

# Global Environmental Security

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### Introduction

Security is a key term in the contemporary political lexicon. Security's multiple meanings and linkages to numerous issue areas make formulating environment in relation to it much more tricky than might at first seem apparent. Both as a conceptual matter and as a guide to policy-making the juxtaposition of security and environment is a fraught endeavor. This has become even more so in recent years as the theme of climate change has been linked to security in a discussion of "climate security." Much of the recent policy debate about climate security either forgets or ignores earlier research work on the links between security, conflict, and environment. Popular accounts frequently reinvent Malthusian fears of scarcities and disruptions as a cause of violence, or naively assume the invocation of security to deal with the problems will necessarily produce sensible and effective policies.

The disruption of the relatively stable climate system in recent decades has been caused by the use of abundant fossil fuels by the huge global economy that has spread into most parts of the planetary biosphere. The scale of human activity in the biosphere and the rapidly growing scientific understanding of these processes have both changed our understanding of humanity's role in the biosphere and made clear the need for policies to deal with our rapidly changing circumstances (Steffen *et al.* 2011). This is necessary to ensure that we don't endanger the key conditions necessary for human civilization to exist. This is very obviously now a matter of global security broadly construed (Dalby 2009). It is more specifically a matter of who decides such things as the future composition of the planetary atmosphere. These emerging new circumstances have changed how politics, technology, and economy link to security policy, but much of the debate still draws on earlier formulations

that usually presuppose that the expansion of the global economy is essential to the provision of security.

As this chapter shows, the changing understanding of humanity's place in the biosphere, and the importance of our growing disruptions of it, have to be worked carefully into the analysis if security is to provide useful policy guidance in coming decades. The chapter first looks back to the history of some key moments in the evolution of a global sensibility that links security to environment. Subsequent sections look at the debate in the 1990s about environmental security and how various formulations shaped the discussion of the links between conflict, war, and environment. The final sections outline how the contradictions in these earlier discussions have become especially pressing in light of the failures of climate mitigation policies to arrest the pace of global change. Climate change now makes environmental factors a crucial consideration for global security, but, as this is a fairly recent innovation, it remains unclear how this will play out in terms of specific policies and their consequences (Webersik 2010). But some important political choices have become unavoidable.

### **The Many Meanings of Security**

All this requires very careful reflection on what security means in particular circumstances, and how it is connected into discussions of war and peace, and the larger stabilities of the global political system that supposedly ought to prevent interstate warfare from recurring. The most important aspect of security is that it is used in political discourse to refer to whatever is the highest priority. Invoking security frequently implies an emergency, which in turn justifies extraordinary powers and sometimes the suspension of aspects of normal civilian life (Buzan *et al.* 1998). But such invocations draw widely on cultural assumptions about danger and safety, and the ability to successfully make a claim that emergency measures are appropriate is a powerful political capability; national security frequently trumps democracy or rights in a crisis situation (Williams 2007). Thus linking environment to security is tied into claims that it is the most important matter needing attention, and a source of danger requiring priority action. When the notion of global security is linked to environment, and now specifically to climate, this clearly is a matter that those who use such language think ought to be a top priority for policy-makers. Activists have sometimes used military analogies with the Second World War to try to suggest that a similar mobilization of society and industry is needed to deal with the threat of climate change (Spratt and Sutton 2008).

However, as Daniel Deudney (1990) pointed out forcefully at the beginning of the major debate on environmental security in the early 1990s, invoking national security, and in particular the role of the military in addressing environmental matters, doesn't usually produce an appropriate policy response. It doesn't because the military is ill-equipped, and certainly not trained to undertake environmental actions; this is a major mismatch between the agency involved and the nature of the problem. If security involves the heavy-handed application of emergency measures it may be completely counterproductive in dealing with rebuilding economies in a sustainable way or expanding citizenship rights and effective participation in the necessary decision-making. There are thus compelling arguments to "de-securitize"

many aspects of the environmental security discussion and return it to the normal processes of political deliberation rather than treat matters as emergencies (Floyd 2010). Nonetheless, as climate change interacts with the increasingly artificial circumstances of urban life and maintaining infrastructure becomes a priority, then security is stretched to encompass matters only indirectly related to traditional concerns with political threats and international violence.

