Reducing the Future to Climate: a Story of Climate Determinism and Reductionism

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Abstract

One hundred years ago, a popular theory contended that various aspects of climate determined the physiology and psychology of individuals, which in turn defined the behavior and culture of the societies that those individuals formed. As the ideological wars of the twentieth century re-shaped political and moral worlds, environmental determinism became discredited and marginalised within mainstream academic thought. Yet at the beginning of a new century with heightening anxieties about changes in climate, the idea that climate can determine the fate of people and society has re-emerged in the form of 'climate reductionism'. This paper traces how climate has moved from playing a deterministic to a reductionist role in discourses about environment, society and the future. Climate determinism previously offered an explanation, and hence a justification, for the superiority of certain imperial races and cultures. The argument put forward here is that the new climate reductionism is driven by the hegemony exercised by the predictive natural sciences over contingent, imaginative and humanistic accounts of social life and visions of the future. It is a hegemony which lends disproportionate power in political and social discourse to model-based descriptions of putative future climates. Some possible reasons for this climate reductionism, as well as some of the limitations and dangers of this position for human relationships with the future, are suggested.

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Introduction

> The general attitude of many critics, however, is in keeping with the reaction during the last few decades against the simple determinism [of Ellsworth Huntington] which led to what Lattimore … has described as "the romantic explanation of *hordes* of erratic nomads, ready to start for lost horizons at the joggle of a barometer in search of suddenly vanishing pastures"—Gordon Manley[1] (1944)

> At plus-4 degrees, *hordes* of climate refugees would flee famine and extreme water scarcity. At plus-5 degrees, climate refugees would number in the tens of millions as massive uninhabitable zones spread—Joanne Ostrow[2] (ca. 2008)

Human beings are always trying to come to terms with the climates they live with. This is as true for the ways the relationship between society and climate is theorised, as it is for the practical challenges of living fruitfully and safely with climatic resources and hazards. The story of how the idea of climate has travelled through the human imagination is well told in Lucian Boia's *The Weather in the Imagination*[3], and an exemplary account of how a society seeks practically to live with its climate is William B Meyer's *Americans and their Weather*[4]. When reflecting on these relationships between society and climate there are two intuitive positions that have frequently been adopted. On the one hand it is obvious that climates influence and shape human psychological, biological and cultural attributes. This is true for individual behaviours, cultural practices and environmental resources. Yet it is equally true that an enduring strand of human encounters with climate seeks both to tame these climatic influences and constraints and

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[1] Gordon Manley, "Some recent contributions to the study of climatic change," *Quarterly Journal Royal Meteorological Society* 70 (1944): 197-220, on 220, emphasis added.
[2] Joanne Ostrow in her review "Six degrees could change the world" a National Geographic TV documentary based on Mark Lynas's award-winning book *Six Degrees*. http://www.denverpost.com/ostrow/ci_8190284, emphasis added.
[3] Lucien Boia, *The Weather in the Imagination* (London, Reaktion Books, 2005)
[4] William B Meyer, *Americans and their Weather* (New York, Oxford University Press Inc, 2000).

to live beyond them. Human beings change micro-climates, they insulate themselves against climatic extremes and adapt technologies and practices for survival and prosperity[5].

Understanding and theorising the relationship between climate and society is therefore prey to two distinct fallacies. The first is that of 'climate determinism' in which climate is elevated to become a – if not *the* - universal predictor (and cause) of individual physiology and psychology and of collective social organisation and behaviour. The second fallacy is that of 'climate indeterminism' in which climate is relegated to a footnote in human affairs and stripped of any explanatory power. Geographers have at times been most guilty of the former fallacy; historians at times most guilty of the latter[6]. Yet not even historical geographers or environmental historians have been always able to hold these two opposing fallacies in adequate and creative tension[7].

At the beginning of the twentieth century, the determinist fallacy achieved considerable salience and popularity in European and, especially, American thought, championed by the likes of the geographers Friedrich Ratzel, Ellen Semple and Ellsworth Huntington[8]. Climate was viewed as the dominant determinant of racial character, intellectual vigour, moral virtue and the ranking of civilisations[9], ideas which had earlier appealed to Greek philosophers and European rationalists alike. However, the ideological wars of the mid-twentieth century re-shaped the political and moral worlds which had nourished such thinking and determinism became discredited and marginalised within mainstream academic geography.

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[5] William W Kellogg and Stephen H Schneider, "Climate stabilization: for better or for worse?", *Science* 186(1974): 1163-1172.

[6] Gabriel Judkins, Marissa Smith and Eric Keys, "Determinism with human-environment research and the rediscovery of environmental causation", *The Geographical Journal* 174(2008): 17-29.

[7] Oskar H K Spate, "Toynbee and Huntington: a study in determinism", *The Geographical Journal* 118(1952): 406-424.

[8] Richard Peet, "The social origins of environmental determinism", *Annals of the Association of American Geographers* 75(1985): 309-333; James Rodger Fleming, *Historical Perspectives on Climate Change* (New York: Oxford University Press, 2005); Innes Keighren, *Bringing Geography to Book: Ellen Semple and the Reception of Geographical Knowledge* (London: I B Tauris & Co, 2010); Georgina Endfield, this volume.

[9] David N Livingstone, "Race, space and moral climatology: notes toward a genealogy", *Journal of Historical Geography* 28(2002): 159-180.

Now, a hundred years later, and at the beginning of a new century, heightening anxieties about future anthropogenic climate change are fuelling – and in turn being fuelled by - a new variety of the determinist fallacy. Although distinct from the politically and ethically discredited climate determinism epitomised by Ellsworth Huntington and his followers, climate has regained some of its former power for 'explaining' the performance of environments, peoples and societies. In seeking to predict a climate-shaped future, the complexity of interactions between climates, environments and societies is reduced and a new variant of climate determinism emerges. I call this 'climate reductionism', a form of analysis and prediction in which climate is first extracted from the matrix of interdependencies which shape human life within the physical world. Once isolated, climate is then elevated to the role of dominant predictor variable. I argue in this paper that climate reductionism is a methodology that has become dominant in analyses of present and future environmental change – and that as a methodology it has deficiencies.

This way of thinking and analysing finds expression in some of the balder (and bolder) claims made by scientists, analysts and commentators about the future impacts of anthropogenic climate change. Here are some examples of claims in which emerge from this climate reductionist form of analysis:

- Every year climate change leaves over 300,000 people dead;
- We predict, on the basis of mid-range climate-warming scenarios for 2050, that 15–37% of species ... will be 'committed to extinction';
- 185 million people in sub-Saharan Africa alone could die of disease directly attributable to climate change by the end of the century;

- The costs and risks of climate change will be equivalent to losing at least 5% of global GDP each year, now and forever ... [rising to] 20% of GDP or more;
- I think there will be substantial change [in climate] whatever we do. If we do nothing over the next 20 years it will be catastrophic. If we do nothing over the next 50 to 100 years it might even be terminal[10].

Such reductionism is also contributing to the new discourse about climate change and conflict. For example, climate change is offered as an explanation of cycles of war and conflict in China over the last millennium: "It was the oscillations of agricultural production brought about by long-term climate change that drove China's historical war-peace cycles"[11]. The civil war in Darfur is categorised in the media as the first 'climate change war' of the new century with the prospect of more to come: "In decades to come, Darfur may be seen as one of the first true climate change wars"[12]. The recent report *Climate Change as a Security Risk* from the German Advisory Council on Global Change[13] was reported in similar neo-determinist tones in the media: "Climate change to cause wars in North Africa"[14] and "Climate change 'likely to cause wars'"[15]. And a team of agricultural and resource economists went even further in predicting the effect of temperature increases on future battle deaths in Africa: "[the] historical

[10] Respectively, these are quoted from: p.1 in Global Humanitarian Forum, *The Anatomy of a Silent Crisis* (Geneva, Global Humanitarian Forum, 2009); p.145 in Chris D Thomas and 18 co-authors, "Extinction risk from climate change", *Nature* 427(2004): 145-148; p.3 in Christian Aid, *The Climate of Poverty: Facts, Fears and Hope* (London, Christian Aid, 2006); p.xv in Nicholas Stern, *The Economics of Climate Change: the Stern Review* (Cambridge, Cambridge University Press, 2006); from Andrew J Watson, "Gaia and accelerating climate change", Transcript of ABC National Radio Programme, broadcast 20 January 2007.

