# Oxford Research Encyclopedia of Climate Science

## Summary and Keywords

Despite scientific consensus on the anthropogenic causation of climate change, and ever-growing knowledge on the biophysical impacts of climate change, there is large variability in public perceptions of and *belief* in climate change. Public support for national and international climate policy has a strong positive association with certainty that climate change is occurring, human caused, serious, and solvable. Thus to achieve greater acceptance of national climate policy and international agreements, it is important to raise public belief in climate change and understandings of personal climate risk.

Public understandings of climate change and associated risk perceptions have received significant academic attention. This research has been conducted across a range of spatial scales, with particular attention on large-scale, nationally representative surveys to gain insights into country-scale perceptions of climate change. Generalizability of nationally representative surveys allows some degree of national comparison; however, the ability to conduct such comparisons has been limited by the availability of comparative data sets. Consequently, empirical insights have been geographically biased toward Europe and North America, with less understanding of public perceptions of climate change in other geographical settings including the Global South. Moreover, a focus on quantitative surveying techniques can overlook the more nuanced, culturally determined factors that contribute to the construction of climate change perceptions.

date: 08 April 2018

The physical and human geographies of climate change are diverse. This is due to the complex spatial dimensions of climate change and includes both the observed and anticipated geographical differentiation in risks, impacts, and vulnerabilities. While country location and national climate can impact upon how climate change is understood, so too will sociocultural factors such as national identity and culture(s). Studies have reported high variability in climate change perceptions, the result of a complex interplay between personal experiences of climate, social norms, and worldviews. Exploring the development of national-scale analyses and their findings over time, and the comparability of national data sets, may provide some insights into the factors that influence public perceptions of climate change and identify national-scale interventions and communications to raise risk perception and understanding of climate change.

Keywords: climate change, climate change belief, belief, perceptions, place, country comparison

# Introduction

The term *climate change* has been part of the public lexicon for nearly three decades, and under the gaze of scientific scrutiny for far longer. In 1979, a *Nature* editorial identified anthropogenic climate change as "conceivably, the most important environmental issue in the world today" (Nature, 1979, p. 1). Since that time, scientific understanding of climate change, including detailed accounts of the human actions contributing to climate change and the associated biophysical risks, has increased (Liverman, 2007). A series of investigations has provided clear evidence of scientific agreement on human attribution of climate change (e.g., Oreskes, 2004; Doran & Zimmerman, 2009).[1]

However, despite this consensus, there are still widely diverging *social* understandings of climate change (Brechin, 2003; Hoffman, 2012). Since the 1980s, a variety of public perception surveys have been tracking awareness of climate change in terms of causes, consequences, and actions (e.g., Yale Project on Climate Change Communication, Pew Polls). This body of literature grew in significance when the positive correlation between public belief in climate change and support for public and private action on climate change became clear (Vainio & Paloniemi, 2011). Nevertheless, climate change remains a strongly contested and politicized issue in many countries across the Global North and South (McCright & Dunlap, 2011A, 2011B).

The dual roles of sociocultural and individual psychological factors in determining public perceptions of and responses to climate change are relatively well-established (Leiserowitz, 2006). Social perceptions are constructed through cultural factors such as worldviews and ideologies (e.g., Shi, Visschers, & Siegrist, 2015) and political ideologies (e.g., McCright & Dunlap, 2011A, 2011B), as well as individual experiences of local climate variability and change (e.g., Dessai et al., 2004; Weber, 2006). Indeed, belief in climate change is thought to be influenced by awareness of and knowledge about the issue,

date: 08 April 2018

beliefs about science, environmental concern, values and ideologies, and situational clues (e.g., direct experiences) (Hornsey, Harris, Bain, & Fielding, 2016). These influences come together to create place-, context-, and time-specific understandings of climate change.

The literature on climate change beliefs has been characterized by a methodological focus on large-scale, nationally representative surveying techniques, a geographic prioritization of countries of the Global North (e.g., North America, Europe, and Australasia), and limited cross-country comparisons due to the variety of approaches and survey questions adopted (Lee, Markowitz, Howe, Ko, & Leiserowitz 2015). Each of these issues have, to varying degrees, been addressed in recent years due to a burgeoning desire to understand the nuanced, culturally-informed, place-based nature of climate change beliefs, but also due to the critical need for "substantial and sustained reductions in greenhouse gas emissions" (Intergovernmental Panel on Climate Change [IPCC], 2014, p. 19), which demands a combination of strong policy, technological innovation, and behavior change. Recent advancements in the field have allowed for greater cross-national comparisons of social perceptions, mapping belief in the reality of climate change along with its causes and support for mitigative and adaptive action across countries of the Global North and, increasingly, the Global South (Lee et al., 2015).