While national security, the protection of the political order and territorial integrity of states, is the most prominent version of security in the modern world, used by state elites to maintain domestic control quite as much as to deal with external threats, the international dimensions of security are crucially important insofar as war between states is understood as the primary danger. Between nuclear-armed powers the dangers are very obvious, and preventing such conflict is a priority in maintaining a state of international security, but even the preparation and testing of nuclear weapons is dangerous, and here the links between radioactive fallout and security connected environment to security long before concerns about climate change were raised. There are few obvious scenarios in which climate change or other environmental matters might trigger a major interstate war, both because the costs of going to war obviously outweigh most plausible environmental benefits, and in many places aggrieved parties do not have a military option (German Advisory Council on Global Change 2008). Bangladesh simply does not have a military option to force states to stop greenhouse gas emissions that are leading to the sea level rise that endangers its citizens on much of its low-lying territory.

Where national security and territorial integrity had been the operating principles of the international system, now human security, shifting the priority from states to people, has raised complicated new discussions of sovereignty and international law. This is now linked to the principle of the Responsibility to Protect, wherein governments are obligated to protect the human security of their populations (ICISS 2001), although how this might be applied to the environment is far from clear, beyond obvious concerns with infrastructure planning (Pascal 2010). Making people rather than states the “referent object” of security is especially important when it comes to matters of environmental security and now, most recently, climate security, which is obviously also very much a global concern (Brauch *et al.* 2011). But linking the focus on small-scale local environmental conflict as a development problem with global atmospheric stability is not easy to do. Not least because fossil-fueled development is precisely what is causing large-scale atmospheric disruptions. The conceptual confusion around security needs to be unpacked carefully if useful policy implications are to be extracted from the discussion, but all of this requires careful reflection on how security has been invoked in the past in relation to the atmosphere, and how this is changing in light of new research, if it is to be appropriately contextualized now.

### **Atmospheric Security: Nuclear Weapons, Ozone, and Climate**

The nuclear destruction of Hiroshima and Nagasaki in August 1945 introduced the world to the dangers of radioactive fallout. Deadly rains, spreading the debris from a nuclear explosion in the atmosphere widely and contaminating food, water, and buildings, made the environmental dimensions of security clear in at least one easily understandable image. The unfortunately named Japanese trawler *Lucky Dragon*,

badly contaminated by the fallout from an American nuclear weapons test in the Pacific in March 1954, reinforced the popular understanding of the environmental aspects of these devices well before active campaigns on the part of pediatricians to collect baby teeth to document the spread of Strontium 90 in particular brought the issue home to Americans (Miller 1986). Documenting the consequences of radiation on populations continues to be a major source of controversy concerning nuclear power, only most recently revived in the case of unexplained death rate increases following the Fukushima nuclear meltdown in 2011 (Mangano and Sherman 2012). The partial test ban treaty of the early 1960s that effectively moved nuclear testing underground to prevent further atmospheric contamination was more an international environmental agreement than an arms control treaty, but the link between nuclear weapons, environment, and global security was clearly indicated in its formulation (Soroos 1997).

Subsequently as industrialization spread rapidly in the latter part of the twentieth century, other environmental pollutants came to widespread attention in the 1960s, substances such as DDT and other pesticides, as well as smog caused by coal-burning and subsequently automobile emissions (McNeill 2000). Part of the solution to local pollution was to build taller smokestacks, ensuring that the pollution was diluted and spread more widely rather than causing immediate damage and health hazards to local populations. Ironically this simply made a local problem a global one when winds moved pollution across frontiers and acid rain formed as a result of atmospheric chemistry. In particular the destruction of forest and lacustrine environments as a result of the transboundary movement of pollution from the United States into Canada and European pollution over Scandinavia added an important international dimension to this and triggered a series of international efforts to reduce sulfur emissions (Park 1987).