[11] Quoted on p.413 in David D Zhang, Jane Zhang, Harry F Lee and Yuan-qing He, "Climate change and war frequency in eastern China over the last millennium", *Human Ecology* 35(2007): 403-414.

[12] Borcher,J. "Scorched", *The Guardian*, 28 April 2007, London edition.

[13] German Advisory Council on Global Change (WBGU), *Climate Change as a Security Risk* (London, Earthscan, 2008)

[14] "Climate change to cause wars in North Africa", *Jordan Environment Watch*, 19 January 2008

[15] "Climate change 'likely' to cause wars", *The Daily Telegraph*, 10 December 2007, London edition.

response to temperature suggests an additional 393,000 battle deaths [by 2030] if future wars are as deadly as recent wars"[16]

And related to this explanatory role of climate in determining war, climate refugees are seemingly set to threaten global, regional and national security in a re-run of the Mongol invasions of Europe alluded to in the opening quote from Owen Lattimore in his caricature of Ellsworth Huntington's climatic theory of world history. The term 'climate refugees' was first seeded by Norman Myers in a 1993 article[17] and his estimate of between 150 and 250 million climate refugees by 2050 has been subsequently widely cited. It is a claim that easily translates into powerful rhetoric, as in this example from the Royal United Services Institute in the UK: "If we fail to stop polluting, we will be committed to catastrophic and irreversible change ... which will directly displace hundreds of millions of people and critically undermine the livelihoods of billions."[18] And recent work has sought to quantify this climate change effect on migration more precisely: "... by approximately the year 2080, climate change is estimated to induce 1.4 to 6.7 million adult Mexicans to emigrate [to the USA] as a result of declines in agricultural productivity alone"[19].

In this new mood of climate-driven destiny the human hand of climate change has replaced the divine hand of God as being responsible for the collapse of civilisations[20], for visitations of extreme weather[21] and for determining the new twenty-first century wealth of

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[16] Marshall B Burke, Edward Miguel, Shanker Shatyanath, John A Dykema and David Lobell, "Warming increases the risk of civil war in Africa", *Proceedings of the National Academy of Sciences* 106(2009): 20670.
[17] Norman Myers, "Environmental refugees in a globally warmed world *Bioscience* 43(1993): December; although also see Svante Arrhenius, *Worlds in the Making : the Evolution of the Universe* (New York & London, Harper & Brothers, 1908) p.53 where the concept, although not the language, is also mentioned.
[18] Nick Mabey, *Delivering Climate Security: International Security Responses to a Climate Changed World* (London, Whitehall Papers No.69, Royal United Services Institute, 2007).
[19] Shuaizhang Feng, Alan B Krueger and Michael Oppenheimer, "Linkages among climate change, crop yields and Mexico-US cross-border migration", *Proceedings of the National Academy of Sciences* 107(2010):14257.
[20] Jared Diamond, *Collapse: How Societies Choose to Fail or Succeed* (London, Penguin, 2005).
[21] Vladimir Jankovic, "Change in the weather", *Bookforum* Feb/Mar 2006: 39-40.

nations[22]. And to emphasise the message and the mood, the New Economics Foundation and its partners have wound up the climate clock which is now ticking, second-by-second, until 1 December 2016 when human fate is handed over to the winds, ocean currents and drifting ice-floes of a de-stabilised global climate: "We have 100 months to save the planet; when the clock stops ticking we could be beyond the climate's tipping point, the point of no return"[23]. Such eschatological rhetoric offers a post-2016 world where the degrees of human freedom and agency are extinguished by the iron-grip of the forces of climate. Such a narrative offers scant chance for humans to escape the inevitability of a climate-shaped destiny[24]. Jim Lovelock offers the most vivid melodrama of such a pre-determined fate. We are travelling, he says, on "a rocky path to a Stone Age existence on an ailing planet, one where few of us survive among the wreckage of our once biodiverse Earth"[25].

My argument in this paper is that these sentiments, and many others which invade contemporary public and political discourses of climate change, are enabled by the methodology of climate reductionism (i.e., a form of neo-environmental determinism). Simulations of future climate from climate models are inappropriately elevated as universal predictors of future social performance and human destiny. I am not alone in making this argument, even if my focus here is exclusively on climate rather than on the role of the wider physical environment. For example geographers Andrew Sluyter, Christopher Merrett and Gabriel Judkins[26] have all detected evidence of a resurgence of the determinist fallacy, citing examples from the work of Jared

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[22] Stern, *Economics of Climate Change*

[23] "One hundred months", New Economics Foundation, http://www.onehundredmonths.org/

[24] Christina R Foust and William O Murphy, "Revealing and reframing apocalyptic tragedy in global warming discourse", *Environmental Communication* 3(2009): 151-167. Stefan Skrimshire (editor), *Future ethics: climate change and apocalyptic imagination* (London, Continuum Press, 2010).

[25] Quoted on p.4 in: James Lovelock, *The Revenge of Gaia: Why the Earth is Fighting Back - and how we can still save humanity* (London, Penguin, 2006).

[26] See respectively: Andrew Sluyter, "Neo-environmental determinism, intellectual damage control and nature/society science", *Antipode* 35(2003): 813-817; Christopher D Merrett, "Debating destiny: nihilism or hope in *Guns, Germs and Steel*?", *Antipode* 35(2003): 801-806; Judkins, "Determinism"

Diamond in *Guns, Germs and Steel* and *Collapse* and Geoffrey Sachs in *The End of Poverty* and *Common Wealth*.

After offering a brief account of how climate reductionism has come to prominence, I turn my attention to understanding why this should be. Why should an explanatory logic – if not an ideology - dating from earlier intellectual and imperial eras, a logic subsequently dismissed by many as seriously wanting, have re-emerged in different form in a new century to find new and enthusiastic audiences? Rather than offering an explanation, and hence a justification, for the superiority of imperial societies, cultures and races – as in past ideological variants of determinism – I will suggest here a different reason for the contemporary attraction of climate reductionism, and how it has come to prominence.

I suggest that the hegemony exerted by the predictive natural sciences over human attempts to understand the unfolding future, opens up the spaces for climate reductionism to emerge. It is a hegemony manifest in the pivotal role held by climate (and related) modelling in shaping climate change discourses. Because of the epistemological authority over the future claimed, either implicitly or explicitly, by such modelling activities[27], climate becomes the one 'known' variable in an otherwise unknowable future. The openness, contingency and multiple possibilities of the future are closed off as these predicted virtual climates assert their influence over everything from future ecology, economic activity and social mobility, to human behaviour, cultural evolution and geosecurity. It is climate reductionism exercised through what I call 'epistemological slippage' - a transfer of predictive authority from one domain of knowledge to another without appropriate theoretical or analytical justification.

[27] See Eric Conway, this volume.

Before elaborating this proposition, I first offer a brief account of the decline in climate determinism through the twentieth century before illustrating the recent rise of reductionist thinking. I then defend my thesis - climate reductionism resulting from the enterprise of climate prediction and the practice of epistemological slippage - drawing upon key events, developments and texts from the 1960s to 1990s. In particular I demonstrate the asymmetry between representations of future climate versus social change which has persisted in the conduct of climate impact assessments. I conclude the paper by placing this reductionist tendency within a wider cultural context of Western pessimism and loss of confidence about the future and by pointing towards some correctives which involve restructuring ideas about how the future can be imagined and made known.

The demise of climate determinism

The story of environmental determinism, and especially the climatic variant on which I focus, is well known - at least it is well known to academic geographers who have had to wrestle with the difficult relationships between environmental conditions and human agency ever since the discipline took form in the later nineteenth century[28]. The argument of previous generations of determinists was that aspects of climate exerted a powerful shaping influence on the physiology and psychology of individuals and races, which in turn shaped decisively the culture, organization and behavior of the society formed by those individuals and races. Tropical climates were said to cause laziness and promiscuity, while the frequent variability in the weather of the middle latitudes led to more vigorous and driven work ethics. Evidence of these

[28] Harold MacKinder, "On the scope and methods of geography", *Proceedings of the Royal Geographical Society* 9(1887): 141-160.

discourses has been well reviewed for the period up to 1800 by Clarence Glacken[29] and for the late nineteenth century in a series of papers by David Livingstone[30] and by Mark Carey[31].

