such arguments are reminiscent of Sen’s analysis of poverty and famines (Sen, 1981).

Upheavals in the human population arising from climate change are also implicated in the escalation of social tensions and conflicts over competition for increasingly scarce natural resources (food, water, safe areas for settlement) (Locke, 2009; McGregor, 1994). These are processes giving rise to human health impacts associated with violence as well as deprivation (Reuveny, 2007). The effects of these processes often extend beyond the areas most directly affected by disasters. Climate change may be a factor contributing to migration to other regions in order to escape the threats to health migrants face in their place of origin (including economic stress, food insecurity, damage to homes and livelihoods from floods, droughts, etc.). Furthermore, in their new places of residence, displaced migrants may experience additional challenges for health, arising from social processes such as racism and social exclusion, as well as relatively poor living conditions often experienced by immigrants in the host country (Curtis and Hoyez, forthcoming; Gatrell and Elliott, 2009).

Linked to these ‘global’ perspectives on human health and climate change, research on emerging infectious disease risks contributes to literature which has put in question conventional theories about the ‘epidemiological transition’ linking human development to fundamental shifts in population health. We now dispute the categories of ‘health profile’ which were traditionally proposed for population health in more and less developed societies around the world. The ‘conventional’ view of the epidemiological transition (Omran, 1971) represented wealthy countries as having progressed beyond significant susceptibility to communicable diseases and infections so that the greatest burden of morbidity and death is due to non-communicable disease, while in low-income countries poor health and mortality frequently occurred early in life due to infections and malnourishment. Climate change renders new areas of the world susceptible to infections due to changes in the environmental risk factors for these diseases. So in wealthier countries, as well as low-income settings, we could also see the emergence or re-emergence of infections (Kovats et al., 2001; Martens et al., 1995; Patz et al., 2005; Zell, 2004). While not all these diseases are life-threatening, they can be a serious threat to public health – for example, Lyme disease (Brownstein et al., 2005), tick-borne encephalitis (Lindgren and Gustafson, 2001) and malaria (Hay et al., 2002; Martens et al., 1999). Public health policy and interventions must follow to maintain population-level protection against these threats to health (Kovats, 2008; NHS, 2011). From a health policy perspective this may imply a need for better evidence to establish whether we need to be rethinking health system priorities and strategies in countries around the world (Kovats et al., 2003).

IV Local contexts and individual responses to climate change

A geographical perspective also focuses on how these broader-scale processes operate in specific ways, according to conditions in more local settings. Health geography illustrates how
individuals interact with their environment in ways which are important for the risks to health of climate change, contributing to geographical inequalities in health at the local level. Well-established streams of research in health geography, concerned with the ‘environment–human health complex’, viewed from a human ecology perspective (Learmonth, 1988; Martin et al., 2002; Meade and Erickson, 2000) are now increasingly directed towards improving our understanding of emerging physical environmental risks (e.g. Estrada-Pena, 2002; Ezenwa et al., 2007; Hales et al., 2002). These studies underline the importance of spatial dimensions of human activity such as proximity, connectivity and the hierarchical structuring of regional settlement and communication systems. For example, infectious diseases can be transferred between localities at a distance from each other, if they are well connected through modern communication links. Such studies illustrate the growing sophistication of Geographical Information Systems used to analyse how spatial relationships influence the interaction of natural environmental hazards with sociodemographic characteristics of the population, and how human use of land interacts with natural conditions to influence variations in risk (Dunn et al., 2007; Emch, 1999; Emch and Ali, 2001; Foody, 2006; Lindsay and Birley, 1996; Pearce et al., 2006b; Snow et al., 2008).

Other types of infectious disease risks associated with climate change include risks of food-borne illnesses, which have been the subject of increasingly sophisticated assessments by geographers and environmental scientists (Bentham and Langford, 2001; Lake et al., 2009), underlining the need to consider not only changing risks due to higher temperatures, which foster the microorganisms that can lead to food poisoning, but also the adaptive behaviour of the food industry and individual consumers in terms of food hygiene practices.

Studies at the more local level have also highlighted how vulnerability to communicable diseases depends on human knowledge, resources and behaviours that affect the risk and impact of exposure – for example, the research undertaken by Adongo et al. (2005) and Dunn et al. (2011) on malaria risk behaviours and the factors influencing the use of bed nets in Africa, and by Elliott et al. (2008) who assessed the determinants of risk behaviours for West Nile virus in the North America. It is clear from this body of research that the position of individuals and families in the social structure of their communities has profound implications for their access to resources and information that might help them to build resilience to protect their health against climate change effects.

Geographical research is also concerned with the links between climate change and non-communicable disease risks. For example, exposure to urban pollution, which may interact with climate change, is another field where complex interrelationships between daily action spaces, mobility and exposure are beginning to be better understood by geographers (Jerrett et al., 2010: 429–432). This illustrates a point which is more generally important for research on climate and health; understanding exposure to health risks in the environment requires knowledge of complex and individually variable behaviours and a perspective that draws on theories of relational spaces which are more sensitive to the complex interactions between individuals, space and time (Cummins et al., 2007).

