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Critical issues in social science climate change research

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This paper ~~makes a series of linked points about~~ the challenges and opportunities for social scientists working ~~either directly or indirectly~~ on climate change research. ~~It argues that much~~ work is required to expose and destabilise taken-for-granted assumptions about: (i) the nature of climate change, ~~paying attention to~~ its complex ontology and ~~the~~ knowledge-making practices ~~that have brought it into view~~; and (ii) academic knowledge ~~as a privileged site in which climate change can be apprehended~~ at the expense of other ways of knowing, doing and being in the world. I examine the relationship between the natural and social sciences ~~and argue that the social sciences are divided on~~ the epistemological question of what people are ~~like. I also call to attention to~~ the multiple spaces, sites and practices across which and about which social science research on climate change is being produced.

Keywords: social science; climate change; ontology of climate change; epistemology; sites; practices

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Introduction

In this paper I will make a series of linked points about the challenges and opportunities for social scientists working either directly or indirectly on climate change research. Although much greater strategic effort – by the International Social Science Council (ISSC) in particular (but see also Castree et al., 2014) – is going into positioning the social sciences[1] as an indispensable part of reframing and understanding climate change as a social phenomena, there remain many questions about how to mobilise a large and disparate field in a common cause. In this paper, I examine some ontological and epistemological issues as well as recent research on spaces, sites and practices. I argue that we must go further in examining the nature of the social science enterprise itself if we are to use its many intellectual resources to solve the world's most pressing problem. To begin, I examine critically the issue of what we are talking about when we talk about climate change by ~~examining~~ its ontological politics.

Ontological politics of climate change

Ontology is the study of being concerned with questions about what actually exists in the world that humans can acquire knowledge about. Writing in the context of conservation biology (though the point holds for climate change research), Moon and Blackman (2014) argue that ontology is

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important because it helps researchers recognise how certain they can be about the nature or existence of objects they are researching. Such choices have consequences for theory, practice and normative positioning (Goodman, 2001) but they are also political, defining intellectual priorities, approaches and solutions. There are two issues in the ontological politics of climate change that I wish to raise here. The first is the problem inherent in climate change itself and the second – blurring into epistemological issues – is the consequences of thinking about climate change in terms of a coupled human–natural system or socio-ecological system. Both the positions I discuss below have implications for almost every aspect of what we study under the banner of climate change research, how we study it and how we communicate it to disparate audiences, and yet they are rarely subjected to any sustained scrutiny in the academic literature (Esbjörn-Hargens, 2010).

Climate change

At the risk of generalisation, the natural sciences are dominated by realism – the idea that a reality exists that can be studied, understood and experienced as truth. But realist climate science has a contaminant at its heart: climate itself. For climate change is not an object. It is a category of knowing (Brace & Geoghegan, 2011) made out of approximately 30 years' worth of meteorological observations including surface variables such as temperature, precipitation and wind (Hulme, Dessai, Lorenzoni, & Nelson, 2009). Naustdalslid (2011, p. 243, original emphasis) observes that

> climate change is 'man-made' … in the sense that it is only visible to man [sic] and society through science … without climate research, without the concerted action of scientists under the IPCC and without the systematic and convincing dissemination from this scientific activity to policymakers and the public, *climate change would not have been visible as a problem for society today.*

Thus, Leyshon and Geoghegan (2012, p. 237) identify what they call a 'metaphysical and semiotic problem' with climate change, exposing the ontological tangle that occurs when climate as a statistical construct assembled from a range of meteorological, oceanographic and atmospheric data is 'treated like a homogenous entity on a trajectory of change towards an altered state on a timescale that exceeds the life expectancy of today's primary school children'. Esbjörn-Hargens (2010, p. 144) characterises climate change as a hybrid ontological object – 'a combination of scientific third-person observations and cultural second-person meanings'. Climate change is, in Brace and Geoghegan's terms (2011), made of the stuff of everyday life (such as weather), but is not in and of itself that stuff. Thus, although we might experience some warmer summer days, suffer longer droughts or observe glaciers retreating, climate has few consistently affective qualities that confirm unequivocally to those outside the science community that change is happening.

The ontological status awarded to climate change in the natural sciences is quickly destabilised by relativism, and it is these same relativist perspectives that help us to s[illegible]hy, despite overwhelming scientific evidence, climate change has not generated, inter alia, widespread public action, behaviour change, coherent local, regional, national or international policy, or successful regulatory tools. Climate change is simultaneously a reality, an agenda, a problem and a context but one with uncertain imminence (Brace & Geoghegan, 2011; Leyshon (née Brace) & Geoghegan, 2012).