The late 1980s also witnessed dramatic alarms about deforestation in the Amazon, and a noteworthy drought in North America in 1988, severe enough to drastically constrain river transport on the Mississippi, and in the process cause economic disruptions in the United States. The global atmosphere had become a matter of concern in the 1980s, and while initially concerns had been about a new ice age, once the recent global climate data were carefully compiled it became clear that rapidly rising levels of carbon dioxide in particular were likely to warm the global climate noticeably (Schneider 1989). Putting these concerns with acid rain, ozone depletion, and then concerns about climate change together raised awareness and political concern about global environmental matters with enough urgency to get them considered as a matter of global security.

In the 1980s the environmental dimensions of nuclear war also came to prominence in the discussion of what was quickly dubbed “nuclear winter” (Turco *et al.* 1983). Where earlier concerns about radiation and the damage to the stratospheric ozone layer by the use of nuclear weapons had been noted, in the early 1980s scientists asked what might happen if huge dust and smoke clouds were lofted into the upper atmosphere by numerous nuclear explosions. The models of the atmosphere used to investigate these things suggested that the Earth would be shaded by debris and smoke to such an extent that the northern hemisphere in particular would be noticeably cooled. The fear was that they would be cooled to such an extent that crops would probably fail and the direct destruction of cities and industries by the nuclear

explosions, fallout, and ozone layer disruptions would be seriously augmented by the collapses of many ecosystems and agriculture. Thus the indirect ecological effects of nuclear war might be even more serious than the immediate destruction (Sagan and Turco 1990). All of this added to the arguments against nuclear war and linked environmental matters once again directly into the discussions of international security. They also emphasized the fragility of the planet's climate system and the potential for humanity to change its basic parameters.

These concerns were emphasized a few years later when it suddenly became clear that 1970s fears of stratospheric ozone depletion were being realized over the South Pole in particular, although with a substantial reduction of stratospheric ozone over the North Pole in northern hemisphere winters too. In part this is because of the pattern of winds in the polar vortex over Antarctica that make a very cold environment in the polar winter night, which facilitates the breakdown of CFCs and the subsequent chemical "scavenging" of ozone in those regions. This matters greatly because in effect stratospheric ozone acts as a shield for life from harmful UVB solar radiation. Hence action needed to be taken rapidly to phase out the production and use of CFCs and related chemicals. The Montreal Protocol and subsequent follow-on agreements have stopped the production of most of these substances, although polar winter ozone holes persist, and will do so for decades to come until atmospheric CFCs diminish to low levels (Benedick 1991).

In this context of alarm about global security and environment, many of the themes that now shape the current international discussion were initially drawn together in Toronto in the June 1988 international conference on "The Changing Atmosphere: Implications for Global Security." While the conference was concerned about ozone depletion as well as acid rain issues, the biggest concern the conference statement identified was "climate warming, rising sea level, altered precipitation patterns and changed frequencies of climatic extremes caused by the 'heat trap' effects of greenhouse gases." All this mattered, the delegates thought, because the consequences of these changes would in the long run be profoundly disruptive for all states. Such major disruptions were understood as a matter of global security because they could lead to conflict in many ways. In the words of the conference closing statement:

The best predictions available indicate potentially severe economic and social dislocation for present and future generations, which will worsen international tensions and increase the risk of conflict among and within nations. It is imperative to act now.

What was also clear was that international cooperation was going to be needed. In the words of the Toronto conference statement: "No country can tackle this problem in isolation. International cooperation in the management and monitoring of, and research on, this shared resource is essential."