This is a determinism which *makes* human and social character. There is also a form of climate determinism which *moves* people. Thus Lattimore's "hordes of erratic nomads" cited at the beginning of this essay are driven, almost involuntarily, by climate variations in search of better pastures, while accounts of Viking arrivals and departures to and from Greenland have sometimes given the impression of being driven solely by the oscillations of warmth and cold[32]. Both these manifestations of climate determinism – the making of character and the moving of people – emphasise the agency of climate over the agency of humans. In more extreme articulations of the idea – i.e., "strong determinism" according to Gabriel Judkins[33] - the human will becomes hostage to the fortunes of climate, too passive and powerless to respond proactively, or even reactively, to changes in environmental fortune.

The apparent simplicities of climate determinism appealed to philosophers of the Grecian Empire (such as Herodotus and Hippocrates) and to rationalists of the European Enlightenment (such as Montesquieu and Hume)[34]. They also appealed to late nineteenth and early twentieth century European and, especially, American geographers. The work of Yale geographer Ellsworth Huntington (1876-1947) best encapsulates its rise during the apogee of modern European and American imperialism. Huntington's major works – from his 1915 *Civilisation and Climate* to his 1945 *Mainsprings of Civilisation* – gained him a contemporary popularity, but among his academic colleagues he generated a range of contrary reactions. As one of his

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[29] Clarence Glacken, *Traces on a Rhodian Shore: Nature and Culture in Western Thought from Ancient Times to the end of the Eighteenth Century* (Berkeley, University of California Press, 1967).
[30] David N Livingstone, "Tropical climate and moral hygiene: the anatomy of a Victorian debate", *British Journal for the History of Science* 32(1999): 93-110; Livingstone, "Race, space and moral climatology"
[31] Mark Carey, this volume
[32] Ian Whyte, *World Without End? Environmental Disaster and the Collapse of Empires,* (London, I B Tauris, 2008).
[33] Judkins, "Determinism"
[34] Fleming, *Historical Perspectives*

protégées, Stephen Visher, admiringly remarked in an obituary published in 1948: "His eagerness to arrive at the big truths, the ultimate principles that crown scientific work, was disturbing to cautious scholars."[35] For example, anthropologist Franz Boas was consistently irked by Huntington's simplistic statistical methods which, Boas argued, offered merely a fig-leaf of scientific credibility to Huntington's claims.

Based on his belief that there were optimal – and universally optimal - climates for physical and mental activity, Huntington drew upon a number of empirical studies of factory workers in America to suggest that 20°C and a humidity of 60 per cent maximised productivity[36]. It was a short step from here to postulate that the energy and vigour needed to develop and sustain civilisations was also related to these climatic optima giving rise to his "mainsprings of civilisation" hypothesis. And for Huntington a further short step into the emerging field of genetic selection was to bring him in the 1920s under the influence of the American eugenics movement.

Huntington's determinism was centrally concerned with the tracing of pattern of climate in history, rather than with predicting the future fates of civilisations. The British politician and writer Sydney Markham, however, later developed and applied some of these determinist arguments in a different direction. In *Climate and the Energy of Nations*, published in 1942, Markham argued not only that climate variations could explain the rise and fall of past civilisations, but could also explain and predict the changing geopolitical balance of power in his mid-twentieth century world. The dependence of contemporary social and economic factors such as trade, wealth creation and human mortality rates on climate offered Markham a way of

[35] Quoted on p.43 in Stephen S Visher, "Memoir to Ellsworth Huntington, 1876-1947", *Annals of the American Association of Geographers* 38(1948): 38-50.
[36] Ellsworth W Huntington, *Civilization and Climate*, (Honolulu, University Press of the Pacific, 1915/2001)

interpreting the tumultuous decade in which he wrote – the 1940s – and forseeing the future political prospects of nations such as Russia, China, America and the region of Europe[37].

As with its rise, there is no shortage of accounts of the demise in geographic thought of environmental determinism. Noel Castree claims the "excesses of determinism" had been countered by the 1930s[38], while others from different sectarian perspectives suggest earlier timelines for this demise. Kent McGregor suggests environmental determinism was subjected to increasing scepticism from the 1920s onwards and "by-mid-century had run its course"[39], while the climatologist Richard Skaggs also claims that "environmental determinism lost intellectual efficacy … during the 1920s"[40]. The Marxist geographer Richard Peet puts it more bluntly: "Environmental determinism became increasingly socially dysfunctional in the 1920s after the main issues of imperialist domination of the world had been settled by World War I"[41]. And from a cultural and political ecology standpoint, Judkins claim that the "historical moment" when determinism handed over to possibilism was around 1920[42].

The strong form of climate determinism was therefore largely discredited and marginalised as the ideological wars of the twentieth century re-shaped the political and moral worlds which had allowed it to flourish. Academic geography embraced more descriptive and reflexive conceptions of the relationships between nature and society. In the 1920s and 1930s the possibilism of Vidal de la Blache and Carl Sauer offered satisfying ways of keeping the role of climate and the environment at more comfortable distances from theories of social organisation and cultural history. The consequence was, according to Andrew Sluyter, that

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[37] Sydney F Markham, *Climate and the Energy of Nations*, (London, Oxford University Press, 1942).
[38] Noel Castree, *Nature*, (London, Routledge, 2005).
[39] Quoted on p.238 in: Kent M McGregor, "Huntington and Lovelock: climatic determinism in the 20th century", *Physical Geography* 25(2004): 237-250.
[40] Quoted on p.447 in: Richard H Skaggs, "Climatology in American geography" *Annals of the Association of American Geographers* 94(2004): 446-457.
[41] Quoted on p.327 in: Richard Peet, "The social origins of environmental determinism" *Annals of the Association of American Geographers*, 75(1985): 309-333.
[42] Judkins, "Determinism"

"geographers abandoned any concerted attempt at nature-society explanations and most of them re-aligned with either the natural or the social sciences"[43].

Vestiges of Huntington's "strong determinism" nevertheless still lingered among those engaged in talking about and analysing climatic data in the context of society and behaviour. William Meyer discusses the persistence of climate determinism in American thought and culture through the middle decades of the twentieth century in his book *Americans and their Weather*[44]. For example, Huntington's final book – *Mainsprings of Civilisation* – was published in America in 1945 and was criticised at the time by Oskar Spate for offering a "pattern to history too much determined by physical factors"[45].

Elsewhere, too, climatic determinism remained engrained in the way some climatologists and other scholars wrote about climate and its role in the world. Sociologist Nico Stehr has deconstructed the 1938 essay *Kultur und Klima* by German social psychologist Willy Hellpach thereby offering an insight into the relationship between Nazi ideology and climatic determinism[46]. Determinism in fact offered a softening of the strident Nazi racism, by claiming that people could be 'improved' if they were put in the right environment; it was not all down to one's Aryan genetic ancestry.

In England, Austin Miller's classic textbook *Climatology,* which went through nine editions between 1931 and 1965, was still claiming in its 8th edition in 1953 that: "The enervating monotonous climates of much of the tropical zone ... produce a lazy and indolent people"[47], while also in the 1950s the prolific English climatologist Charles Brooks was taken to

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[43] Sluyter, "Neo-environmental determinism", 816.
[44] Meyer, *Americans and their Weather*, 168-172 & 206-214.
[45] Spate, "Toynbee and Huntington", 414
[46] See respectively: Nico Stehr, "The ubiquity of nature: climate and culture", *Journal of the History of Behavioural Sciences* 32(1996): 151-159; Willy H Hellpach, "Kultur und Klima" in *Klima-Wetter-Mensch,* ed. Heiz Wolterek, (Leipzig, Quelle & Meyer, 1938), 428-429.
[47] Austin A Miller, *Climatology,* 8th edition, (London, Methuen & Co. Ltd, 1953).

task for the determinist outlook pervading his bestselling book *Climate in Everyday Life*[48]. One reviewer of the book complained: "The author has apparently not realised that the fumbling, prejudice-ridden speculations on human climatology which marked the earlier years of this century must now be replaced by ... more adequate enquiries and emancipated from the restrictions of a race-dominant culture"[49]. And in 1958, also in England, Gordon Manley was writing about the revival of climate determinism[50], even if a weaker variant, with a poorly disguised ambivalence about the adequacy of earlier deterministic theories: "It is an opportune moment to be reminded that man [sic] is still subject to a variety of constraints that may yet be imposed by Nature"[51].