"Climate change belief" is examined cross-culturally and defined as a combination of the following distinct if interrelated beliefs: (a) the climate is changing, (b) human actions are causing the climate to change, (c) climate change poses a threat to humanity and/or the natural environment, and (d) humans have the capacity to prevent or limit the severity of climate change. While this is a rather broad conceptualization of climate change belief, it allows for insights across these domains. The purpose is to explore geographically specific belief in climate change (a–d). To do this, the diverse meanings attached to the concept of climate change belief are explored and the determinants of climate change belief are reviewed. A range of literatures across geographical regions is examined, with particular emphasis on qualitative studies, where available. The value of quantitative survey data is juxtaposed with place-based studies through the specific example of agricultural-focused climate change research. The rise of cross-cultural and comparative approaches to examining climate change beliefs is described, and research gaps are highlighted.

## Language, Terminology and "Belief" in Climate Change

Climate change is framed as a socio-scientific issue (SSI) that exposes public interactions with and trust of science and *scientists*. It is therefore of interest to the study of science communication and the promotion of scientific literacy (Levinson, 2006; Sadler, Klosterman, & Topcu, 2011; Walsh & Tsurusaki, 2014), particularly relating to how complex socio-scientific dilemmas are understood (Levinson, 2006). The language used to discuss climate change links with an SSI framing. For instance, unlike most other environmental

date: 08 April 2018

or scientific phenomena, perceptions and understandings of climate change are spoken of in terms of "belief": an acceptance that climate change exists or is true, "especially one without proof" (Oxford Dictionaries, 2016).

Language is central to communication, through the construction and maintenance of particular frames and discourses (Fløttum, 2010). Frames provide "interpretive story lines" which communicate "why an issue might be a problem, who or what might be responsible for it, and what should be done about it" (Nisbet, 2009, p. 15). Through language, understandings are created, sustained, and transformed. Likewise, the terminology used to discuss an issue is not neutral, but subjectively interpreted and used to construct particular ways of understanding. Alongside health communication, risk communication, and science communication, climate change communication has become a particularly salient scientific and societal topic (Nerlich, Koteyko, & Brown, 2010). The social meanings ascribed to climate change are closely related to how climate change is communicated (e.g., Hulme, 2009). This has led to calls from the scientific community for a common climate language, and the translation of climate science into "simpler, more useful terms" (Bowman, Maibach, Mann, Moser, & Somerville, 2009, p. 36) and "terms that non-scientists can readily understand and use" (Bowman et al., 2009, p. 37).

Despite evidence to suggest that they are understood and interpreted in different ways (Whitmarsh, 2009; Schuldt, Konrath, & Schwarz, 2011; Leiserowitz et al., 2014), the terms *global warming* and *climate change* are still used synonymously and interchangeably within research and subsequent publications (see Schuldt, this volume). These definitional problems are at the heart of ambiguities around climate change (Brace & Geoghegan, 2010), and contribute to complexities in communicating climate change, which can result in low levels of public support for the development of policy and behavioral responses.

## Exploring the Meaning of Belief

Philosophical and sociological explorations of knowledge and belief have challenged academic thought for much of modern history, with roots to Plato 2,500 years ago (Southerland et al., 2001). Drawing upon or diverging from Plato's Theory of Knowledge, this literature makes an intuitive distinction between knowledge and "the form of 'non-knowledge' usually referred to as 'belief'" (Strohmayer, 2003, p. 522). Much of this work has shown how the structures of knowledge are intimately linked with a range of human practices including external everyday experience and internal thought processes (Strohmayer, 2003). Under Plato's reasoned true belief account of knowledge, three conditions must be met: truth, belief, and evidence (Southerland et al., 2001). In other words, "if p is true, and you believe that p, and your belief is justified, then you know that p." While Plato's work is foundational to philosophical studies of knowledge, "the adequacy and meaning of the conditions . . . have long been debated" (Southerland et al., 2001, p. 328). For instance, "Gettier cases" (Gettier, 1963) demonstrate that justified true belief is not *sufficient* for knowledge as it can be accidental, relative to our evidence, that

date: 08 April 2018

our belief is true, even in a case where the belief is justified by that evidence (Zagzebski, 1994).