Tentative steps in this direction came from the subsequent Earth Summit in Rio de Janeiro in 1992 at which the United Nations Framework Convention on Climate Change (UNFCCC) was agreed to by many states. The overall purpose of the convention clearly states that it is necessary to prevent humanity causing dangerous levels of climate change. While there are arguments about how much climate change is dangerous, by the mid-1990s there was a widespread agreement that the climate

should not warm more than 2 °C. However, this was more a political compromise than a scientific evaluation. Two decades later current projections frequently suggest that we are headed well past this mark unless things change very soon (Anderson and Bows 2011). Major ecological changes will inevitably follow if present atmospheric trends continue. In Rio it was obvious that international cooperation was key to solving this problem and dealing with curbing greenhouse gas emissions. But developing countries were also very clear that those who were creating the problem, the rich developed states that used huge amounts of carbon fuels, were going to have to be those who started to solve it, and would need to pay compensation to the poorer states for forgone development opportunities (Kjellen 2008).

### **Sustainable Development and Environmental Security**

Simultaneously with the emerging awareness of atmospheric fragilities, there was a parallel global discussion of resource management, environmental degradation, and development. This lengthy discussion has also led into the global security discussion related to environment, but from the ground up, as it were, in contrast to the top-down global atmosphere discussion. The formulation of sustainable development was effectively institutionalized by the World Commission on Environment and Development (WCED) in its report *Our Common Future* in 1987. Taken for granted in the document is the assumption that violence is likely in imminent struggles for access to scarce resources. And at least implicit in much of the discussion is the argument that renewable resources are a key part of this problem and that such shortages will likely be aggravated by environmental degradation of various sorts. This line of argument fed the initial formulations of what became the discourse of environmental security and has continued to shape many of the discussions since (Dalby 2002).

One theme that emerged in the late 1980s was fears of North–South hostilities as impoverished states took action against the rich North. A variation on that theme suggested that conflict in Southern states, driven by environmental difficulties, might cause spillover effects as migrants caused political difficulties for destination states. All of this might lead to global security issues if the resultant instabilities led to interstate warfare (Homer-Dixon 1991). This discussion was part of a larger re-evaluation of international security, in the United States in particular, that came about due to the collapse of the Soviet Union and with it the end of the Cold War, coincident with the military mobilization of the coalition that reversed Saddam Hussein's invasion of Kuwait in 1990 in the brief Gulf War early in 1991 (Allison and Treverton 1992). Among the many new contenders for priority concern for security were ethnic nationalism, international migration, the drugs trade, nuclear proliferation, emergent diseases, and the global environment (Klare and Chandrani 1998). In the Soviet Union itself matters of environment and the need to think very differently about global security had been raised following the Chernobyl nuclear meltdown in 1986, although these were dismissed by commentators and politicians in the West, not least because the Soviet Union had an appalling record on environmental matters (Dabelko 2008).

These two key questions – first the empirical one concerning if and when environmental changes might cause conflicts and if so, where and how, and second the

question of the appropriate framework for security planning in the new geopolitical circumstances – structured the debate through much of the 1990s. These are explicitly linked by implicit assumptions concerning what is to be secured, and whose environments matter for security (Barnett 2001). Subsequently, as later sections of this chapter will show, these themes have returned to influence how, most recently, “climate security” is formulated as a global issue.

The initial premise of the WCED (1987) that environmental degradation would cause conflict was widely accepted among the commentators at the time. What is notable about Thomas Homer-Dixon’s (1991) intervention in the early 1990s is that he, for one, did not accept the basic premise and turned from a wide-ranging policy discussion to try some detailed empirical work that would establish the parameters of how environmental change might be a problem, and specifically how it might lead to what he called acute conflict. He subsequently concluded that inadequate political institutions were crucial to explaining where conflict was most likely (Homer-Dixon 1999). How precisely these connect to more traditional matters of security has been under debate in the last couple of decades, but Malthusian fears of population growth and resource shortages have been reinvented frequently despite the robust empirical research that suggests that violence is not a frequent result of environmental change (Kahl 2006) or, most recently, specifically a response to climate-change-induced droughts (Theisen *et al.* 2011).