The rise of climate reductionism

Notwithstanding these examples, the fortunes of "strong determinism", both as an ideology and as an explanatory framework for climate-society relationships, waned through the twentieth century. Yet with the emergence over the last 25 years of anthropogenic climate change as a physical and social phenomenon of worldwide importance, how the challenging relationship between climate and society is conceived has taken on fresh importance. Geographer Bill Riebsame has offered four ways of viewing physical climate in relation to human society: climate as setting, as determinant, as hazard and as resource[52]. As Riebsame explains, seeing climate as determinant requires the identification of "causal chains that link climate to specific elements or behaviours of biophysical and socioeconomic systems"[53],

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[48] Charles E P Brooks, *Climate of Everyday Life*, (New York, Philosophical Library, 1951).
[49] Douglas H K Lee, "Book review", *Quarterly Review of Biology* 27(1952): 75-76.
[50] See Georgina Endfield, this volume.
[51] Quoted on p.105 in: Gordon Manley, "The revival of climatic determinism", *Geographical Review* 48(1958): 98-105.
[52] William E Riebsame, "Research in climate-society interaction" in, *SCOPE27 - Climate Impact Assessment*, eds. Robert W Kates, Jesse H Ausubel and Mimi Berberian, Chichester, Wiley & Sons, 1985), 85-104.
[53] Ibid., 72.

whether these elements be crop yield, malaria risk, economic performance or violent conflict. The burgeoning climate change impacts literature of the 1990s and 2000s has been dominated by research "identifying" such causal chains, as witnessed by some of the examples cited earlier in the paper. Such claims have been driven by a methodological reductionism.

Reductionism is an approach to understanding the nature of complex entities or relationships by reducing them either to the interactions of their parts or else to simpler or more fundamental entities or relationships. In the case of climate change studies, this means isolating climate as the (primary) determinant of past, present and future system behaviour and response. If crop yield, economic performance or violent conflict can be related to some combination of climate variables, then knowing the future behaviour of these variables offers a way of knowing how future crop yield, economic performance or violent conflict will unfold. Other factors that influence these future environmental, economic or social variables – factors which may be more important than climate or perhaps just less predictable – are ignored or marginalised in the analysis. To illustrate such reductionism at work, I offer two examples selected from among many possible examples.

The way climate reductionism requires and seeks out simple chains of climatic cause-and-effect is perfectly illustrated in an empirical study of the relationship between climate change and economic growth published by the US National Bureau of Economic Research[54]. The authors recognise that whether or not climate change has a direct effect on economic development is contentious, but they claim nevertheless that their global analysis using data from over 180 nations reveals a "substantial contemporary causal effect of temperature on aggregate [economic] output ... on average, a 1°C increase in average temperature predicts a fall in per-

[54] Melissa Dell, Benjamin F Jones and Benjamn A Olken, *Climate Shocks and Economic Growth: Evidence from the Last Half Century* (Cambridge MA, National Bureau of Economic Research Working Paper No. 14132, 2008).

capita income by about 8 per cent"[55]. Since they find this effect is asymmetrical between richer and poorer countries they are then able to extend their analysis to consider the impact of *future* climate change on economic performance. They conclude: "The negative impacts of climate change on poor countries may be larger than previously thought. Overall, the findings suggest that future climate change may substantially widen income gaps between rich and poor countries"[56]. The complex relationships that exist between climate and economic performance are first reduced to a dependent relationship between temperature and GDP per capita and then, using projections of future climate warming, future economic performance is predicted for the twenty-first century. The many subtleties and multiple contingencies of national and regional economic performance are ignored or suppressed. Climate reductionism opens up the prospect of developing a narrative about future economic growth in which climate change becomes the primary driver of performance.

A second example of climate reductionism at work is Peter Halden's analysis of the geopolitics of climate change from an international relations perspective[57]. Halden, a social and political scientist working for the Department of Defence Analysis at the Swedish Defence Research Agency, takes as given the climate predictions from the Intergovernmental Panel on Climate Change (IPCC) for the year 2050. But he makes no attempt to envisage the possible social or political worlds of 2050, "a venture" he claims from his position as a political scientist "that would be flawed at best and approaching hubris at worst"[58]. He rejects the attempt of combining natural science forecasts with "speculative" social science in favour of a presumption of the social and political status quo. This reasoning hands the future over to Earth system

[55] Ibid., 4, 6.
[56] Ibid., 27-28.
[57] Peter Halden, *The Geopolitics of Climate Change: Challenges to the International System,* (Stockholm, Swedish Defence Research Agency, 2008).
[58] Ibid., 22-23.

models and their claims of revealing the impacts of climate change unfolding on a passive, unimaginative and static humanity. Climate reductionism results in a narrative about future geopolitical movements in which, again, climate change becomes the primary driver.

Both these examples offer a one-eyed view of the future, yet it is one which pervades many recent academic analyses of climate change and social impact[59]; and consequently it is an account of the future which enters easily into public perception and discourse[60]. Inadvertently or not, such reductionist reasoning opens these analyses of climate impact to the charge of operating within neo-determinism explanatory frameworks. The two examples above are offered as archetypical illustrations of a widespread pattern of methodological climate reductionism as it is applied to many different dimensions of the imagined future: health, food production, biodiversity, tourism and recreation, human migration, violent conflict and so on. The precise numbers and fearful tones cited in the introduction to this paper are the result of such reductionist reasoning and analysis. But given the demise of climate determinism described above, at least within large parts of the academy, how is it possible to have arrived back at an understanding of climate-society relationships which, I am suggesting, distorts and over-emphasises the causative role of climate in shaping the future prospects of society and the well-being of individuals?

The hegemony of model predictions of the future

Andrew Sluyter offers one explanation for this resurgence of neo-environmental determinism, or climate reductionism in the cases I am looking at. He suggests that the Enlightenment dichotomy between nature and culture, so pervasive in Western thought and

[59] For example, see the two recent studies cited earlier: Burke *et al.* "Civil war" and Feng *et al.* "Cross-border migration".
[60] Two examples among many referring to the Burke *et al*. and Feng *et al*. studies are: "Climate change will lead to civil wars in Africa, says research" Headline in *The Daily Telegraph* (London), 25 November 2009; and "Climate change set to boost Mexican immigration to the US, says study" Headline in *The Christian Science Monitor* (Boston), 27 July 2010.

practice, began increasingly to be challenged in the 1980s and 1990s – for example, as described through Beck's manufactured global risks[61] and through Latour's entanglements of nature and culture[62]. In response to such a move, Sluyter argues environmental determinism offered one means for a "quick and dirty integration of the natural and social sciences"[63]. As if belatedly realising the inadvisability of the dualistic thinking pervading Western thought, there was a rush to forge a new rapprochement between nature and culture. Determinist thinking was the simplest and most available ideology to hand. Sluyter is scathingly dismissive of such opportunism, however, and the intellectual credulity exhibited by what he calls the "neo-determinists", authors such as Jared Diamond and Geoffrey Sachs.

Whilst I think there is some merit in his argument in the more general field of environment-society interactions, I wish to suggest a different line of reasoning which applies very specifically to the case of climate reductionism I have illustrated above. It is a line of reasoning which emerges from the way in which the understanding of climate change developed over the last decades of the twentieth century.