The sheer range of topics and environmental issues that are studied under the banner of climate change both reflects and compounds the metaphysical and semiotic problem (Box 1). These also demonstrate that climate change is not mutually exclusive from other pressing

global environmental issues. As the World Social Science Report 2013 points out, climate change is only one of a suite of linked global environmental challenges that encompass all the biophysical changes happening on land, in the oceans, and in the cryosphere and atmosphere (ISSC/UNESCO, 2013) and which include biodiversity/habitat loss, energy security/peak oil, population growth, ocean system collapse and water degradation. The nature of these conjoined biophysical and social problems required a new conceptual framing, to which I now turn.

Box 1. Prominent topics and themes in social science research (Hackmann and St Clair 2012, p.15).

- Central issues of climate change impacts, adaptation, mitigation, vulnerability, resilience and sustainability.
- Concerns related to ecosystems, environmental services and biodiversity.
- Problems of primary resource depletion and needs related to water, energy, land, food and so on.
- Population growth, migration, displacement to urbanisation, waste management, oceans and coastal vulnerability, extreme events, disaster risks, social protection, peace, security and conflict, poverty, inequality, governance, innovation technological assessment.
- Sector-specific priorities: development pathways, green growth, education, media, health, agriculture, law, international relations, transport, science policy.
- Policy and response: clean development mechanisms, geo-engineering, economic initiatives, developing country-focused programmes.

Coupled human–natural systems

It has become increasingly popular to talk about 'coupled human–natural systems' – sometimes also phrased as a 'socio-ecological systems' or 'human–environment systems' – when discussing global environmental issues. The dominance of the 'system' as a way of conceptualising the world has its modern roots in the Enlightenment, through, for example, Thiry's *The System of Nature* (1770). One consequence of this way of thinking has been to focus on the component parts of the system, often through disciplinary specialisms which have, over time, neglected an exploration of the complexity of the whole earth system in favour of every more forensic and detailed examinations of its component parts (Funtowicz & Ravetz, 1993; Lowe, Phillipson, & Wilkinson, 2013). In climate science, concepts like 'feedback' and 'tipping points' suggest a recognition that some aspects of the interactions of the 'system' are not sufficiently well understood to be able to accurately predict their outcomes (Hall & Pidgeon, 2010).

There is clearly no appetite to abandon the dominant ontology of the system in the face of the unprecedented challenge of climate change, but there are calls to work differently to understand the system. There are repeated assertions that, as systems combine 'human, biological and physical elements that link together diverse people, places and processes through multiple material flows and intermediaries' (Lowe et al., 2013, p. 213), they must be studied in an interconnected way. There is growing recognition that, rather than study the individual parts in isolation, the *relationships between* the individual parts may be more important, as are the processes that effectuate the system as much as its structures. Further, Popa, Guillermin, and Dedeurwaerdere (2014, p. 2) show that, in contexts where there are 'a plurality of decision-makers, pervasive uncertainties, spatial and intertemporal externalities, interplay of human and natural components and an evolving understanding of policy objectives' the problem becomes one of managing complex social-ecological systems under conditions of uncertainty and with a plurality of values and perspectives.

However, as academics from across the natural and social sciences strive to haul the whole system into view, in all its magnificent complexity, they are driven by a familiar Enlightenment

belief in the ability of reason to illuminate not only problems but solutions to our world's most pressing crisis. As the recent ISSC/UNESCO World Social Science Report (2013, p. 7) on changing global environments asserts, 'approaching global environmental change from a systems perspective draws attention to nonlinear relationships and the potential for irreversible changes and surprises'.

Thus, the reliance on the system represents what we might call academic path dependence, particularly in the way that a broad research community seems to be locked in. One consequence of this, as Castree et al. (2014, p. 764) note, is that a particular framing of the human dimensions of climate change has become normalised.

> The frame's major presumption is that people and the biophysical world can best be analysed and modified using similar concepts and protocols … A single, seamless concept of integrated knowledge is thereby posited as both possible and desirable, one focused on complex 'systems'. The frame positions researchers as metaphorical engineers whose job it is to help people cope with, or diminish, the Earth system perturbations unintentionally caused by their collective actions.

Having said this, there is evidence in the idea of a coupled human–natural system of a modest ontological evolution away from what might be described as Enlightenment ways of thinking in which the social or cultural realm of human endeavour was symbolically separated from the natural world. The conjoining of the human and the natural in the phrase 'human–natural system' works in several ways as a heuristic. First, it goes a little way to dissolving a metaphysical boundary between artificially constructed realms (something that geographers have been attempting by working with human–non-human relations and more-than-human geographies, see, for example, Whatmore, 2006). At worst, however, the idea of a coupled human–natural system is used uncritically to simply describe a system in which people interact with natural components (Liu et al., 2007).