In the early years of the new millennium this discussion was effectively turned upside-down when the “greed not grievance” arguments suggested that abundance rather than scarcity was related to violence in the “new wars” of the 1990s (de Soysa 2002). Here the suggestion is that resources that are worth fighting for when few other economic options are available are the source of organized violence. One fights to control revenue from natural resources if one has few other options. Thus the discussion of conflict diamonds, the violence surrounding oil resources in many places, and the destruction of tropical forests to support insurgencies suggested a very different set of circumstances relating to conflict, and more directly tied concerns with violence in the peripheries into discussions of consumption in the metropolises of the global economy (Le Billon 2012). This suggests a very different set of ideas about the sources of violence and which security policies might be appropriate.

Critics have suggested that the concept of security is so caught up with the processes of the global economy that it isn’t a helpful way of engaging contemporary politics (Neocleous 2008). Although this line of critique refers largely to the militarization of policing as part of the war on terror, it is worth remembering that at least so far much of security has been about the protection and support of the mode of economic development that has set in motion the transformation of most of the Earth’s ecosystems, and the atmosphere in particular. Jon Barnett’s (2000, 2001) critique of environmental security focused on why in these circumstances so much of the literature in the 1990s in particular focused on the global South and insecurities there, rather than on the larger political economy that was causing the global disruptions.

The critical literature on development has suggested that the quasi-imperial way that carbon sinks are now arranged and offsets calculated is in many ways a reinvention of colonizing practices of the past (Lohmann 2006). Indeed development discourse is increasingly related to matters of instability in peripheral places, where

violence and military interventions are part of the process of governing and security merges with development (Duffield 2007). Attempts by richer states to secure supplies of food in the face of likely future disruptions are in places perpetuating the dispossession of marginal and poor peoples as practices of land-grabbing spread (Matondi *et al.* 2011). The political protests around the world in 2011 have, however, now raised questions about global governance in ways that are connecting matters of global economics with larger matters, including climate change.

The overall logic of sustainable development on the one hand and the immense wealth involved in petroleum and gas industries on the other have combined to maintain fossil-fueled economic growth as the priority, despite repeated warnings that more fundamental rethinking and reorientation of the global economy is necessary. Nearly all the discussion thus far has focused on mitigating climate change on the entirely sensible understanding that preventing climate change is the first priority, not least because, as the influential British review of the economics of climate change, the so-called Stern Review (Stern 2007) pointed out forcefully, it is much cheaper to pay for incremental changes now than try to fix the problem after disastrous disruptions are underway. But it has become clear that contemporary policies are not likely to lead to a situation where the climate system remains in the configuration we have taken for granted as a premise for global security until very recently, a situation that now requires a much more comprehensive re-evaluation of security risks (Mabey *et al.* 2011). Clearly the quasi-imperial view of an external Earth to be managed from the metropolises, while maintaining their modes of consumption, is not an adequate formulation of security if sustaining a viable biosphere into the future is the goal of climate security (Steffen *et al.* 2011).

### Climate Security

Concerns over atmospheric changes and sustainable development concerns came together at the Earth Summit in Rio de Janeiro in June of 1992, where the UNFCCC was signed. It formally entered into force in March 1994. While the UNFCCC wasn't a document that contained enforceable limits on greenhouse gas emissions, it clearly stated that its purpose was to constrain greenhouse gas concentrations at levels that would prevent "dangerous anthropogenic interference with Earth's climate system." While this isn't phrased in terms of security, clearly it is both a matter of global concern and something that deals with a threat to human civilization at the largest scale. Instead the convention focuses on mitigating climate change dangers by reducing greenhouse gas emissions.