While beliefs can be *directed toward* almost anything (e.g., politics, art, the environment), they have stable characteristics in that they are shared, persistent, internally linked, and receive commitment. These features allow for beliefs to be studied "as a distinct type of behaviour" (Borhek & Curtis, 1975, p. 4). Beliefs are also argued to be strong determinants of emotion, and in the reverse, the role of emotion on belief is seen to influence "the content and the strength of an individual's beliefs, and their resistance to modification" (Frijda, Manstead, & Bem, 2000, p. 1). Indeed, Strohmayer (2003, p. 524) argues that "knowledge is not just the outcome of academic or scientific ways of analysing the world, it also constituted a social practice," which depicts the space for other types of knowledge (beyond acquaintance, ability, and propositional knowledges), which could include local knowledge—an important source of place-specific information on climate change trends and potential impacts.

A "sociology of belief" perspective is concerned less with the validity of a particular belief than with the social processes that make ideas believable or unbelievable (Borhek & Curtis, 1975). From this viewpoint, beliefs have five core features:

1. Belief systems are cultural, and belief is an aggregated phenomenon;
2. Beliefs are unintelligible unless they are understood in both a context of meaning and of social organization;
3. While people become and remain committed to belief systems, to persist, they must be validated;
4. The rise and change in belief systems can be explained by utility in group adaptation to strain and disorder;
5. While belief systems are social, they also require an internal logic (among other nonsocial aspects) that provide direction irrespective of the believers.

And while beliefs are persistent, they also have the capacity to alter over time, through a process of "belief revision" (Gärdenfors, 1992). This occurs when "a new piece of information that is inconsistent with the present belief system . . . is added to that system in such a way that the result is a new consistent belief system" (Gärdenfors, 1992, p. 3). Such a revision can result in expansion, revision, or contraction of the original belief. Thus, through this process "when an agent is faced with new information which contradicts his/her current beliefs, he/she will have to retract some of the old beliefs in order to accommodate the new belief consistently" (Gabbay, Pigozzi, & Rodrigues, 2006, p. 72). This can explain the process through which climate change beliefs shift, not merely across a dualism of belief and deny, but through a spectrum of positions, oftentimes because of changing internal and external conditions.

Other concepts used to understand the interpretation of new information include confirmation bias and other forms of motivated reasoning (e.g., Kunda, 1990; Corner, Whitmarsh, & Xenias, 2012), which reflect (in)-consistency between the interpretations of

date: 08 April 2018

new information and existing beliefs. Less is known about the type, strength, and direction of new information required to change beliefs, but it is likely to be a cumulative effect that challenges habitualized discourse dynamics (Gotsbachner, 2001), particularly as the reality of climate change that is experienced is not unmediated, but rather constructed within discourse (Teubert, 2010, p. 11).

Climate change discourses are situated and created through culture (Hulme, 2008a). Discrete discourses on climate change are evident in science, politics, and the mass media (Weingart, Engels, & Pansegrau, 2000), each with distinct geographies of production and consumption, and implications for the communication of climate change. Hulme (2008a) traces a history of climate change discourse, and identified contemporary discourses of fear, finding that public discourse on climate change used language of catastrophe, terror, danger, extinction, and collapse. And while discourse changes over space and time, Capstick (2012) has previously reported a high degree of continuity over time in the ways in which the public expresses perceptions of climate change within particular discourse.

When a belief is defined as rational or irrational, justified or unjustified, the judgement is not only on the belief but is also about the believer (Owens, 2003). This judgement can contribute to the polarization of climate change beliefs, where scientific understanding of climate change becomes subjectively entangled with personal identity (Kahan, 2015). This research also suggests that whether climate change *exists* is less important than whether an individual *believes* it exists and will have harmful effects. Thus beliefs could have greater emotion-sensitivity than knowledge (Frijda et al., 2000).

The practical importance of research examining public perceptions of climate change became clear when the link between belief in the reality, seriousness, and anthropogenic causation of climate change, and support for individual or collective action, was articulated (Bord, O'Connor, & Fisher, 2000; Vainio & Paloniemi, 2011). Belief has been shown to stimulate mitigative and adaptive action (e.g., Blennow & Persson, 2009) as well as the approval of the actions of others (Frijda et al., 2000). Adaptive and mitigative responses to climate change requires public awareness of climate change, perceptions of climate change as a risk, support for policy action, and knowledge of behavioral responses (O'Connor, Bord, & Fisher, 1999; Leiserowitz, 2006; Marx et al., 2007; Spence, Poortinga, Butler, & Pidgeon, 2011). This suggests that increasing belief in climate change could contribute to increased support for policy action and encourage low-carbon behavior change.

