



Mapping climate change knowledge: an editorial essay

CLIMATE CHANGE: THE VERY IDEA

The relationship between climate and society has always been dynamic. Physical climates have played important roles in the biological and social evolution of human beings and fashioned the biogeophysical systems which provide the goods and services from which human economic and cultural life emerges. Similarly, humans have imposed themselves upon climate, both in the ways in which climates have been imagined, studied, and articulated in thought and language and in the growing influences that human actions have had on the physical operations of climate.

This relationship between climate and society has been characterized throughout history and pre-history by both creativity and fear.¹ Climates have offered societies productive resources and stimulated new technologies. They have also moulded personal and collective identities and inspired artists and storytellers. But climates have presented societies with risks and danger too. They have induced fear about survival and presaged anxiety about the future. This intense relationship between climate and society is now even more intimate as the actions on a global scale of a burgeoning humanity are changing in unprecedented ways the physical properties of the climate system, also on a global scale. Future weather will not be like past weather; future climates will not be like past climates.

Climate Is Not What It Was

Human societies have long worried about this possibility and now the knowledge claims of the climate sciences² have given us new reasons to be concerned about the future and a new language through which to express such concerns. At the same time as the physical processes of climate are being altered, the very idea of climate change is now part of cultural life and is itself changing societies in novel ways. Humanity is firmly embedded within the functioning of the climate system. Yet we have only tentative understanding of the implications of such a new role and only limited means at our disposal to exercise purposeful, as opposed to inadvertent, agency.

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These physical manifestations and cultural representations of climate change are interacting in ways that have no historical analogues from which we can learn. And they are doing so in ways that continue to surprise us. The past, through historic emissions of greenhouse gases, is constraining the future in new ways that are still only crudely understood, whereas the future, through scientific predictions and artistic depictions of climates to come, is making new incursions into the present. The idea of climate change is a consequence of this interpenetration of past, present, and future and is acting as a powerful and novel motor for cultural change.

These emergent physical-cultural expressions of climate change present extraordinary challenges to human societies and to the individuals and institutions that comprise them. They are challenges, too, that are reflected in the organization, practices, and productivity of the knowledge communities. Climate change—although starting as a rather esoteric research question for natural scientists in the middle decades of last century—has now entrained researchers of all varieties and of different instincts. Their research is interacting with politicians, entrepreneurs, celebrities, campaigners, engineers, priests, and citizens in an enlarging search for understanding, for solutions and, ultimately, for security.

Climate change, then, is having to be understood both as physical change—to the planetary systems which create weather, and to biogeophysical environments around the world that are shaped by the weather—and increasingly as an idea that is changing society and the way people think about the future. Researchers have to understand and illuminate the ways these different facets of the phenomenon are shaping each other. Social actions are changing the climate of the future, or at least constraining it, just as physical climates—and simulated virtual climates of the future—are changing society in the present. It is now the turn of climate to reveal the deep entanglement of nature and culture.^{3,4}

The research challenges that arise from this interpenetration of climate and society are made more difficult by the differing research cultures and methods among the disciplines that are contributing to these quests. Witness the recent controversies over the validity of the economic assumptions built into the

latest assessments of climate change,^{5,6} the different ways in which climate modeling uncertainties should be characterised and communicated,⁷ the contrasting positions adopted over the necessity and efficacy of various forms of geo-engineering,⁸ or the political adequacy of the Kyoto Protocol.⁹ ‘Science’—in a broad interpretation of the practice—does not speak with one voice on climate change.

These examples of contestation emphasise the need for stronger interactions between the traditional climate disciplines of meteorology, oceanography, ecology, and economics on the one hand, and the social sciences and the interpretative humanities on the other. The perspectives and contributions of these latter disciplines are now probably more important than the climate sciences to ongoing public and policy debates. As John Sterman has recently observed: ‘There is no purely technical solution to climate change . . . for public policy to be grounded in the hard-won results of climate science, we must now turn our attention to the dynamics of social and political change’.¹⁰

THE WIREs CONCEPT

It is with the intention of capturing, reflecting, and commenting on this scientific and cultural dynamism that the new concept of *Wiley Interdisciplinary Reviews* (WIREs) has been applied to climate change. This new journal—*WIREs Climate Change*—is thus launched.