In 2007 once again the environment forcefully entered the security discussion at the largest of scales when the American security establishment finally paid attention to the issue of climate change and released several major reports raising the alarm about the possible violent consequences of climate change (Campbell *et al.* 2007; CNA Corporation 2007; Campbell 2008; Pumphrey 2008). Memories of the destruction caused to New Orleans by the flooding that followed Hurricane Katrina in 2005, which posed the question of vulnerabilities bluntly, were then combined with the attention paid to the fourth assessment report of the Intergovernmental Panel on Climate Change (IPCC) released in 2007. While the IPCC report did not consider the security implications of climate change, the attention paid to both this



report and Al Gore's movie *An Inconvenient Truth*, which together won the Nobel Peace Prize in 2007, revived the environmental security agenda by reworking it in terms of climate change. The German advisory committee on security and climate change released its own comprehensive evaluation of numerous security risks in 2008. In 2009 the United Nations Secretary General released a report suggesting that climate change might act as a conflict enhancer and explicitly linked climate to security (United Nations Secretary General 2009).

But as with the 1990s discussion, much of this literature still focused on potential violence in underdeveloped states and the potential for violence if climate disrupted rural subsistence, rather than focusing on the larger ecological transformations in motion or the increasing vulnerabilities of urban populations dependent on complicated infrastructure and lengthy commodity chains for their survival (Dalby 2009). Africa continues to gain most of the attention given the supposed vulnerabilities of its rural populations (Brown *et al.* 2007), despite research that suggests that the adaptive capabilities of even very poor people are largely misunderstood by much of the development literature (Carr 2011). American preoccupations with national security (Busby 2008) or military responses to migration and related matters (Smith 2007) continue to focus on external threats to metropolitan security (Briggs 2010; Moran 2011), rather than engaging in a more fundamental analysis of the forces driving global change. Where this has been the focus, in the lengthy processes of negotiating mitigation measures designed to reduce carbon emissions and enhance the "sink capabilities" of forest ecosystems, it is clear that measures taken so far have failed to substantially reduce the overall rate of increase of greenhouse gases.

As other chapters in this volume make clear (Chapter 1 and Chapter 20) over the last couple of decades mitigation hasn't even slowed the rate of accumulation of greenhouse gases in the atmosphere. Attempts to provide a follow-on to Kyoto and extend Kyoto were a matter of intense political argument in COP meetings, notably in Copenhagen in 2009, and it was only in Durban in December 2011 that states finally agreed to negotiate a binding agreement by 2015 that will come into force in 2020. By then many climate scientists now argue it will be too late to keep climate changes within the range fairly close to that which made civilization possible in the first place; there is an "emissions gap" between the political aspirations in the Copenhagen and Durban COP agreements and the rising CO<sub>2</sub> levels in the atmosphere (United Nations Environment Programme 2010). In these circumstances policies of adaptation, trying to change societies in ways that deal with the consequences of climate change and minimize the vulnerabilities of societies to more extreme weather and unpredictable droughts, storms, and floods, simply have to be addressed.

### *Adaptation*

Rising sea levels, changed storm tracks, hotter summers, more extreme rain events, reduced Arctic ice cover, possible new disease vectors, and numerous other matters are possible consequences of climate change. Adaptation requires the simple recognition that what has been understood to be the normal conditions for particular societies in terms of temperature patterns, water supplies, and crop-growing conditions no longer apply (Pascal 2009). While much of this is specifically local, when disaster strikes numerous international implications may occur, and disaster

diplomacy is part of the larger considerations of adaptation that now require global attention (Adger *et al.* 2009). Not least this is because disasters may have implications for international relations quite as much as for the immediate victims of infrastructure failures. The interconnectedness of the global economy and its fuel supplies was made abundantly clear in 2005 when hurricanes disrupted American production and refining facilities in the Gulf of Mexico, driving the international price of oil upward (Yergin 2011).