Second, the phrase signals a recognition that humans have responsibility for widespread and potentially irreversible alterations to the planet's biophysical processes (which has also engendered a new framing – the Anthropocene – and a new journal *The Anthropocene Review* Oldfield et al., 2014). Third, it implies something about possible solutions to the problems that are of our own making and need a much greater understanding of the system and our place in it from across ontological, epistemological and disciplinary communities to improve policy, management and governance of the environment (Liu et al., 2007). As Castree et al. (2014) note, this is much easier to aver than achieve. Finally, the phrase 'human–natural system' and its variants hint at the complexity of the issues that face us – the so-called 'wicked problem' of climate change. For Naustdalslid (2011), climate change represents a modern environmental problem which 'normal science' cannot resolve. He is not alone in his appeal to post-normal science as a means of increasing the salience, credibility and legitimacy of science to make it more useful in practice (Knapp & Tainor, 2013).

Like other recent heuristic devices – such as Ecosystem Services (Leyshon, ~~in press~~) – the idea of a coupled human–natural system is not one which achieves immediate resonance beyond academe. Further, despite some now quite strident assertions of the value of the social sciences in understanding and responding to climate change through the heuristic of the coupled human–natural system (Hackmann & St Clair, 2012; ISSC/UNESCO, 2013), it is a rhetoric that is perhaps proving difficult to realise in practice.

Epistemology

In this section I consider the nature of the dialogue between the social and natural sciences, and the fundamental epistemological issues that must be faced if the social sciences are to fulfil their potential in tackling climate change.

The social and natural sciences

Lowe et al. (2013, p. 207) have recently observed that it 'has become part of the mantra of contemporary science policy that the resolution of besetting problems calls for the active engagement of a wide range of sciences' including the social sciences. This, Lowe et al. (2013) argue, has become necessary because the nature and ubiquity of environmental change has called attention to the contingency of the natural (as well as the social) and undermined belief in the permanence of the natural world. However, the enrolment of the social sciences has been nowhere near straightforward for a couple of reasons. First, the problem is urgent: the climate science is unequivocal and changes to individual and societal attitudes and behaviours must be enacted *now*, in accordance with international agreements and previous ~~IPCC~~ reports. Prevarication seems like an indulgence. The rhetoric of urgency militates against the sort of reflexive consideration of social science's means and ends. Second, and in a linked point, the historical dominance of the natural sciences in framing climate change research conditions the terms of entry for other disciplines.

Moon and Blackman (2014) propose a guide to social sciences research for natural sciences that will achieve three aims: (i) understand the philosophical basis of the social sciences; (ii) interpret social science; (iii) appreciate alternative approaches to scientific inquiry. Their purpose is to 'open the door' to social science research and assert the legitimacy of its principles, assumptions and interpretations (Moon & Blackman, 2014, p. 2). The very fact that these authors feel the need to assert the legitimacy of a field of enquiry that has been in existence for at least the last two hundred years illustrates and also does nothing to challenge the dominance of science at the top of a hierarchy of ways of knowing.

It is not only the absence of knowledge about the intricacies of social science that prevents natural scientists engaging. It is also, as Lowe et al. (2013, p. 208) suggest, the 'casting of social science in an end-of-the-pipe role', as the translator of scientific and technological developments (see also Hackmann & St Clair, 2012). Thus, Lowe et al. (2013, p. 207) suggest that 'social scientists have typically been forced into an auxiliary role of supporting and interpreting developments in natural science and technology'. Such an auxiliary position is still evident in Weaver et al's assertion (2014, p. 256 – emphasis added) that a key role of the social sciences is to '*elucidate* the processes that turn knowledge into action' and enable collaborations and dialogues between scientists of all kinds and practitioners, producing 'effective, science-based decision-support for global change-related problems' and 'knowledge that is practically relevant, usable, credible, legitimate and actionable'. Castree et al. (2014) argue that the potential fruits of interdisciplinary exchange are not only far greater than those being propounded in various reports but different in character. They suggest that researchers interested in global environmental change should consider different 'values-means-ends' packages, wherein:

> values are those fundamental beliefs that motivate people's behaviour (for example, love of nature, the right to free speech); means are those various practices, procedures, institutions and technologies by which values can get instituted; and ends are the concrete goals to which means are orientated and which provide a measure of how well values are being realized at any one time or place. (Castree et al., 2014, p. 766)

This would position researchers across disciplines as working together to 'open up the range of choice available to societies' and 'rather than assuming that one form of broad-based, integrated, actionable knowledge 'fits' any given situation, researchers would together make visible a number of actual and possible realities'. This may be very discombobulating for some physical scientists who have 'grown accustomed to a certain "style" of human dimensions research' (Castree et al., 2014, p. 766) which they find easier to accommodate than approaches which

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are broadly post-positive, critical and interpretative. Leyshon (~~in press~~) identifies this as 'epsitemic distance decay' wherein the social science disciplines with at least some recognisably scientific ontological, epistemic and methodological concerns feature most strongly as collaborators with the natural sciences.