WIREs are a generic new publishing model from Wiley-Blackwell, launched in 2009 and applied to a growing number of inter-disciplinary knowledge domains such as Systems Biology and Medicine, Computational Statistics, and Nanomedicine and Nanobiotechnology. The editorial goal of the WIREs is to emphasise the importance of inter-disciplinarity in science and to support cross-disciplinary collaborative efforts in research and education. The WIREs are not new journals *per se*; rather, they are hybrid publications that combine the most powerful features of traditional reference works and of review journals in a format designed to exploit the full potential of online publishing. WIREs focus on high-profile, well-funded research areas at the interfaces of the traditional disciplines. They emphasise collaborative and integrative approaches to scientific research, presenting cutting-edge science from a multidisciplinary perspective. They operate as serial publications so that they can benefit from full abstracting and indexing and, especially, impact factors. And they result in a highly structured, comprehensive coverage of a field of knowledge, adopting a common ‘templated’ editorial format and structure that maximizes quality

and consistency within and between the works. To raise their visibility and to drive online usage, the WIREs are initially available (for a period of 2 years) free of charge to institutional subscribers—and hence to individual end-users at academic, government, and corporate institutions.

The goal of *WIREs Climate Change* is therefore to facilitate and enhance the introduction and expansion of knowledge about climate change across disciplinary boundaries. It is to promote fruitful new discourses and mutual learning about how climate change is conceptualized, analyzed, and communicated in different research traditions. As with the other WIREs projects, *WIREs Climate Change* achieves these goals by performing the functions of a review journal, a dynamic online reference work, and a platform for synthesizing and catalyzing new inter-disciplinary contributions to our understanding of climate change.

If we examine the various international academic journals that are centred on the idea of climate or climate change, there is no other journal that simultaneously performs these roles. A search through all listed academic journal titles reveals that there are currently 14 journals that have the string ‘climat’ in their title. This search captures the words ‘climate’, ‘climatic’, and ‘climatology’ (see Table 1) and therefore captures the journals whose primary subject matter is the study of climate or climate change. (Of course there are a number of other journals that have traditionally published high-profile work on climate change—*Nature* and *Science* to name but two—but it is instructive in this instance to focus just on those journals whose first and dominant remit is climate).

WIREs Climate Change thus becomes the 15th such journal. Of these 14 ‘climate journals’, 8 of them have been launched since the establishment of the Intergovernmental Panel on Climate Change (IPCC) in 1988 and 5 of them have been launched since 2005. The disciplinary scope of these climate journals has broadened somewhat in recent years beyond meteorology, climatology, and quaternary science. New journals have been launched recently connecting climate change with development studies (e.g., *Climate and Development*, 2009), with policy and legal sciences (e.g., *Climate Policy*, 2001), and with general social science (e.g., *Weather, Climate, Society*, 2009). Yet with the exception of *Climatic Change* (1977), none of them could claim to be expansively inter-disciplinary.

There are research journals (e.g., *Journal of Climate*, *Climate Policy*) that publish new contributions to knowledge about disciplinary aspects of

TABLE 1 | The 15 International Academic Journals That Have the String 'Climat' in Their Headline Title