Over the last few decades humanity has become a species that lives in cities. Long before this happened, urban-based economies dominated rural areas, drawing materials, food, and fuel from hinterlands to make urban life possible. Urban populations are increasingly dependent on the communications infrastructure, on roads, rails, pipelines, sewage systems, electricity, and phone systems, and these are highly vulnerable, to storms in particular (Graham 2010). Coastal cities are especially vulnerable to flooding, as the residents of Bangkok discovered in 2011. In the short run emergency aid, often provided by military forces, is a key mode of adaptation, providing food, water, shelter, medical assistance, and sometimes evacuation to stricken people. International cooperation in these matters is growing and as such global security is enhanced as peoples are assisted in periods of danger. Climate change might indeed precipitate peace (Gartzke 2012). Cooperation in the face of adversity is a much better response than treating victims of disasters as a potential threat. But at best these are stopgap measures, unless they lead, as they sometimes do, to reducing political tensions and encouraging cooperative mitigation and adaptation measures. Coping with such disruptions is now a key part of security policy-making in many places (Brauch *et al.* 2011).

Migration is one of the major issues related to adaptation but has mostly been seen as a problem in the security literature (Smith 2007). The contradiction between national security and a global vision that takes adaptation seriously poses one of the major policy issues for coming decades. In the last couple of generations boundaries and borders have been settled and assumptions that populations are stable and fixed within certain geographical areas has become the norm of a fixed territorial order. Movement is the most basic adaptation measure of natural systems to large-scale environmental changes. Species move, and indeed now are moving wholesale in response to climate changes. If people try to do the same thing across national frontiers, will the states into which they try to move see these people as a threat to political stability (Guild 2009)? The current popularity of boundary-fence construction in many places where there is a notable disparity of wealth across a frontier suggests that political elites are already trying to use territorial means to protect “national security” from migration (Jones 2012). While this is frequently done in terms of anti-terror measures, it is clear that these policies can easily be invoked in the face of migration caused by disasters in the short run or longer-term environmental disruptions.

All of this is made most difficult, because, despite the frequent use of the term environmental refugee, there is no such legal category, nor any international convention that recognizes environmental causes as a legitimate reason for migrants to claim refugee status or international protections (Pigué *et al.* 2011). While climate change may set people in motion due to the indirect effects of agricultural changes or outright failures caused by droughts, floods, or other disruptions, the territorial

structure of the present geopolitical order is ill-equipped to deal with the human consequences (Pascal 2010). Technically this may not be a matter of global security understood in the traditional manner of things that might lead to large-scale political disruptions and interstate conflict, but it clearly is a matter of global change induced human insecurity.

### *Geoengineering*

But now just as adaptation measures are beginning to be taken seriously by infrastructure planners, given the failures of mitigation policies over the last couple of decades, the science of climate change is pointing to the increasingly likely occurrence of very dangerous climate change. This is what will happen when the climate system crosses some of the tipping points or thresholds beyond which the climate system will begin to operate in entirely new and largely unpredictable ways (Lenton *et al.* 2008). While a good deal of the argument about how much climate change is dangerous has long assumed that 2 °C average global warming is “safe” in that it will not cause rapid transformation, and the scientific basis of that claim has long been understood to be dubious, if present trends continue, global temperatures will increase more than this, with all sorts of unpredictable results (Mabey *et al.* 2011).

If mitigation strategies, which ought to be both easier and safer given that they are about preventing the problem rather than trying desperate experiments after the fact, have failed, then there may be no alternative to geoengineering, unless, that is, humanity effectively decides that a radically changing climate isn't a bad thing, and that there is no good reason why we should live in a biosphere that has two polar ice caps. The planet after all has had periods in the geological past in which no permanent ice existed at the poles; it may well face this prospect once again, and indeed it seems that this is the future that current human activity is now setting in motion. But it is precisely the potential for massive human suffering and death, not least because of huge agricultural disruptions in the process of so transforming the planet's climate, that makes scientists invoke notions of global security in arguing that such a course with its numerous imponderables is just too risky to seriously contemplate (Schneider *et al.* 2010). In these new circumstances global security now means keeping the planetary climate system within the parameters that we have known for the last few millennia; that is, close to the conditions that gave rise to human civilization in the first place.