Leaving aside the question of how the dialogue between the natural and social sciences should be taken forward, there is also the issue of how the social sciences represent their endeavour. For Hackmann and St Clair (2013), the way forward is in joint, reciprocal framing, mutual learning and then the co-design, execution and application of research. To facilitate this, they set out six 'transformative cornerstones' of social science research that describe the unique capabilities of the social sciences. They are transformative because they 'work together to inform action for deliberate transformation that is both ethical and sustainable' (p.16).

Box 2. Transformative cornerstones of social science research (Hackmann and St Clair 2012, pp.16–20).

> Cornerstone 1 – Historical and contextual complexities – distinguishing multiple stressors, drivers and interdependencies; learning from history; dealing with differences across geographical, cultural, personal, professional contexts and identities.
>
> Cornerstone 2 – Consequences – living with global change: taking stock of threats and impacts across different groups and regions; identifying social boundaries and tipping points; measuring success: improving the outcomes of specific actions and instruments.
>
> Cornerstone 3 – Conditions and visions for change – understanding how we can change behaviour and social practice; speeding and scaling up processes of change; building consensus on the directions for change.
>
> Cornerstone 4 – Interpretation and subjective sense making – understanding the nature and role of subjectivities; exposing blindspots; explaining scepticism, indifference and denialism.
>
> Cornerstone 5 – Responsibilities – foregrounding normative agendas; fostering global and intergenerational solidarity and justice; safeguarding ethical approaches.
>
> Cornerstone 6 – Governance and decision making – coming to grips with policy processes and political will; making knowledge work; building relevant institutions and structures.

Impressive though the scale of ambition set out by these cornerstones, such agendas repeat for scholarly audiences the very mistake made in trying to shift public attitudes and behaviours in the face of climate change: the assumption that knowledge straightforwardly and unproblematically produces change. This is a model – grounded in falsification and replicability – that has successfully led to advances in scientific thought and practice with benefits to society. However, the problem of climate change seems stubbornly resistant to this approach.

The transformational cornerstones present what their authors consider to be an irresistible case to a natural science community, predicated on the idea that the culture of science and research will be shifted by the clarity and precision with which the case is presented. The cornerstones are designed to alter 'the fundamental attributes of the system, including … structures and institutions, infrastructures, regulatory systems, financial regimes, as well as attitudes and practices, lifestyles, policies and power relations' (Hackmann & St Clair, 2012, p. 16). The task set by the social sciences is no less than 'to innovate in ways that lead to new social relations, new social understandings of and responses to the challenge of global change, and new revolutions in socio-economic, political, scientific, educational and legal systems and institutions' (p. 16). But, as Shove (2012, p. 2) cautions in this special issue, 'social theories do not lead directly to prescriptions for action'. AQ4

There is little here to challenge the Enlightenment inheritance of the power of reason and rationality. Indeed, the enormity of the task is only matched by the belief in the ability of western-knowledge-making to deliver on it: to make the complexity of the world visible and knowable, to aggregate, scale-up, typify, create typologies, categorise and to therefore engender change on a grand scale, as envisaged by Weaver et al., (2014, p. 657):

> Moving beyond individual knowledge producers and users, we need to understand decision-support processes in the aggregate. We should identify typologies of users, develop comparative studies of decision processes across contexts and scales, and rigorously evaluate the success of such processes.

Even as the World Social Science Report suggests that social transformation is not well understood, the authors are asserting the importance of 'people's capacity to imagine futures that are not based on hidden, unexamined and sometimes flawed assumptions about present and past systems' (ISSC/UNESCO, 2014, p. 9). The social sciences seem to be in the process of creating a narrative in which they seek to be accommodating the dominant ontologies of science (human–natural system) and in which they seem to feel the need to simplify its diversity in order to become accessible to natural sciences. The scale of the climate change problem might be so pressing that we have to smooth and simplify in order to be accepted. We promise to offer insights into complexity without chaos. Castree et al. (2014, p. 766) caution against pulling any punches: 'Framing the 'offer' in terms that meet the … expectations of many physical scientists will inevitably perpetuate the truncated perception [of the environmental social sciences and humanities] we are questioning here'.