Journal	Launch year	Predominant disciplinary scope
<i>Theoretical and Applied Climatology</i>	1948	Climatology
<i>Journal of Applied Meteorology and Climate</i>	1962	Meteorology and climatology
<i>Paleogeography, Paleoclimatology, Paleoecology</i>	1965	Quaternary sciences
<i>Climatic Change</i>	1977	Inter-disciplinary
<i>International Journal of Climatology</i>	1981	Climatology
<i>Climate Dynamics</i>	1986	Meteorology and climatology
<i>Journal of Climate</i>	1988	Meteorology and climatology
<i>Climate Research</i>	1990	Climatology and geography
<i>Climate Policy</i>	2001	Policy sciences
<i>Climate of the Past</i>	2005	Paleoclimatology
<i>Carbon and Climate Law Review</i>	2007	Policy and regulation
<i>Climate and Development</i>	2009	Development sciences
<i>Weather, Climate and Society</i>	2009	Social sciences
<i>Climatic Change Letters</i>	2009	Inter-disciplinary
<i>WIREs Climate Change</i>	2010	Inter-disciplinary

Year of first publication and predominant disciplinary scope of each journal are also listed.

climate change, and there are some research journals (e.g., *Climatic Change*, *Global Environmental Change*) that do so across disciplinary boundaries. Some of these journals may occasionally publish unsolicited or invited review articles about climate change topics, but there is no broadly based climate journal devoted exclusively to review-type content. And there is no journal that aspires to provide a comprehensive and structured coverage of the full diversity of academic thinking about climate change—from the ontological status of climate to climate system dynamics.

WIREs Climate Change therefore offers something new compared with existing academic climate journals. It also offers an additional service to the knowledge community compared to other major compilations of climate change knowledge such as various climate change assessment reports and print or online encyclopaedias.

The IPCC is one obvious benchmark for comparison. The IPCC has been a unique and pioneering institution for bringing scientific knowledge to bear on an important public policy issue—namely, climate change. Through its various assessment reports prepared at 5 or 6 yearly intervals, the IPCC entrains considerable numbers of experts from around the world in surveying, evaluating, and assessing published knowledge about climate change. As an inter-governmental activity operating under a United Nations mandate, the IPCC is charged with seeking consensus within and across disciplines and also, ultimately, with securing formal agreement between the academy and governments through line-by-line approval of the summary for policymakers. IPCC knowledge is thus co-produced knowledge (cf. Ref 11). This is both its strength and its weakness.

WIREs Climate Change offers a different platform for knowledge synthesis and dissemination. The scope and disciplinary reach of this journal is considerably greater than that of the IPCC and, indeed, greater than most other climate change assessments and journals (see above). In designing the intellectual structure of *WIREs Climate Change*, we have de-privileged natural science and economics in telling the story of climate change and introduced stronger contributions from the social sciences and humanities. Thus, *WIREs Climate Change* gives considerable weight to reviewing knowledge about climate change from the perspectives of history, psychology, sociology, ethics, and science and technology studies, areas of knowledge that are not well represented in the IPCC structure.¹²

WIREs Climate Change is also able to embrace and reflect disagreement and contestation in the understanding of climate change without the constraint of needing to work towards consensus. The journal adopts conventional practices of academic peer-review in ensuring quality in the material published but, unlike the IPCC, this peer-review does not extend to governmental and extra-governmental interests, nor does it require a process of line-by-line approval of key summary texts and messages. As highlighted above, it is naïve to think that 'science' in its various disciplinary manifestations speaks with one voice about climate change, and it is important for scholars and practitioners to be given access to the origins and nature of disputed or plural knowledge. If climate change is an exemplar of what Silvio Funtowicz and Jerry Ravetz have called 'post-normal science',¹³ then revealing the origins and reasons for disputed and uncertain knowledge is as important for public policy as is constructing a consensus of 'agreed' knowledge.

If *WIREs Climate Change* is uniquely positioned in relation to conventional research journals and to knowledge assessments such as the IPCC, how does it compare with another—more traditional—mode of knowledge mapping: the encyclopaedia? The leading print encyclopaedia covering climate change is probably the *Oxford Encyclopedia of Climate and Weather*,¹⁴ with a second edition forthcoming.¹⁵ Another, more recent, contribution is Sage's *Encyclopedia of Global Warming and Climate Change*¹⁶ and many aspects of climate change are also covered in other sectoral encyclopaedias such as the *Encyclopedia of Global Change*¹⁷ or the *Encyclopedia of Paleoclimatology and Ancient Environments*.¹⁸ There are also a growing number of online encyclopaedias, from the generic open-source Wikipedia (en.wikipedia.org) to the new *Encyclopedia of Earth* (www.eoearth.org) from the Environmental Information Coalition. Then there is also the poorer cousin of the encyclopaedia—the dictionary—for example, the *Dictionary of Physical Geography*¹⁹ or the *Dictionary of Environmental Governance*.²⁰