Thus serious consideration is increasingly being given to artificially changing the atmosphere in ways that will counteract the enhanced warming effects of carbon dioxide and methane (Royal Society 2009; Bipartisan Policy Center 2011). Under the rubric of “geoengineering” discussions of solar radiation management are taking place around scenarios for such things as injecting aerosols into the atmosphere to reflect sunlight back into space rather than have it heat Earth's surface. In theory this can be done, mimicking the consequences of large volcanic eruptions that put sulfur aerosols in the high atmosphere and shade the planet. Other technical suggestions include creating artificial clouds over the oceans using mobile automatic ships to spray water into the atmosphere. While there is some fascinating speculation about science-fiction-type scenarios involving the construction of huge mirrors in space, they undoubtedly require more lift capacity than space-travel programs can provide.

What is clear is that these ideas are no more than stopgap measures to buy time while more fundamental rethinking is done (Steffen *et al.* 2011).

Geoengineering raises numerous new questions of governance and environmental policy, not least because widespread agreement would seem to be necessary prior to initiating major planetary engineering efforts (Humphreys 2011). To return to classical considerations of security in international relations, the inevitable question becomes what happens if one state decides to take matters into its own hands and starts inserting aerosols into the upper atmosphere to cool the planet, an industrial enterprise now within the capabilities of at least some of the larger countries (Dyer 2008). Once again the intersection of technology and an endangered atmosphere is unavoidable, but now rather than environmental change being an unintended consequence of nuclear warfare or unrestricted CFC production, the atmosphere has become an arena for deliberate manipulation, perhaps even by using technology derived from the missiles and environmental engineering that were earlier seen as part of the threat to humanity.

## Conclusion

Having effectively taken our collective fate into our own hands, now the traditional assumption of environment as a relatively benign backdrop for human activities is no longer a valid assumption in thinking about global security (Dalby 2009). There are many gaps in global governance and there is no deliberative body that decides on how many polar ice caps the planet ought to have, or what the average atmospheric temperature considered optimal for human life should be. But these decisions are effectively being taken by the carbon-fueled mode of economic activity that continues to expand rapidly despite 20 years of discussion about greenhouse gas emission levels and the existence of the UNFCCC, explicitly committed to ensuring that dangerous levels of anthropogenic atmospheric change are prevented.

The failures of international diplomacy to solve the problem of rising greenhouse gas concentrations have, however, spawned numerous new experiments in trying to tackle climate change (Hoffman 2011). Innovative business models are being used by a growing economic sector that is mobilizing carbon markets and the possibilities of cap-and-trade systems to re-engineer economies in ways that reduce carbon fuel use (Newell and Paterson 2010). Albeit very late in the day, numerous organizations and institutions are beginning to try to reduce emissions and operate in more sustainable manners, suggesting quite clearly that if sustainable security is to be provided it will likely come from new innovations in technology and energy systems as well as their governance rather than from international treaty initiatives by the major powers (Lilliestam *et al.* 2012). A new geopolitics with new ecological notions of security may now be in the making.

In the face of such considerations the question of who is securing what future is unavoidable. So far the political institutions of the modern nation-states system and the political economy of carbon-fueled industrialism suggest that if present tendencies remain on track, in the face of mounting disruptions, global security will be an extension of what Paul Rogers (2010) calls “keeping the violent peace,” where military forces are used to quell insurrections and maintain the existing political and

economic arrangements. Political elites may well decide to use the wealth accumulated by carbon-fueled economic growth to build the technologies for geoengineering instead of trying to tackle the more fundamental political questions of inequality and instability that threaten global security.

The alternative is a more radical political orientation that takes seriously the logic of the UNFCCC and recognizes that new modes of energy use and a much more just system that facilitates participation in decision-making by a much larger portion of humanity are necessary for a sustainable economic system that makes a stable climate system the basis for global security. This vision suggests a much less militarized version of the future, one not dependent on technological manipulation of the planetary environment by a self-appointed elite (Klein 2011). Which course is taken in the next couple of decades will not only determine how human societies evolve, it will probably also quite literally determine how many polar ice caps the planet has, and the course of evolution of life itself for many millions of years. Nothing less is involved now in attempts to secure the globe.

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