Moon and Blackman's (2014) call for natural scientists interested in social science to understand its philosophical principles and theoretical assumptions contains the implicit assumption that social scientists are transparent about such matters. However, as the literature reveals, social scientists rarely make their philosophy and theoretical position clear because: (i) publishing and presentation conventions in general do not demand reflexivity; thus few scholars are required to be absolutely explicit about the ontological and epistemological foundations of their work; (ii) following from this, assumptions go unexamined because they are shared by disciplinary colleagues. Social science is not a single discipline and we should not talk about it as if it was a

Figure 1.

homogenous intellectual endeavour with shared and stable philosophies, theories or methods. Indeed, despite a growth in the gross number of articles on climate change within the social sciences (Figure 1), the history of scholarly publishing on climate change in social science disciplines from 2000 to 2010 demonstrates that environmental studies, economics and geography have dominated whilst scholars from other disciplines with significantly different epistemic and methodological concerns have published fewer papers on the topic (Figure 2).

One of the fundamental epistemological questions that separates different disciplines in the social sciences and which is of importance for climate change research is simply 'what are people like?'. I explore this in the next section.

What are people like?

The answers to the question 'what are people like' range from rational maximisers of self-interest (homo economicus), social subjects of particular discourses (a structuralist perspective) and subjective agents engaged in relational negotiations, improvisations, practices and performances (a view informed by critical theory) – and many variants on these (Gregory, Johnston, Pratt, Watts, & Whatmore, 2009). 'What are people like' is possibly the most critical question for social scientists of climate change because it influences every other question we as social scientists seek to answer: why has not knowledge of climate change altered the way we live in the West? Why do people do what they do, think what they think? Why do they not act in accordance with their beliefs? How can we change ourselves and our societies to adapt and mitigate to climate change? How can we inform successful policy-making for climate change? And, the problem that currently seems to be occupying the minds of leading social science organisations and funders (such as ISCC), how can we work together on climate change research? These and other questions are the foundations of work on climate change as a social-cultural phenomenon (McCarthy, Chen, López-Carr, & Endemanõ Walker, 2014).

In our epistemic communities, our answer to 'what are people like' rarely requires articulation to our peers and this neglect of reflexivity means that working assumptions about values,

Figure 2.

identities, behaviour, society, the individual and the nature of change remain implicit and unchallenged. Yet at least some of the concepts at large in the literature have very different readings in different disciplines. To take but one example: identity. The concept of a person as self-sustaining entity possessed of the capacity of conscious reason and with a core that is essentially fixed and continuous is a product of Enlightenment thinking (Gregory et al., 2009). Whilst it has been modified by research which attempts to retheorise identity as (variously) fluid, fractured, unstable, mobile or as a narrative achievement (Gregory et al., 2009), in some social sciences identity is often still seen as a stable site from which interactions with society (as a distinct entity) proceed. From psychology, Gatersleben et al (2012, p. 3) speak of values and identities as 'generally stable factors that transcend specific situations' whilst from cultural geography Geoghegan and Leyson (2012) see also Geoghegan and Leyshon (2012) start from the position of identity as relational, practiced, performed and represented. Nagel (2012), meanwhile, examines the significance of gendered identities for understanding the relative vulnerability of men and women to the impacts of climate change.

Such a divergence makes a tremendous difference to the analysis and interpretation that can be brought to bear on empirical data. Gatersleben et al. (2012, p. 1), for example, argue that 'stable individual factors such as values and identities … affect a wider range of behaviours' (see also Jaspal, Nerlich, & Cinnirella, 2014). Leyshon and Geoghegan (2012) on the other hand focus on the embodied, experiential processes and practices around which social meaning is made.

The ISSC/UNESCO World Social Science Report (2013, p. 7) argues that:

> Critical to a social-ecological systems perspective is the role of humans as reflexive and creative agents of deliberative change. Understanding how values, attitudes, worldviews, beliefs and visions of the future influence systems structures and processes is crucial.

If, as a thought experiment, we replace the words the words 'reflexive', 'creative' and 'deliberative' with 'unconscious', 'destructive' and 'thoughtless', we start to see that humans are commonly framed – perhaps even reified – in the social sciences as excogitative, rational agents whose unconscious, habitual, or even wilfully lethiferous behaviours go largely unexamined. Meanwhile values, attitudes, worldviews and beliefs are treated a separate, stable, knowable drivers of behaviour. Dominant approaches from, inter alia, economics, psychology and sociology forestall much consideration of the fugacious, commingled qualities of values, attitudes and beliefs or how they inform behaviour. As Shove observes (2012), there is a common understanding of behaviour as something that is driven by rational self-interest, attitude/motivation or habit. There is also an assumption that actors themselves will be able to unproblematically articulate their values, attitudes and beliefs. However, as Kobayashi and Mackenzie (2014, p. 229): suggest,

> action, and particularly the culture-building routines of everyday life, are none the less commonly taken for granted and opaque to actors … the causes of action (or inaction) are not always apparent to actors themselves.