In summary, my argument concerns the hegemony held by the predictive natural and biological sciences over visions of the future. In the case of climate change, this hegemony is rooted in the knowledge claims of climate, or Earth system, models. In the absence of comparable epistemological reach emerging from the social sciences or humanities, these claims lend disproportionate discursive power to model-based descriptions of putative future climates. It thus becomes tempting to adopt a reductionist methodology when examining possible social futures. 'Lots of things will change in the future, but since we have credible and quantitative knowledge about future climate let us examine, also quantitatively, what the consequences of

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[61] Ulrich Beck, *Risk Society: Towards a New Modernity*, (London, Sage, 1992).
[62] Bruno Latour, *We Have Never Been Modern* (translation by C Porter), (New York, Harvester/Wheatsheaf, 1993).
[63] Sluyter, "Neo-environmental determinism" 817.

these climates for society might be'. The subsequent and derived climate impact modelling then boldly calculates, for example, the billions of people who because of climate change will become starving or thirsty[64], or the millions who because of climate change will be made destitute or homeless[65]. Climate reductionism is the means by which the knowledge claims of the climate modellers are transferred, by proximity as it were, to the putative knowledge claims of the social, economic and political analysts.

This transfer of predictive authority, an almost accidental transfer one might suggest rather than one necessarily driven by any theoretical or ideological stance, is what I earlier defined as "epistemological slippage". If not quite the inexorable geometric calculus of Malthus, it nevertheless offers a future written in the unyielding language of mathematics and computer code. These models and calculations allow for little human agency, little recognition of evolving, adapting and innovating societies, and little attempt to consider the changing values, cultures and practices of humanity. The contingencies of the future are whitewashed *out* of the future. Humans are depicted as "dumb farmers", passively awaiting their climate fate. The possibilities of human agency are relegated to footnotes, the changing cultural norms and practices made invisible, the creative potential of the human imagination ignored.

To give some substance to this argument I need to explore some of the historical contexts which have allowed climate models to claim such hegemony over the future and which have allowed climate reductionism to thrive. This requires an examination of the emergence of anthropogenic climate change as a matter of scientific concern in the 1970s and 1980s and as a matter of public policy debate in the 1980s and 1990s. There are three developments that are

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[64] Nigel W Arnell, Melvin G R Cannell, Mike Hulme, R Sari Kovats, John F B Mitchell, Robert J Nicholls, Martin L Parry, Matt T J Livermore and Andrew White, "The consequences of CO_2 stabilisation for the impacts of climate change", *Climatic Change* 53(2002): 413-446.

[65] Norman Myers, "Environmental refugees: our latest understanding", *Philosophical Transactions of the Royal Society* B 356(2001): 16.1-16.5; Mabey, *Delivering Climate Security*

important for my argument: the retreat of the social sciences, and geography in particular, from working at the nature-culture interface; the emergence of a new epistemic community of global climate modellers; and the asymmetrical incorporation of climate change and social change into envisaged futures. Each of these three developments will be examined in turn.

The absence of theory about climate-society interactions

The previous sections have shown how the academic discipline that had thought the longest and hardest about relationships between climate and society – geography – had by the 1960s become suspicious about grand theories of climate-society interaction, particular those tinged with any trace of the old determinist ideology[66]. This reaction against the worst excesses of determinism " left geographers without a coherent conception of causality that would 'bridge' the social and natural sciences"[67]. It also meant that the study of environment-society relationships "became a subject without an academic home, a stateless person in the world of sovereign disciplines"[68]. It was in fact a small number of historians and atmospheric scientists, rather than geographers, who were the most willing to re-engage substantively with questions about climate change and human society. Historians such as Emmanuel Le Roy Ladurie, atmospheric scientists such as Reid Bryson and historical climatologists such as Hubert Lamb produced the most significant investigations during the 1970s into the nature of past interactions between climate change and social organisation[69]. But they did so in the absence of any

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[66] John F Hart, "The highest form of the geographer's art", *Annals of the Association of American Geographers* 72(1982): 1-29.
[67] Castree, *Nature*, 63.
[68] Meyer, *Americans and Their Weather*, 2009.
[69] See respectively: Emanuele Ladurie, *Times of Feast, Times of Famine: a History of Climate Since the Year 1000* (translation by Barbara Bray), (New York, Doubleday, 1971); Reid A Bryson and Thomas J Murray, *Climates of Hunger: Mankind and the World's Changing Weather* (Madison WI., The University of Wisconsin Press, 1977); Hubert H Lamb, *Climate: Past, Present and Future: Vol.2 Climatic History and the Future* (London, Methuen, 1977).

coherent theoretical framework to explain such interactions and certainly without any basis for prediction.

Against this background of disciplinary manoeuvres and intellectual hesitancy, there were an increasing number of important questions emerging in the 1970s about how climate change and social change were related. Accelerated by the cultural background of a new environmental consciousness[70], concerns were mounting over global food and energy security and about the social impacts of drought in Africa and weather modification in America[71]. "Climate change and human affairs" were becoming entangled in new ways, as was masterfully narrated by Crispin Tickell in his eponymous 1977 book[72]. To understand these interactions required some grasp of both the dynamics of climate and the nature of human agency, whether individual, collective or institutional. And as the story moved from the 1970s to the 1980s, it became increasingly clear that climates worldwide *were* changing, at least in part due to human activities. New questions were being asked by researchers, environmentalists and policy-makers about what these emerging and prospective changes in climate might mean for society[73]. Geographers and social scientists, however, remained rather poorly positioned to answer such questions, lacking agreed (or else acceptable) theories and tools for investigating the interactions between climate and society. Judkins, for example, describes how for geographers and social scientists the period from the 1960s to the 1980s was characterised by competing and contradictory theoretical accounts of environment-society interactions[74].

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[70] Sheila Jasanoff, "Image and imagination: the formation of global environmental consciousness", in *Changing the Atmosphere: Expert Knowledge and Environmental Governance*, eds. Clark Miller and Paul N Edwards, (Cambridge MA, MIT Press, 2001), 309-337.

[71] CIA, *Potential Implications of Trends in World Population, Food Production and Climate*, (Washington, Central Intelligence Agency Report OPR-401, 1974).

[72] Crispin Tickell, *Climate Change and World Affairs* first edition, (Cambridge MA, Harvard University Press, 1977).

[73] For example: Jill Williams, ed., *Carbon Dioxide, Climate and Society* (Oxford, Pergamon Press, 1978); Council of Environmental Quality, *Global Energy Futures and the Carbon Dioxide Problem* (Washington, US Government Printing Office, 1981).

[74] Judkins, "Determinism"

It was against this background of theoretical and methodological uncertainty about how society and climate were related that the methods and claims of a new community of climate modellers and global change scientists were emerging.

The epistemic community of global climate modelling

The 1960s and 1970s had witnessed the development of the first computer-based simulation models of a universal and globally-connected climate system[75]. Originally an extension of numerical weather prediction models, these new climate-oriented models allowed experiments with global models to be performed in virtual reality which were not possible in physical reality. These models were constructed initially by meteorologists and atmospheric scientists in a small number of research centres in the USA, UK and Germany. They were later joined by oceanographers, atmospheric chemists and biologists as the models extended their representation from simply the climate system (initially the atmosphere) to the deeply coupled components of the Earth system. This move was encapsulated in NASA's 1988 report *Earth System Science: A Closer View*, the so-called 'Bretherton Report'[76]. The report was lead-authored by Francis Bretherton, an applied mathematician and atmospheric scientist, and the goal of this new scientific mission was "to obtain a scientific understanding of the entire Earth system on a global scale" and predictions were to be secured by using "quantitative models of the Earth system to identify and simulate global trends"[77].

In barely 25 years - from the early 1960s to the late 1980s – scientific accounts of the causes and properties of climate had become progressively more complex. Climate was now

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[75] Paul N Edwards, *A Vast Machine: Computer Models, Climate Data and the Politics of Global Warming* (Cambridge MA, MIT Press, 2010).
[76] NASA, *Earth System Science: a Closer View*, (Washington, Report of the Earth System Sciences Committee of the NASA Advisory Council, 1988).
[77] Ibid., 11.

viewed as the outcome of the functioning of an interconnected biogeophysical global system whose past, present and future behaviour could be modelled – and hence 'predicted' - using mathematical equations and advanced computing technology. This marked a distinct break from the more varied conceptions of climate as used by geographers, climatologists and synoptic meteorologists of earlier in the twentieth century. Clark Miller makes the interesting observation that the "First Annual Conference on Statistical Climatology" was held in 1979. Prior to this time there was no reason to refer to *statistical* climatology because there was no other form of climatology to distinguish it from[78].