WIREs Climate Change advances the traditional role of encyclopaedias—and the dictionary—in two ways. It offers a dynamic, serialised platform for the systematic presentation of knowledge about climate change in contrast to the frozen-in-time depictions of knowledge offered by traditional print encyclopaedias. By building incrementally a consolidated body of knowledge, frequently refreshed and expanded through newly written content, *WIREs Climate Change* offers more than the print encyclopaedia can offer and all that is offered by the online encyclopaedias. But it also offers more. It achieves its goal through inviting leading researchers to write review-type articles that tackle important themes, methods, and emergent topics, rather than through one-off entries describing or defining static concepts. *WIREs Climate Change* therefore brings the immediacy and peer-reviewed authority of the research journal medium alongside the flexibility of online reference works.

Structuring *WIREs Climate Change*

How have we applied this generic *WIREs* publishing model to knowledge about climate change? We can summarise our approach by commenting on three aspects of our structuring: the arrangement of content, the style of articles, and the goal of inter-disciplinarity.

Content

The content of *WIREs Climate Change* is organised around the 14 knowledge domains listed in Table 2. In

TABLE 2 | The 14 Knowledge Domains Around Which *WIREs Climate Change* Is Structured, Together With the Editor Responsible for Each Domain

	Domain Title	Domain Editor
1	Climate, history, society, culture	Jim Fleming
2	Paleoclimates and current trends	Neville Nicholls
3	Climate models and modeling	Hans von Storch
4	Assessing the impacts of climate change	Tim Carter
5	Climate, ecology and conservation	Lee Hannah
6	Perceptions, behavior and communication of climate change	Irene Lorenzoni/ Loraine Whitmarsh
7	Climate economics	Gary Yohe
8	Climate, nature and ethics	Dale Jamieson
9	Integrated assessment of climate change	Brian O'Neill
10	Vulnerability and adaptation to climate change	Jon Barnett
11	The carbon economy and climate mitigation	Roger Pielke Jr.
12	Climate and development	Daniel Murdiyarto
13	Climate policy and governance	Harriet Bulkeley/ Michele Betsill
14	The social status of climate change knowledge	Myanna Lahsen

structuring the content in this way we have steered a path between, on the one hand, merely adopting well-established categories—such as ‘observations’, ‘climate modeling’, and ‘adaptation’ as used in the IPCC assessments—and, on the other, creating a completely new set of categories. In this we have followed in the path pursued by the New Encyclopaedia Project in seeking to tension the mapping of knowledge around ‘creative and innovative dimensions of research ... [with] ... the necessity of teaching and writing in succinct and accessible ways’ (Ref 21, p. 16).

We have balanced the predominance of the natural sciences and economics in many previous assessments of climate change with knowledge domains more strongly rooted in history, geography, psychology, ethics, and sociology. This structure gives greater salience to the development of inter-disciplinary knowledge about climate change (e.g., the domain of ‘Integrated assessment of climate change’) and also to areas of fruitful emerging research rarely seen in IPCC reports (e.g., ‘Climate, nature and ethics’ and ‘Perceptions, behavior and communication of climate change’). The category ‘Climate, history, society and culture’ is included to allow historical

understanding of the changing relationships between climate and society to set the context for subsequent research about what climate change means for the future. And the category ‘The social status of climate change knowledge’ recognizes that one of the central questions affecting how climate change is debated in public concerns the status—the legitimacy, credibility, and saliency—of knowledge claims about climate change. We need to understand how such knowledge comes into being and what types of authority it carries when it circulates through society.