The expectation that people as rational agents will always be able to articulate and account for their actions is to overlook not only people's messiness and complexity but also their capacity for creative and imaginative thinking, doing and making – see, for example, Paschen and Ison (2012) on narrative approaches which 'story' climate change. Yusoff and Gabrys (2011) and Gabrys and Yusoff (2012) call for more attention to climate as a dynamic cultural force capable of reshaping societies and environments. To fully appreciate and engage this approach, it is necessary to take seriously the power of the human imagination 'as a way of seeing,

sensing, thinking and dreaming the formation of knowledge, which creates the conditions for material interventions in and political sensibilities of the world' (Yusoff & Gabrys, 2011, p. 516). They identify three distinct temporal and spatial imaginative framings of climate change: the future, everyday life and science–art collaborations. While, as Brace and Geoghegan (2011) note, the future is the *sine qua non* of climate change, crucial to the scientific practices of modelling and prediction, it has also provided the imaginative fuel for catastrophic renderings in art, literature and film of abrupt climate change. Meanwhile, an imaginative recasting of climate change as something that is not 'out there' but 'in here' has engendered a tacit acceptance of the need for adaptive strategies embedded in everyday life. Finally, science–art collaborations have sought to reconsider the 'social spaces of climate interaction and the science–policy–public interface' (p. 517).

Such research innovations clearly draw on the epsitemologies, theories and methods of the humanities to understand human creativity. However, as Castree et al. (2014, p. 765) argue, the environmental humanities have much more to offer, addressing

> fundamental questions of value, responsibility, rights, entitlements, needs, duty, faith, care, government, cruelty, charity and justice in a world marked by (1) significant differences in people's customs and aspirations, (2) manifest inequalities in people's living conditions and material prospects, and (3) complex material and moral interdependencies among people and non-humans stretched across space and unfolding through time.

In the next section, I wish to call attention to the multiple spaces, sites and practices across which and about which social science research on climate change is being produced.

Spaces, sites, practices

Spaces, sites and practices are material and conceptual – for example, research on climate change in urban areas is not just about the urban as a space but the city as a discursive site, and urban governance as a practice. Thinking about spaces, sites and practices helps us to recognise that everyday life is conducted in specific places and through different, sometimes highly routinised, performances which are themselves the product of discursive regimes, constellations of political and personal power, governance structures, regulation and so on. Highly reductionist social science on climate change has tended to elide this complexity but it is now more widely recognised that it must be embraced rather than evaded (Geoghegan & Leyson, 2012; ISSC/UNESCO, 2013).

Although, as noted above, climate change research in the social sciences has tended to see the social, the technological, the economic and the cultural as separate realms, new research is providing more nuanced insights through well-theorised empirical work. Bulkeley and Castán Broto (2012), in this volume, draw together the material, the social and lived experience of a zero-carbon development in Bangalore to explore the possibilities and complexities of transformational change. In so doing they highlight that climate change is an important urban issue – large populations in cities are vulnerable to its effects and cities themselves are significant sources of emissions. However, research on climate change in urban areas has often focused on policy for infrastructure development: water, sanitation, energy, transport, the built environment rather than the material infrastructure itself or the practices and political economies that sustain them. Bulkeley and Castán Broto (2012) instead focus a on niche or experimental project – a zero-carbon gated community in Bangalore aimed at the wealthier classes. They view this as a socio-technical experiment co-produced through the interrelation of social and material elements, rather than the product of an ideal urban policy model of evidence,

goals, planning and action. Indeed, this socio-technical experiment mediates traditional governance responses and foregrounds governance itself as a contested, partial and fragmented process.

Bulkeley and Castán Broto (2012) propose a different way of thinking about urban climate governance through processes of making, maintaining and living. 'Making' relates to the processes of assembling the material and semiotic networks necessary to legitimate alternative experiments outside mainstream policy – in this case the T-Zed zero-carbon development of 16 houses and 75 apartments built from sustainable materials which offer residents high-end but low-emission lifestyles with reduced dependence on the city's resources such as water and electricity. 'Maintaining' refers to the processes of readjustment that takes place in order to deal with the experiment within the political economy and political ecology of the city – manifest in questions over water supplies, landownership disputes and the relationship between the developers and the residents. Finally, through 'Living' the lived experience and everyday practices of the residents are examined. The experiment produced new forms of conduct and normalisation but also conflict about the purpose and future of the housing development as a climate change experiment.