The more systemic concept of climate as Earth system science, together with the representation of this concept in simulation models, formed the twin bases around which a new epistemic community of global climate modellers formed. An epistemic community is a community of experts who share sets of beliefs about factual and casual understandings of particular phenomena[79]. Furthermore, these shared beliefs and values guide the community in drawing policy conclusions from their knowledge. By the 1990s "computer modelling had become *the* central practice for evaluating truth claims"[80] for this community of global climate change scientists. Yet as Clark Miller has argued, epistemic communities and the knowledge they produce do not form in isolation of wider social, institutional and political settings[81]. And the knowledge thus produced has a very distinctive geography of production. For example, the role of the Cold War was crucial in the development of American climate science[82] and by the 1970s and 1980s it was the growing political interest in human-induced climate change and the

[78] Clark A Miller, "Climate science and the making of a global political order", in *States of Knowledge: the Co-Production of Science and the Social Order,* ed. Sheila Jasanoff, (London, Routledge, 2004), 46-66.
[79] Peter M Haas, "Epistemic communities and international policy coordination", *International Organization* 46(1992): 1-35.
[80] Edwards, "Representing the global atmosphere", 53.
[81] Clark A Miller, "Challenges in the application of science to global affairs: contingency, trust and moral order" in *Changing the Atmosphere: Expert Knowledge and Environmental Governance,* eds. Clark A Miller and Paul N Edwards, (Cambridge MA, MIT Press, 2001), 247-286.
[82] David M Hart and David G Victor, "Scientific elites and the making of US policy for climate change research", *Social Studies of Science* 23(1993): 643-680.

globalisation of environmental politics[83] which drove forward this new intellectual programme. The development of global climate and Earth system models and their application to examine questions about the future performance of a now "global climate", and one being subjected to human-induced changes in atmospheric composition, occurred against the new environmental geopolitics of the post-Stockholm era[84]. The First World Climate Conference held in 1979 and the 1983 US National Academy of Sciences report[85] were evidence of the growing political saliency of climate change.

The consequence of this co-production of knowledge between what Miller has called "climate science and the global political order"[86] was the foregrounding of model-based predictions of future climate change in academic and policy discourses. Models became seen as "the only practical way to discern the effects of policy choices about climate change" and all important knowledge and choice about climate change seemed to revolve around such models[87]. The early battles about the credibility of anthropogenic climate change in the 1990s[88] were therefore fought largely around the credibility of these models, because both sides recognised the political significance of their knowledge claims about the future.

Yet to answer the demanding questions being asked about the significance of anthropogenic climate change for human society required more than mere knowledge of future climate. They demanded some translation of future changes in climate into future impacts for society. The First Assessment Report of the IPCC in 1990, for example, was organised around three separate volumes: one on climate science, one on climate impacts and one on climate

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[83] Paul K Wapner, *Environmental Activism and World Civic Politics*, (New York, State University of New York Press, 1996).
[84] Clark A Miller, "The dynamics of framing environmental values and policy: four models of societal processes", *Environmental Values* 9(2000): 211-233.
[85] National Academy of Science, *Changing Climate – Report of the Carbon Dioxide Assessment Committee*, ed. William A Nierenberg, (Washington, National Academy Press, 1983).
[86] Miller, "Climate science and the making"
[87] Edwards, "Representing the global atmosphere", 63.
[88] Fred Pearce, "Greenhouse wars", *New Scientist* 19 July(1997).

policy options. If climate modellers were by now offering credible predictions of future climate change, then before policies could be developed and evaluated, it was argued (implicitly perhaps) that plausible accounts of the impacts of these changes on human society were needed. It was here that the asymmetry between the knowledge claims of the predictive natural scientists and those of geographers and other environmental social scientists emerged most acutely. Given the poorly developed and a-theoretical understandings of climate-society relationships in the social sciences, how were these demanding questions going to be answered? How did the first IPCC assessments address these relationships?

The asymmetrical incorporation of climate and social change into envisaged futures

The first studies assessing the consequences of future anthropogenic climate change for society were undertaken in the late 1970s and early 1980s, some of this work being summarised in Williams and Kellogg and Schware[89]. But to investigate the methodological challenges these new policy-driven questions were posing for academic environmental social science researchers in the 1980s and 1990s I examine two seminal books published in this era. Both books were methodologically oriented and, taken together, they illuminate how methodological space was created within which climate reductionism could emerge.

The first is the volume commissioned and published by ICSU's Scientific Committee on Problems of the Environment (SCOPE) on climate impact assessment[90]. This SCOPE Report No.27 was a response to the new World Climate Impact Program (WCIP) - whose aim was "to advance our understanding of the relation between climate and human activities" - which had

[89] See respectively: Williams, *Carbon Dioxide, Climate and Society*; William W Kellogg and Robert Schware, *Climate Change and Society: Consequences of Increasing Atmospheric Carbon Dioxide*, (Boulder CO., Westview Press, 1981).
[90] Robert W Kates, Jesse H Ausubel and Berberian,M., eds., *SCOPE27 - Climate Impact Assessment*, (Chichester, Wiley & Sons, Chichester, 1985).

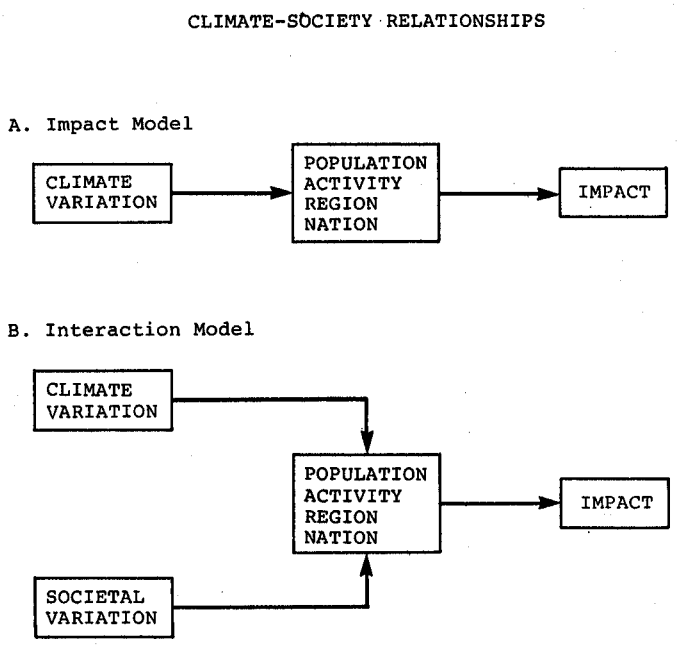
been agreed at the WMO's First World Climate Conference held in 1979. This SCOPE volume was one of the first outputs from WCIP and became a standard text in the field. I have already quoted from Riebsame's chapter in this volume which offered four ways in which climate may be viewed. But the crucial methodological chapter was written by the respected geographer Robert Kates. The WCIP, the SCOPE 27 volume and Kates' specific chapter are all therefore a direct response to the growing policy demand for credible and salient knowledge about what anthropogenic global climate change might mean for future society.

Kates lays out the methodological challenges of performing climate impact assessments, three of which are particularly relevant for the argument presented here. First, he acknowledges an explicit knowledge hierarchy between the "hard" sciences and the "soft" sciences. As one moves from understanding global heat balances to the impacts of climate change on nutrition, for example, there is "less predictability, more speculation and greater uncertainty"[91]. Complexity increases, precision decreases and uncertainties are compounded. The second challenge identified by Kates and of particular interest in the present context is that of linking very different methodologies: for example models of global climate with analysis of energy trends or assessments of population dynamics. The poverty of theoretical and methodological development in this area was recognised by Kates when he says that "as yet there has been no comprehensive study of the problems of integrating such scientific apples and oranges"[92]. [This is the field which today is more commonly known as integrated assessment modelling (IAM) and which is still deficient in its ability to represent processes of societal adaptation[93]].