Article Types

WIREs Climate Change publishes review articles rather than the primary results of empirical or theoretical research. The bimonthly serial editions of the journal carry four different types of review articles: Opinion Articles, Overviews, Advanced Reviews, and Focus Articles.

Opinion Articles provide a forum for thought-leaders, hand-picked by the editors, to provide more individual perspectives on specific issues or to set out new agendas for research and action. These may be deliberately provocative, or else co-authored, to capture the essence of some live debate about climate change knowledge. In addition to these review article types, occasional invited commentaries will also be included highlighting various challenges within and between domains, for example new concepts, interdisciplinary practice, or paradigm conflicts.

Overviews provide broad and relatively non-technical treatments of important topics at a level suitable for advanced students and for researchers without a strong background in the field. They provide rapid orientation to the important theories, knowledge, uncertainties, and controversies in the field, placing current knowledge in its historical context.

Advanced Reviews are aimed at researchers and graduate students with a strong background in the relevant topic, these articles reviewing—with a critical edge—key areas of emerging research in a citation-rich format. These reviews are more ‘disciplinary’ in focus than Overviews, offering more technical content and seeking to engage readers through new insights and syntheses of familiar themes.

Focus Articles offer mini-reviews or case studies focusing on a particular concept, for example, region, method, or debate, and which therefore illustrate aspects of broader ideas covered in Overviews and Advanced Reviews. These review article types fulfil one or more of the four functions of the overall WIREs project: mapping knowledge, critiquing knowledge, reflecting debates, and setting agendas.

These functions may co-exist within a given article—indeed, some reviews may have elements of all four functions—although most reviews will tend to emphasise one of these characteristics over the others.

- **Mapping knowledge:** Articles will review the most significant primary research literature in order to guide readers to the principal contributions of the field and to help readers keep up to date in an area of research. Reviews fulfilling this function therefore aim to be comprehensive (i.e., neither exhaustive nor too selective), offering an intellectual map to a given field or topic. They will acknowledge relevant diversity in theory, method, and geographical focus and be non-partisan. Overviews provide such navigation at an introductory level, whereas Advanced Reviews at a more specialist level. Focus Articles will do so through a narrower scope or perhaps by being based on new literature just published in a growing field.
- **Critiquing knowledge:** This function entails not only reviewing the published literature on a topic (as above), but additionally offering a strong and visible authorial perspective on how robust or tentative this knowledge is and the reasons for this perspective. Elements of critique can be present in all article types if appropriate and, most definitely, will be evident in Opinion Articles.
- **Reflecting debate:** It is essential for *WIREs Climate Change* to tackle issues and debates that are the subject of controversy inside the academy and across wider social worlds. Some reviews are therefore deliberately structured so as to reveal controversy and contestation, but to do so in a non-partisan manner. Overviews may identify what some of these controversies are, whereas Opinion Articles are a way of further exposing different perspectives on specific questions. Invited commentaries are a further way in which we can offer a service to the wider community by identifying the origins and reasons of such disputes.
- **Setting agendas:** This function of a review article seeks to review knowledge in emerging and/or inter-disciplinary areas, where new research is particularly fluid or yet needed. This provides opportunities for provoking new thinking from knowledgeable perspectives and for setting new agendas in research and practice. This is especially the case in disciplinary traditions which have weakly engaged with climate change thus far (e.g.,

history, anthropology) and also in areas where new thinking is needed, often through bringing together insights across disciplinary boundaries (e.g., the sociology of modeling). Elements of agenda-setting can be present in all article types, perhaps rather less so for Overviews which are more of a general introduction to a topic.

Inter-Disciplinarity

Inter-disciplinary research is a widely lauded aspiration and a frequently claimed necessity in order to advance human understanding of a wide range of troubling, exciting, or otherwise important phenomena. Climate change is without doubt one of these, as was recognized as far back as 1977 by Stephen Schneider in his opening editorial of the journal *Climatic Change*.²² Yet it is far easier to use 'inter-disciplinary' in a rhetorical or descriptive sense than it is to define what constitutes inter-disciplinary research in theory and, even more so, than it is to achieve it in practice. There is much inertia both in the practices of science and in the conduct of the academy to achieving the nirvana of inter-disciplinarity (see Refs 23 and 24 for some helpful reflections on this).