Bulkeley and Castán Broto conclude that the T-Zed development has become part of an emergent low-carbon urbanism by: first, creating the space for innovation; second, reconfiguring the city's infrastructure systems; and third providing an arena in which new discourses of responsibility and carbon control for middle class residents have flourished by showing that low-carbon living is compatible with modern urbanism in Bangalore. In making this argument, they are developing a thread in contemporary urban studies across a range of disciplines which tries to understand new political orders being forged in the face of climate change, and new spaces for politics engendered therein (Braun, 2014). Braun, for example, argues that combined city growth and climate change are producing new political orders that are increasingly urban in focus and which attempt to produce strategies to manage complex relations between the city and the globe, including the city as a contributor to global climate change and a recipient of its impacts.

Bulkeley and Castán Broto and Braun's research goes some way to acknowledging that 'the surprisingly uncontrollable, surprisingly living system that is daily life' (Shove, 2012, p. 12) not only modifies extant systems of governance but insists on expanding our conceptual repertoire in order to understand it. Bulkeley and Castán Broto's research steps outside dominant approaches to climate change policy in urban areas to focus on the socio-technical relations that produce the practices of everyday life, and in so doing mediate both policy and governance. The relationship between policy and practice speaks to one of the most vexed questions for social scientists: how does change happen? Shove (2012) argues that the task of sociology, anthropology, material cultural studies and (I would add) geography is to understand how social arrangements come to be as they are. She suggests that this is important for theories of social-technical change, transition and practice, but that few of these intellectual resources have found their way into policy-making for behavioural change. Like Gatersleben et al. (2012), Shove (2012) voices disquiet about, first, the focus on the individual (in research and policy) at the expense of understanding social relations in place and, second, explanations which propose a unproblematic, linear, causative link between attitudes and behaviours. Shove's solution (2012) is to focus on 'practice'.

Practice theory takes social action to be constructed, situated and performed but, crucially, also asks how practices emerge, persist and disappear. Practices in this sense are entities 'that exist across time and space, that depend on inherently provisional integrations of elements, and that are enacted by cohorts of more and less consistent or faithful carriers' (Shove, 2012, p. 4). Thus, various resource-intensive practices that contribute to climate change – such as a daily commute by car – are not simply an individual act but have been constituted and enabled by constant repetition and are the product of historical conditions and contemporary meanings, competencies and materials. This is why they are so difficult to change with conventional policies

which tend to work on the deficit model – that is, if only people had enough of the right sort of information, they would change their behaviours. Pidgeon and Fischhoff (2012, p. 35), for example, argue that

> few citizens or political leaders understand the underlying science well enough to evaluate climate-related proposals and controversies. As a result, it is hard for political leaders to generate and sustain broad public support for ambitious climate policies or for citizens to take effective personal action.

Such an approach is itself a product of the entrenched view of humans as rational agents, which I discussed above.

Our dependence in the west on a high-carbon, centralised energy system which currently provides enough power to meet our many uses is one issue which lends itself to the analysis of practice that Shrove proposes. People's energy use is a historically specific outcome of – amongst other things – the abundance of cheap energy, the invention and rapid adoption of a plethora of technology from tumble dryers to smart phones, and expectations about connectivity, information gathering, social networking and communication. This is why changing elements of our practices of energy consumption is not straightforward. Moving to a decentralised energy (DE) system is frequently proposed by advocates and academics as a means of reducing emissions but the means by which this transition can be achieved are still opaque. ~~XXXX~~ (2014, p. 1) seek to go beyond a functional definition of DE as 'the supply of electricity and heat generated on or near the site where it is used' using renewable energy sources like solar, hydro, wind and biomass, to understand it as a 'multi-dimensional concept, encompassing technical, financial, political and behavioural aspects'. A wide range of public, private, third sector and community organisations are involved in developing DE projects in urban areas, with different motivations, drivers and levels of success. The research shows that the DE sector is highly heterogenous, and the success of any project is dependent on the participants' skills, access to resources, incentives, governance and more esoteric factors like local structures of feeling, trust and altruism. Such findings obviously present policy-makers with a challenge as one-size-fits-all approaches to encouraging the development of DE along with other attempts to shift behaviours will clearly have to be rethought.

AQ6

The questions of regulation and incentivisation of DE raised by ~~XXXX~~ raises the broader issue of whether emissions can be accounted for and ultimately reduced through the use of complex financial instruments and accounting procedures. Such issues go well beyond a concern with the individual and their behaviours and instead focus on the way emissions are produced by production, supply chains, trade and other functions of the global economy. Turner, Xin Cui, Jung Ha, and Hewings (2012) offer a detailed mathematical evaluation of whether input–output accounting techniques are appropriate for tracking pollution embodied in complex economic interactions and supply chains. They are especially concerned with the scale at which such accounting methods are applied to sub-national regional economies.