The psychological, as well as the physical, health effects of impacts on the environment produced by climate change is also receiving increasing attention (Curtis, 2010). These include theories of solastalgia associated with loss of environments with which one has an emotional bond (Albrecht et al., 2007). Also, research is accumulating on post-traumatic stress (or, in some very resilient individuals, post-traumatic growth) arising from events such as major floods and storms. Examples come from countries including the UK (Carroll et al., 2009; Tapsell and Tunstall, 2006; Tunstall et al., 2006), the
USA (McLaughlin et al., 2010), India (Telles et al., 2009) and Mexico (Norris et al., 2009). All of these studies underline the ways that human attachment to place is disrupted and undermined by the loss of places, people and livelihoods that are important to well-being in psychological, as well as physical terms. These fields of work draw partly upon geographical research on culturally specific emotional ties with the land, which demonstrate the importance of place for sense of identity and well-being (Ford et al., 2010; Panelli and Tippa, 2007). Geographical researchers such as Davidson and colleagues (Davidson and Milligan, 2004; Davidson et al., 2005) have extended the debate on the role of emotion and affect in the relationships between the human body and mind and individual geographical experience. Their work is also expanding perspectives in health geography. There is ample scope to enrich research on climate and health through a stronger connection between these perspectives on geographies of emotion and affect and other strands of health geography.

Also of growing concern are the impacts of extreme weather on health service provision. Heat waves and cold waves are most dangerous for human health when they exceed those to which the local population has adapted through built structures and protective behaviours (Armstrong et al., 2011; Carson et al., 2006; Curriero et al., 2002; Lindley et al., 2007; McKee, 1989; Wolf et al., 2010). Thus extreme weather events place strain on service systems due partly to surges in demand for treatment of the morbidity associated with climatic conditions. Furthermore, in some cases the delivery of services may be directly impacted by extreme weather events, especially in the case of floods and heavy or prolonged snowfalls (Skinner et al., 2009).

V Conclusion: the emerging agenda

Current and future developments in research in this field lead us to anticipate a growing emphasis on some key themes which we have noted above, emerging in work relating to geographies of health and climate change.

There is clear potential to expand research which privileges civic intelligence as well as expert views and explores how these may inform each other (Dunn, 2007). A stronger appreciation of the significance of affect (Thrift, 2004) and emotion for the perception and communication of hazard and risk associated with the health impacts of climate change will help to inform this debate (see, for example, Slovic and Vastfjall, 2010). Geographers may also draw on work by authors such as David Smith (2000) to understand factors involved in empathy and motivation to collaborate with ‘distant others’. This enhanced sensibility to the experience of distant others, as well as a sense of shared vulnerability, is important to motivate us to work cooperatively and internationally to build resilience to the health hazards of climate change. We do, however, acknowledge that building this empathy with distant others is as problematic as it is necessary.

We also noted above that current research trends illustrate the importance of perspectives which adopt a relational view of space and place and their importance for human health (Cummins et al., 2007) that is more sensitive to individual pathways through different environments over the lifecourse, as well as the significance of affect and emotion in our responses to changes in climate and risks for health. A more ‘differentiated’ perspective on the links between climate change and health is needed to capture the variable factors influencing health vulnerabilities and resilience to climate change of individuals and groups in different societies and different geographical settings. We have noted above the need to consider how experience is differentiated by gender, age and socio-economic position, for example. A limited focus on the most deprived parts of the population may not, however, be sufficient. For example, Finch et al. (2010) point
to the challenges faced in reconstruction after Hurricane Katrina by the ‘middle stratum’ of socio-economic groups, whose resources are sufficient to lift them above the poverty thresholds defining groups qualifying for special social assistance, but have insufficient resources to cope independently with the costs of repairing their lives and livelihoods.

We have also noted that conceptual frameworks need to be developed that are more adequate to structure our thinking about complex processes operating at various geographical scales. The tendency in health geography to consider health problems ‘regionally’ (for example, concentrating particularly on infectious diseases in low-income countries and examining psychological health issues in more detail in wealthier countries) needs to be reconsidered. Research in this field leads us to consider whether there are fundamental priorities that are shared internationally and that might lead societies towards a re-evaluation of the priorities that drive our political economies as well as our public health systems. As an illustration, Tonn (2003) explores the idea of a social justice framework that might be relevant to inform a more global debate on policy to address global climate change, with loss of human life emphasized as one of the key ‘fundamental criteria’ to be weighed in such judgements. These arguments tend to encourage a stronger emphasis on sustainability and intergenerational health and well-being, in contrast with current social goals that prioritize economic growth and national territorial interests in the exploitation of resources, and which contribute to damaging climate change effects.

Thus, as argued above, ‘health’ will clearly feature in future debates about the adjustments we shall have to make in response to climate change. ‘Slow cities’, low carbon, active transportation methods, and cooperation around local or global initiatives that may enhance local social capital or international ties are all proposed as ways to make human life on the planet more sustainable. Although the link is not always made explicit, these are also very closely bound up with our understanding of how such changes might be important for health and well-being. Our knowledge of geographies of health and of sustainability needs to be brought more closely together.

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