WIREs Climate Change approaches this elusive property of inter-disciplinarity at three different levels: at a meta-level for the journal as a whole; at a domain level for different thematic areas of knowledge; and at the level of individual articles. For the journal as a whole, *WIREs Climate Change* encompasses knowledge about climate change drawn from a very broad range of disciplines. Organizing this knowledge systematically across a single publishing project so that relationships and conflicts between different areas of knowledge are made visible is a form of inter-disciplinarity, if only the weakest form; indeed, this should more properly be described as facilitating simply a multidisciplinary approach to mapping knowledge.

At the structural level, each of the 14 domains designated in *WIREs Climate Change* has a potential fruitfulness through allowing inter-disciplinary reviews to flourish. Each domain engages with a number of different disciplines—for example, the domain 'Perception, behavior and communication of climate change' draws upon psychology, sociology, risk and media studies—and articles in each domain can draw upon different disciplinary methodologies in composing their reviews. Individual review articles can therefore be solicited which engage with the synergies and conflicts that emerge at the junctures of different disciplinary theorizing and practice. This too is another facet of inter-disciplinarity. There will be occasions when this inter-disciplinary goal is

further enhanced through co-authorship of articles, where co-authors are writing from within different knowledge traditions and yet where they seek to offer reconciliation between them.

The above illustrations focus on the practice of inter-disciplinarity in the *writing* of research reviews. *WIREs Climate Change* also affords opportunity for the advancement of inter-disciplinarity through the *reading* of review articles. By mapping climate change knowledge across such heterogeneous terrain and through offering navigable online access to readers of this kaleidoscopic map, the journal will introduce students, researchers, and practitioners to ways of conceiving, analysing, and reflecting on climate change with which they may be unfamiliar. If this offer is accepted, it may be a good starting place for readers to embark on a different journey of discovery. An inter-disciplinary understanding of climate change can be cultivated in the mind of the reader as much as it can be constructed through the productive craft of the researcher and author.

NEW MAPS OF CLIMATE CHANGE KNOWLEDGE

Climate change is altering the world around us. It is changing the physical dynamics and configuration of the planet and the distribution and properties of material resources. Maps of world climate will look very different to our grandchildren than they looked to our grandparents. Climate change is also changing the world around us in other ways. Business, political, and social worlds are changing in response to climate change, and for many people climate change is altering their imaginary worlds, the ways in which the future impinges on the present.

WIREs Climate Change is a new journal seeking to reflect these new worlds in the making, and to interact with them, by bringing together into one systematic and dynamic structure emerging knowledge of climate change from across the academic disciplines. It is a new publishing model in that we seek to blend the systematics of a reference work with the dynamics of a research journal, and to do so using the versatility of the online medium for connecting and navigating through complex inter-disciplinary maps of knowledge. We seek to engage readers wishing to access reviews of established knowledge of climate change drawn from disciplinary traditions other than their own. And we seek to stimulate readers with reviews of emerging inter-disciplinary ventures and of debates where the socially engaged nature of climate change research

rubbed uncomfortably up against knowledge created in the quieter spaces of the laboratory or the study.

We believe that *WIREs Climate Change* is a project that can play an active role in the construction of new knowledge about climate change by stimulating research reviews that demand new ways of thinking in both authors and readers. It is a publishing concept to which Wiley-Blackwell is firmly committed and is an intellectual project in which all of the editors of the journal believe. We look forward to receiving

feedback from you, the readers, about the venture, and we would also like to hear from you with ideas about review articles—Opinion Articles, Overviews, Advanced Reviews, or Focus Articles—which will contribute to our goal of creating new maps of climate change knowledge.

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NOTES

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