While the mathematics of such research is beyond the understanding of most ordinary mortals, such research raises important broader questions. First, this research demonstrates that scale – both temporal and spatial – is of utmost importance. When Stern (2006) called climate change the widest ranging market failure ever seen, he identified the solution in the instruments of the market itself. Key policy instruments would operate to mitigate climate change, such as 'taxes, trading based on the allocations of property rights, and regulation' (p. 7), operating at the scale of the state, or federated states such as the EU. These property rights could be allocated 'over different time horizons and across countries, firms and individuals in different ways'. At the global scale, aggregate emissions targets would determine the sum of rights to emit.

Second, markets, economics and growth are not a-political. The economic question that Turner et al. (2012) ask about the efficacy of input–output accountancy methods is also fundamentally a political one, about the distribution of the cost of climate change, the apportionment of responsibility for pollutants, and the negotiation between region and nation over economic winners and losers. Thus political capital is also expended when economic policies for climate change are implemented – as in the case of Australia's recent experience with carbon tax (Robson, 2014). Third, Turner et al's (2012) concern with the degree to which consumers or producers share the responsibility for pollution demonstrates, if only implicitly, how indifferent most of us are to the global processes that bind us to distant makers, exporters and providers (Cook & Woodyer, 2012). As Turner et al. observe, human consumption decisions lie at the heart of the climate change problem, at whatever scale.

Conclusion

For Law and Urry (2004, p. 390), the work of social science is to 'interfere in the realities of [the] world, to make a difference, to engage in ontological politics, and to help shape new realities'. There is no doubt that the cogs of the social science research machine are now grinding across a number of disciplines where interest in climate change is burgeoning. And, like the mill of the gods, these cogs are grinding very small, producing detailed empirical work on a wide range of topics including behaviour, identity, values, economics, policy, governance, regulation, everyday life, co-production – the list goes on. Meanwhile, and perhaps paradoxically, the relationship between the natural sciences and the social sciences is being managed through a series of meta-narratives of the social sciences which seek to bring consistency and order to the monstrous anthill on the plain (to misquote Wordsworth).

Current attempts to assert the value of social science are political, and do not really leave much room for reflexive, critical practice. The prescription for a successful engagement between the natural and social sciences is for each to better understand the other, but in order to do this we must first better understand ourselves. Questions of ontology and epistemology are rarely brought to the fore. Methodological assumptions and interpretative frameworks are described but rarely interrogated. The structure of academic publishing regimes, funding and career trajectories in which one seeks to thrive in one's own disciplinary area tend to mitigate against taking ~~the time to do this~~.

AQ7

Ultimately, however, much work is still required to destabilise taken-for-granted assumptions about: (i) the nature of climate change, paying attention to its complex ontology and the knowledge-making practices that have brought it into view, as well as its likely manifestations, unevenly distributed in time and space and differently mitigated by relative levels of resilience; and (ii) academic knowledge as a privileged site in which climate change can be apprehended at the expense of other ways of knowing, doing and being in the world. In this paper I have organised some extant work from disparate social science disciplines around spaces, sites and practices as a way of demonstrating not only that apparently different scholarly accounts have at least some congruence but that grounding our research in the places and practices of everyday life is productive. Needless to say, much still needs to be done. But most crucially we should learn to be more reflexive and embrace the challenge to our epistemic assumptions if we are to allow the social sciences to address the complex problem of climate change.

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Note

1. Throughout this paper I refer to the social sciences in the plural but note that recent reports (Hackmann & StClair, 2012; ISSC/UNESCO, 2013) refer to social science in the singular, which suggests a theoretical, epistemological, methodological and empirical consistency which is counterproductive to the claims for the usefulness of the social sciences in addressing climate change.

Notes on contributor

Catherine Leyshon is a cultural geographer interested in landscape, identity and sense of place. Recently, she has explored these themes in the context of climate change and landscape management in papers in Progress in Human Geography, Climatic Change, Area, Landscape Research and Geography Compass. Leyshon was part of the UK's National Ecosystem Assessment Follow on Phase (2014), involved in Work Package 4 on Cultural Ecosystem Services. To this, she has contributed a case study on partnership working on the Lizard Peninsula in Cornwall, UK. Leyshon teaches Geography at the University of Exeter's Penryn Campus in Cornwall. She holds a BA in Geography (CNAA), MA in Geography (Toronto) and Ph.D. in Geography (Bristol).

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AQ8

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