
Commentary

Four reasons for concern about adaptation to climate change

Human-induced climate change is real and is likely to drive increasingly dramatic changes in environments in this century and beyond. So, given the necessity to adapt to the impacts of these climate changes, key issues arise as to the feasibility, cost, and social distribution of the burden of these adjustments at multiple scales.

The scale of the human challenge on climate change was portrayed vividly in the Intergovernmental Panel on Climate Change (IPCC) report of 2001, in the form of five ‘reasons for concern’ about climate impacts: the risk to unique and threatened ecosystems; the risk of extreme weather events; the distribution of impacts; the scale of aggregate impacts; and the risks of large-scale discontinuities. An iconic diagram, known as the ‘burning embers’, showed that these five reasons for concern become critical as global mean temperature increases beyond 2°C of global average warming. The IPCC made this assessment in 2000. At that time emissions and projected future emissions already meant that the earth was committed to increased risk of irreversible change in some ecosystems. But the risk of ‘large-scale discontinuities’, such as significant deglaciation of West Antarctica’s ice sheet, were not thought to become significant until perhaps 3–4°C of global average warming over 1990 averages. The burning embers diagram was widely publicised and republished. It came to summarise the IPCC results on the impacts of climate change and contributed to global public concern over climate change.

In 2009 a group of authors involved with the IPCC updated the ‘reasons for concern’ framework (Smith et al, 2009). This update uses new knowledge about the sensitivity of environmental systems to climate change, and new models of potential thresholds and irreversibilities in the earth system. The authors show that the sensitivity of systems at risk is now greater, and so the risk of large-scale disruption is higher than before for any given level of mean temperature rise. This assessment is backed by similar assessments of tipping elements in earth systems (Lenton et al, 2008).

The Smith et al (2009) reasons for concern analysis implies that adaptation will stave off the worst excesses of such impacts up to a point. We agree with this assessment in principle, but have our own reasons for concerns about the ability to *adapt* to such impacts and the likelihood of sustainable adaptation. We explain below four reasons for concern about adaptation: contractions and uncertainties in the window of opportunity for adaptation; the difference between adaptive capacity and adaptive action; the risk of maladaptation; and misguided measures of loss.

Four reasons for concern

The *first* reason for concern is that the scale of change and interconnectedness of impacts may be such that the window of opportunity for adaptation is smaller than previously imagined. In addition, the task is less likely to be successful given the possibility of significant surprises. The scale and interconnectedness of the impacts of climate change are growing with every passing year of cumulative emissions of greenhouse gases. Recent research that projects future concentrations of greenhouse gases based on emissions trends since 2000 (coupled with evidence of virtually no emissions reductions in practice this decade) suggests that there will have to be a major turnaround in policy, planning, and behaviour to avoid an atmospheric concentration that poses a significant risk of global mean warming of 2°C or beyond

(Meinshausen et al, 2009). Such emissions reduction paths are many times greater in scale than precedents of emission reductions associated with economic recessions or technological switches of the past (such as France's nuclear expansion or the UK's 'dash for gas') (Anderson and Bows, 2008). With higher levels of cumulative emissions there is a significant likelihood of mean warming of 4°C or more above preindustrial levels, with serious implications in terms of impacts (Parry et al, 2009). This is part of the new realism about climate change, which has yet to pervade thinking about adaptation.

These realities complicate the temporal challenge of adaptation. It may be within the capacity of human ingenuity to adapt to 2°C of warming above preindustrial levels. If emissions slow so that climate stabilises at this level, the pace of change may be such that adaptation can, by and large, be successful. This is effectively the argument implicit in the EU's 2°C target and policy position. In such scenarios of adaptation, many people in most places can continue to lead valuable and meaningful lives. But even at these levels, important justice issues are raised, given the likelihood that some people and ecosystems will not be able to adapt. However, it is far less certain that widespread adaptation is possible beyond 2°C of warming. The International Scientific Congress on Climate Change in Copenhagen in March 2009, for example, suggested that "warming above 2°C would be very difficult for contemporary societies and ecosystems to cope with" (conference report at www.climatecongress.ku.dk).