The third challenge therefore was how to develop even the most basic of analytical frameworks for performing such "linked studies" of climate impact assessment. Kates offers two

[91] Ibid., 4.
[92] Ibid., 5.
[93] See Hans-Martin Füssel, "Modelling impacts and adaptation in global IAMs" *WIREs Climate Change* 1(2010):288-303

schematic diagrams, one of which he calls the "impact model" and one the "interaction model" (reproduced here in Figure 1). In the former, climate change determines the impact directly, whilst in the latter the impacts are the joint products of the interaction between climate and social change. And it is the former model which Kates claimed was predominant in nearly all attempts at climate impact assessment, these studies "going directly from climate events to inferences of higher-order consequences"[94]. Reflecting on the reasons for this paucity of studies which sought to embrace a more interactive framework of climate-society relationships, as opposed to the instinct to revert to a cruder deterministic or reductionistic account, Kates remarks that it is due "partly to disciplinary isolation and partly to the limited effort expended to date on the study of the interaction of climate and society as compared to the study of the dynamics of climate itself"[95].



[94] Kates et al., 31. Füssel states: "Adaptation has received only limited attention in global IAMs so far", p.288.
[95] Ibid., 31.

Figure 1: Schematics of impact and interactive models are highly simplified graphic depictions of types of study methodologies. It was the more reductionist "impact model" which predominated in most impacts studies. [Source: Kates et al., 1985]

The SCOPE 27 volume therefore reveals, I suggest, how the idea of an explicit knowledge hierarchy, the lack of any theoretical frameworks for integrated analysis and the preferred linear model of climate-response contributed to a climate reductionism at work in impact assessments. At this crucial moment in the 1980s, when climate predictions were asserting their knowledge claims about the future and when policy was demanding knowledge about future consequences of climate change for society, it was easy for simple reductionist accounts of future climate change impacts to emerge.

Kates *et al.* do not explicitly address the development of climate predictions or scenarios which have become the pivotal component of so many climate impact studies. The second book I wish to examine, however, does so. Published in 1998 under the title *Climate Impact and Adaptation Assessment*[96], this was a widely-read guide to the IPCC approach for assessing climate change impacts and adaptations. This book offered "a readable guide" to the *Technical Guidelines for Assessing Climate Change Impacts and Adaptations* published a few years earlier by the IPCC in 1994[97], guidelines which became widely cited and used internationally in the field. Here in these IPCC assessment guidelines, as interpreted by Martin Parry and Tim Carter, the default methodological assumptions and practices revealed by Kates in the 1980s were reinforced. In this case it was by privileging predictions of future climate over explorations of

[96] Martin L Parry and Timothy R Carter, *Climate Impact and Adaptation Assessment: the IPCC Method,* (London, Earthscan, 1998).
[97] Timothy R Carter, Martin L Parry, Hideo Harasawa and Shuzo Nishioka, *IPCC Technical Guidelines for Assessing Climate Change Impacts and Adaptations,* (London/Tsukuba, UCL/CGER, 1994).

how the many other dimensions of cultural, social and political life may change in the future. Climate reductionism through "epistemological slippage" was the result.

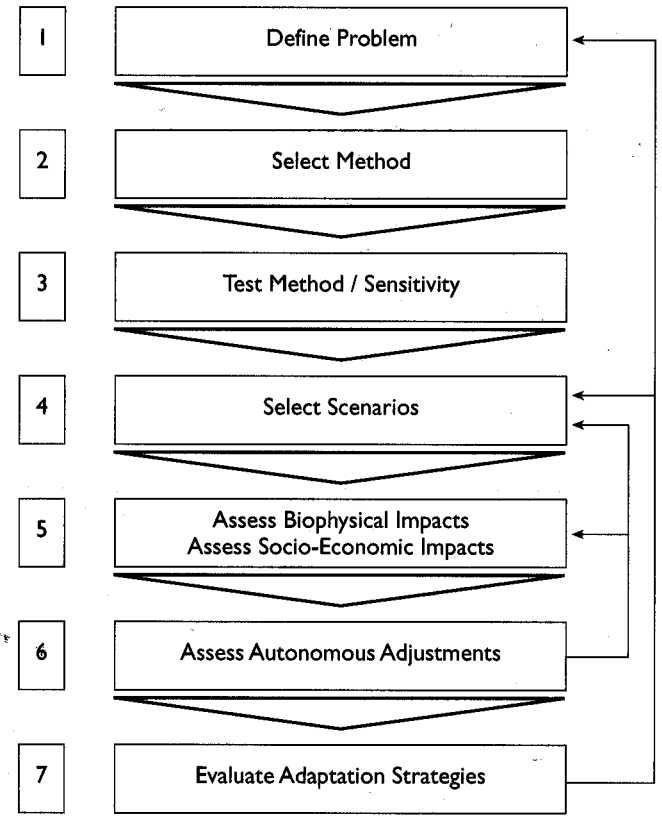


Figure 2: Seven steps of climate impact assessment, adopted by the IPCC. Step 4 is the crucial stage of creating the future. [Source: Parry and Carter, 1998]

The IPCC method for impact and adaptation assessment had seven recommended steps (Figure 2), at the centre of which – Step 4 - was the selection of future climate scenarios. With future climate(s) thus established, the method proceeded to estimate the consequences of climate change for both natural and social environments, before examining how such consequences might be adapted to. In their summary of Step 4, Parry and Carter take care to emphasise the importance of recognising social dynamics: "Environment, society and the economy are not

static' in the absence of climate change"[98]. But the subsequent practical guidance for how to incorporate such dynamism into scenarios of the future is limited. Out of 23 pages in this crucial scenario chapter, less than 3 are devoted to the representation of social change, whereas over 14 pages offer guidance on how to develop future climate change scenarios. And most of this guidance refers to the use of data and results from global climate models.

The asymmetry evidenced in the Parry and Carter chapter between methods for depicting climate versus social futures is merely representative of much wider practice in the field of climate impact assessment over the last 25 years. For the first 12 years of the IPCC process (1988-2000) there were no systematic attempts to develop methods or scenarios which represented future social, cultural or political change, even though large amounts of effort were directed to advancing and distributing model-derived representations of future climate. Only with the publication of the IPCC Special Report on Emissions Scenarios in 2000[99] was significant visibility given to the representation of different social futures in climate impact studies. This deficiency contributed to the widespread adoption of what I call climate reductionist methods in climate impact assessment, the consequences of which have been earlier illustrated. The IPCC Third Assessment Report in one of its chapters lamented this practice: "Future socioeconomic ... changes have not been represented satisfactorily in many recent impact studies" and "... many impact studies fail to consider adequately uncertainties embedded in the scenarios they adopt"[100]. And at a national scale, a review of the UK Climate Impacts Programme in 2005 noted that climate impact studies have seldom been able to incorporate

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[98] Parry and Carter, *Climate Impact*, 72.
[99] IPCC, *Special Report on Emissions Scenarios*, (Cambridge, Cambridge University Press, 2000).
[100] Quoted on p.181 in: Timothy R Carter and Emelio La Rovere, "Developing and applying scenarios", in *Climate Change 2001: Impacts, Adaptation and Vulnerability*, eds. Jim McCarthy, Osvaldo Canziani, Neil A Leary, Dave J Dokken and K S White, (Cambridge, Cambridge University Press, 2001), 145-190.

alternative social futures "preferring instead to concentrate on exploring 'climate-only' impacts"[101], a direct illustration of climate reductionism at work.

Reactions against climate reductionism have emerged in the last decade or so from parts of the social science community, notably the concepts of vulnerability and resilience[102]. The origins of these less reductionist conceptual and analytical paradigms are to be found in hazards research and ecological respectively and were introduced into climate change research in the late-1990s (vulnerability) and early 2000s (resilience). They offer ways of exploring sensitivities of socio-ecological systems to climate perturbations – and other environmental and social stresses – without being dependent upon the predictive claims of climate modelling. Although they have gained some visibility in recent climate change research, because they are less dependent on model-based climate projections vulnerability and resilience approaches to understanding climate-society relationships have been slow to overturn the standard IPCC climate impact methodology[103].