As we move beyond 2°C of warming, social ecological systems may transform into new states. For example, at 2°C of localised warming coral reefs are likely to bleach annually (Donner et al, 2005), and ocean acidification will potentially start to dissolve all corals when elevated atmospheric CO₂ doubles from preindustrial levels (Silverman et al, 2009). Hence the failure of reefs to grow may mean coral systems, including barrier reefs and atolls, progressively transform into states that can no longer support human populations in the same way.

In terms of research, there is much that can be learned about adaptation by examining sensitivities to existing perturbations and changes, analogous events, and capacities to adapt. However, the applicability of this evidence base to an understanding of vulnerability and adaptation in a world where there is 4°C of warming is highly questionable given the unprecedented changes that lie ahead. It may also be the case that the changes in the earth system and its interconnected parts are very rapid. The possibility of unanticipated impacts that are not planned for in the design of adaptation responses makes the implicit economic and strategic calculus of actions and inaction unreliable.

The possibility of transformation of the world's biogeography creates extremely complex and highly sensitive research challenges, associated with understanding when, where, and how such transformations may arise. When thresholds are crossed it is not clear how such situations can be managed to minimise widespread social disruption or how such transformations should be implemented, with legitimate and democratic deliberation about such radical futures. There is a need for careful thought about the ways in which potential transitions of sectors and places to reduce vulnerability should be conceived of, initiated, and managed.

Careful thinking is required here lest ill-conceived strategies to reduce vulnerability stimulate social and market responses that create adverse effects of a kind similar to, if not worse than, what might be expected due to climate change. For example, we previously argued (Barnett and Adger, 2003) that talk of purportedly inevitable relocation of island communities due to climate change may be undermining the confidence of investors, donors, and local people, so that economies stagnate, resources are used unsustainably, and people begin to seek to leave. Such reactions hence affect the kind

of economic, social, and environmental impacts that the possible relocation was supposed to avoid. There is also a danger that the possibility of transformation is used by powerful actors to achieve outcomes that were otherwise not possible. Powerful actors may, for example, use climate change as an excuse to conduct forced migrations for political or economic gain (Barnett and Webber, 2009).

As the impacts of climate change increase they are also likely to amplify one another. Coastal communities and regions will face sea-level rise but also changing coastal ecosystems, changing regimes of coastal storms, and changing freshwater availability all at once. But the interconnectedness of markets across the globe now means that in many societies the proximate impacts of climate change are not the only stress to plan for. For example, the impacts of climate change on agriculture and fisheries will affect relative prices and availability everywhere, such that adaptation plans that address proximate impacts alone may not prepare for some of the more powerful drivers of impacts on people and places.

The *second* reason for concern is that adaptive capacity will not necessarily translate into action. Robert Repetto (2009) has termed this the ‘adaptation myth’. He argues that the US has in effect decided that its economy is invulnerable to climate change impacts and will be able to adapt to climate change. Yet public and private bodies charged with adaptation have failed, in Repetto’s assessment, to deal with present risks and emerging future risks. In storm preparedness, for example, New York City’s building codes and even flood risk maps are based on historical and existing risks rather than projected future risks. Present flood risks were clearly inadequate in Louisiana and New Orleans when Hurricane Katrina made landfall in August 2005. Repetto concludes that “to say that the United States *can* adapt to climate change does not imply that the United states *will* adapt” (page 20, emphasis in original).

Adaptation has not been well embedded in planning systems until now despite changes in weather extremes. In the UK, for example, the summer floods of 2007 demonstrated the vulnerability of people and infrastructure to increased intensity of rainfall that has been observed over the past thirty years (Osborn and Hulme, 2002). But changes are slowly underway. In Australia, for example, the Victorian Coastal Strategy of 2008 recommends a policy of planning for sea-level rise of not less than 0.8 m by 2100, and that this benchmark be progressively revised as new science comes to hand (VCC, 2008). This recommendation may be difficult to implement, and may not eliminate the difficulties local authorities in coastal areas face in attempting to manage their jurisdictions in order to minimise potential losses and damage due to sea-level rise. The process is being significantly complicated by a growing awareness of the potential for local authorities to be legally liable if the courts decide they did not do enough to minimise exposures to climate change (McDonald, 2007).