The combination of these historical developments – the rise of a powerful epistemic community of climate modellers, the asymmetrical incorporation of climate and social change into envisaged futures and, confounding the whole enterprise, the lack of theory-making around climate-society interactions – have allowed a form of climate reductionism to dominate contemporary analysis and thinking about the future. Although it is clear to many social scientists that "the impact of any climatic event depends on the local ecological setting and the organisational complexity,

[101] Quoted on p.61 in: Chris West and Megan Gawith eds., *Measuring Progress: Preparing for Climate Change Through the UK Climate Impacts Programme* Oxford, UKCIP Technical Report, 2005).
[102] Marco A Janssen and Elinor Ostrom, "Resilience, vulnerability and adaptation: a cross-cutting theme of the International Human Dimensions Programme on global environmental change", *Global Environmental Change* 16(2006):237-239.
[103] For a discussion about some of the reasons why progress has been slow see: Karen L O'Brien and Johanna Wolf, "A values-based approach to vulnerability and adaptation to climate change", *WIREs Climate Change* 1(2010): 232-242.

scale, ideology, technology and social values of the local population"[104], current intellectual endeavours in this area unduly privileges climate as the chief determinant of humanity's putative social futures.

Quantitative climate predictions for the 2050s, 2080s or even further ahead continue to offered by a powerful community of climate modellers, most recently at very high spatial and temporal resolutions. For example, the latest climate projections from the UK Government[105] incorporate climate (weather) information at hourly intervals for regions as small as 25 km^2 and for several decades into the future. Yet the "complexity, scale, ideology and social values" of future local populations and communities are for the most part ignored or assumed to be static. The study by Halden summarised earlier is a good example of this asymmetry in representations of the future. Quantified – and often unconditional - predictions of future climate change impacts therefore abound, such knowledge claims drawing power from the epistemic muscle of climate and Earth system models in a process of epistemological slippage.

By emasculating the future of much of its social, cultural or political dynamism, climate reductionism renders the future free of visions, ideologies and values. The future thus becomes over-determined. Yet the future is of course very far from being an ideology-free zone. It is precisely the most important territory over which battles of beliefs, ideologies and social values have to be fought. And it is these imagined and fought-over visions of the future which - in many indeterminate ways - will shape the impacts of anthropogenic climate change as much as will changes in physical climate alone.

And so the future is reduced to climate.

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[104] Quoted on p.40 in: Fakri A Hassan, "Human agency, climate change and culture: an archaeological perspective", in *Anthropology and Climate Change: From Encounters to Action* eds. Susan A Crate and Mark Nuttall, (Walnut Creek CA, Left Coast Press, 2008), 39-69.

[105] UK Climate Projections 09 (UKCP09) web-site. http://ukcp09.defra.gov.uk/

Putting society back into the future

Climate reductionism – a form of neo-environmental determinism - offers a methodology for providing simple answers to complex questions about the relationship between climate, society and the future. In its crudest form it asserts that if social change is unpredictable and climate change predictable then the future can be made known by elevating climate as the primary driver of change. But such reductionism downgrades human agency and constrains the human imagination. So, looking back, Jared Diamond claims that "history followed different courses for different peoples because of peoples' environments"[106], while looking forward James Lovelock fears that "despite all our efforts to retreat sustainably, we may be unable to prevent a global decline into a chaotic world ruled by brutal war lords on a devastated Earth"[107].

Although offering accounts of the past and the future which were more popular than academic, both Diamond and Lovelock adopt inadequate and impoverished reductionist frameworks for understanding the past and envisioning the future. Many of the statements concerning the impacts of future climate change emerging from the more analytical research community suffer from the same limitations. The consequence of such reductionism is expressed clearly in Karl Popper's attack from a generation ago on historicism and its deterministic roots: "Every vision of historicism expresses the feeling of being swept into the future by irresistible forces"[108]. Whilst Popper, writing in a different era, had historical materialism and the enemies of an open society in mind, his reasoning well applies to climate change today.

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[106] Quoted on p.25 in Jared Diamond, *Guns, Germs and Steel: the Fates of Human Societies* (New York, W W Norton, 1997).
[107] Lovelock, *The Revenge of Gaia*, 198.
[108] Quoted on p.160 in Karl Popper, *The Poverty of Historicism*, (London, Routledge & Kegan Paul, 1957).

The allure of determinist thinking is that it offers the appearance of 'naturalistic' explanations (justifications?) of cultural or economic dominance (as in past variants of determinism), or 'naturalistic' accounts of the future which evacuate it of human agency (as I have contended is the case with climate change today). In contrast to earlier climate determinisms which flowered in the ascendant and optimistic imperial cultures of classical Greece, and of imperialist Europe and a youthful United States, I suggest that the climate reductionism I have described here is nurtured by elements of a Western cultural pessimism which promote the pathologies of vulnerability, fatalism and fear[109]. It is these dimensions of the contemporary cultural mood which has offered the milieu within which this particular form of neo-determinism has emerged. By handing the future over to inexorable non-human powers, climate reductionism offers a rationalisation, even if a poor one, of the West's loss of confidence in the future.

These characteristics of Western culture have also been described by sociologist Frank Furedi in his book *Invitation to Terror*[110]. Furedi explains the confusion that has emerged in Western culture about the new international terrorism of this century and links it to a pessimism about the accomplishments of modernity and science - and fear of their legacy. Such pessimism evacuates the future of belief, vision and promise. The knowledge claims of intelligence experts – or, in the case studied here, of climate modellers – are invited to fill the voids in the human imagination thus created. Whilst Furedi's is a contested position – for many the promises of new technologies remain as alluring as ever - sociologist Ulrich Beck describes a similar phenomenon when he talks about the non-existent and fictitious future replacing the legacies of the past as the basis for present-day action: "Expected risks are the whip to keep the present in line. The more

[109] See: Pat Devine, Andrew Pearman and David Purdy, eds., *Feelbad Britain: How to Make it Better* (London, Lawrence & Wishart, 2009); Rod Liddle, *Social Pessimism: the New Social Reality of Europe* (London, Policy Network, 2008).
[110] Frank Furedi, *Invitation to Terror: the Expanding Empire of the Unknown*, (London, Continuum, 2007).

threatening the shadows that fall on the present because a terrible future is impending, the more believed are the headlines provoked by the dramatisation of risk today"[111].

Climate reductionism is a limited and deficient methodology for adequately accessing the future. In his poetic essay "The end of the world", environmental historian Stephen Pyne offers an insight into similar reductionist limitations with regard to the past:

> Reductionism is good for extracting resources and for creating instruments, medicines, gadgets; but it does not – cannot – tell us how to use them or when or why. It cannot convey meaning because meaning requires contrast, connections, context ...
>
> [reductionism] cannot tell us what we need to know in order to write genuine history, even when that history involves nature[112].

If reductionism is a limited form of reasoning for interpreting the past, then climate reductionism is even more emasculated with regard to telling the future. The epistemological pathways offered by climate models and their derived analyses are only one way of believing what the future may hold. They have validity; and they have relevance. But to compensate for the epistemological slippage I have described in this article it is necessary to balance these reductionist pathways to knowing the future with other ways of envisioning the future.

The "contrast, connections and context" to which Stephen Pyne refers must be created by putting society back into the future. Since it is at least possible – if not indeed likely - that human creativity, imagination and ingenuity will create radically different social, cultural and political worlds in the future than exist today, greater effort should be made to represent these possibilities in any analysis about the significance of future climate change. Some of these futures may be better; some may be worse. But they will not be determined by climate, certainly

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[111] Quoted on p.20 in Ulrich Beck, "Global risk politics", in *Greening the Millennium: the New Politics of the Environment*, ed. Michael Jacobs, (Oxford, Blackwell, 1997), 18-33.

[112] Quoted on p.650 in Stephen J Pyne, "The end of the world", *Environmental History* 12(2007):649-653.

not by climate alone, and these worlds will condition – perhaps remarkably, certainly unexpectedly – the consequences of climate change.

Acknowledgements

Earlier forms of this paper were presented at the workshop 'Climate Matters' at the University of Manchester, UK, in October 2008 and at the conference 'Climate and Cultural Anxiety' at Colby College, Maine, in April 2009. The participants of those workshops, especially Jim Fleming and Vladimir Jankovic, are thanked for their helpful questions, comments and suggestions which have improved this paper. Jon Barnett and David Livingstone also carefully read a draft of the paper and offered helpful criticism, as did three anonymous reviewers. The author alone, however, takes responsibility for the views contained here.