The *third* reason for concern about adaptation is the extent to which actions already in place are not sustainable. Maladaptation abounds in water resources, flood plain development, and the like. In southern Australia the response of governments to declining streamflows—which in extreme cases such as Perth have been 25% of long-term averages (Preston and Jones, 2006)—has been to trade energy for increased water supply. Desalination plants are now planned or being constructed in Adelaide, the Gold Coast, Sydney, Melbourne, and Perth. The Wonthaggi Desalination Plant planned for Melbourne has been controversial, and estimates are that its construction will lead to the emission of over a million tonnes of CO₂-equivalent gases, and its operation will produce over 900 000 tonnes of CO₂-equivalent gases per year (Mitchell et al, 2008).

Also in Melbourne, the Sugarloaf Pipeline Project, which will pump water saved from the associated Northern Victoria Irrigation Renewal Project, will entail increased emissions of greenhouse gases to meet Melbourne's water needs—needs which could otherwise be met by efficiency and demand management policies. Both projects are likely to have considerable downstream environmental effects, including in the case of the pipeline project, the reduction of flows in the already critically stressed Murray River. It has recently been reported that the analysis of water returns that justified both projects was flawed, and that the costs of both will be higher than initially anticipated (Davidson, 2009).

In addition, moral hazard issues are not well addressed in public subsidies and in insurance and compensatory mechanisms. For example, a recent review of the Australian government's 1992 National Drought Policy has shown that the system of payments to provide relief for farm households and businesses suffering hardship during a drought do not help farmers improve their self-reliance, preparedness, and climate change management (Productivity Commission, 2009). It may indeed have created a moral hazard inasmuch as it may have discouraged actions that would otherwise have been taken to manage risks. Further, the determination of an 'exceptional' drought is likely to become increasingly difficult due to climate change, which may see the recent drought events in Australia become the normal state of affairs (Hennessy et al, 2008). For these reasons it has been suggested that the drought policy be reformed, but there are as yet no firm commitments from the Australian government about this.

The *fourth* reason for concern is that the metrics that may be used to determine the goals of adaptation, the measures of its success, and the trade-offs that may be involved can be understood only in terms of the social context in which adaptation takes place. Communities value things differently and these must be taken into account if adaptation is to be effective, efficient, legitimate, and equitable (Barnett and Campbell, 2009). Thus, what may be perceived as a successful adaptive response from a policy point of view may not be perceived the same way by those who have presumably benefitted from the activity. For example, the widely held idea that relocating populations from islands can save them from the likely impacts of climate change on morbidity and mortality must be set alongside the significance of islands and their local cultures to their inhabitants. Research in Funafuti, Tuvalu, for example, shows that some people have such significant cultural, spiritual, familial, and historical ties with the island that relocation would entail unbearable psychosocial losses, such that many people say they would refuse to leave (Mortreux and Barnett, 2009).

Thus, there will be difficulty in adapting cultures and lifestyles when some impacts of climate change involve irreversible losses of things individuals care about. Most of these impacts are invisible (Turner et al, 2008) because governments and planners inevitably focus on material well being and issues that they can handle through planning systems. But adaptation must seek to include and sustain important values, including places and identity, which means that adaptation will not necessarily be straightforward (Adger et al, 2009).

Conclusion

It now appears that some geographers bemoan the fact that "the term environment is being subsumed under the hegemonic imperative of climate change" (Whatmore, 2008, page 1777). But while climate change does indeed dominate environmental policy agendas it does so with a purpose—to avoid irreversible shifts in earth systems unprecedented in human history with negative impacts on those least to blame and probably least able to cope. Whatmore (2008) calls for a counterhegemony of research

on environmental change at the interface between geography, anthropology, and archaeology. We suggest in the examples and issues in this commentary that, rather than being in opposition, such research is extremely apposite in the context of a changing climate.

Underlying our four reasons for concern about adaptation is what we perceive to be a widespread belief that adaptation will be smooth, cheap, and easy to implement. The reality may be that adaptation to climate risks may be punctuated, messy, more costly than we are willing to pay, and be at odds with legitimate values and strongly held conviction concerning place and identity. The future will be a testing time.

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