People with strong beliefs in climate change and its impacts perceive a higher risk of climate change (Saleh Safi, James Smith, & Liu, 2012). Similarly, Krosnick, Holbrook, Lowe, and Visser (2006) find evidence to suggest that belief in the seriousness of climate change can contribute to greater support for government mitigation policy. Belief in anthropogenic causation will play a key role in motivating engagement and action, and can predict pro-climate action (Vainio & Paloniemi, 2011). A positive association has been

date: 08 April 2018

reported between belief in climate change and engagement in climate-friendly behaviors (e.g., among forestry owners, Blennow & Persson, 2009) and key beliefs about climate change and engagement with political advocacy in the United States (Roser-Renouf, Maibach, Leiserowitz, & Zheo, 2010). It is important to note, however, that behavioral intentions are complex, and a simple dichotomy of believers and nonbelievers disguises a range of ambiguities related to support for action on climate change (O'Connor et al., 1999).

# A Brief Review of Factors that Contribute to Public Perceptions of Climate Change

In this section, some of the key factors that contribute to how people understand, and construct belief in, climate change, are reviewed. This section aims to highlight the key debates and literatures, which are then drawn upon in section three, where the geographies of climate change belief are elaborated.

date: 08 April 2018

## Sociocultural Connections and Worldviews

The notion of *cultural worldviews* originated with cultural theory (Douglas & Wildavsky, 1982), and early research on social perceptions saw the utility of this conceptualization in climate change perception research. Indeed, it has been suggested that cultural worldviews (e.g., hierarchicalism, egalitarianism, individualism) help to form individual and collective perceptions of risk in many domains (Kahan, Braman, Gastil, Slovic, & Mertz, 2007), including climate change. In this way, perceptions are likely to be congruent with and shared by members of the main in-group. This pattern can result in the rejection of contrary information, which may arise from a perceived "out-group." Kahan et al. (2007) refer to this process as "identity-protective cognition," protecting the status and self-esteem associated with group membership. In relating worldviews to risk perception, Kahan and colleagues (2007, 2010) use cultural cognition theory to examine the four cultural values across two dimensions: hierarchy-egalitarianism (hierarchy), and individualism-communitarianism (individualism).

In a study of residents of Beijing, China, Xue, Hine, Marks, Phillips, and Zhao (2016) report that participants with egalitarian and non-fatalist worldviews reported greater climate change risk perception, and support for climate change policies and mitigative behaviors. Participants who scored high on individualism, however, were less likely to support policies responding to climate change. Nevertheless, this was not mediated by climate change risk perception. Thus, Xue et al. (2016, p. 134) conclude that "cultural worldviews may influence policy support both directly and indirectly through risk perceptions." People with strong hierarchical and individual worldviews are less likely to believe climate change is occurring, while people higher in egalitarianism and communitarianism are more likely to believe climate change is occurring and that human actions are contributing to it (Kahan, Jenkins-Smith, & Braman, 2011). In related work, Tindall and Piggot (2015) consider the role of social ties and cultural milieu in determining climate change concern. Their research suggests that if an individual has social connections to a member of an environmental organization this will increase the likelihood of that individual planning to respond to climate change. They refer to this communication and social pressure as the "social influence" mechanism (Friedkin & Johnsen, 2011), by which members of environmental groups help to shape public perceptions of climate change.

## Knowledge

There are contrasting reports on the contribution increased climate knowledge has on climate change beliefs (Shi, Visschers, Siegrist, & Arvai, 2016). A range of studies have suggested that knowledge has limited effect on climate change beliefs and degrees of concern. But Shi et al. (2016) argue that this is reflective of typical measures in climate change studies; they found that knowledge about the causes of climate change relate to increased concern whereas knowledge of the physical impacts of climate change had

date: 08 April 2018

little or no impact upon climate change concern. Thus the content of knowledge is an important consideration in climate change research, along with the interactions between knowledge and other factors (e.g., cultural worldviews, Shi, Visschers, & Siegrist, 2015).

Different types of knowledge have been reported to result in different outcomes. For instance, causal knowledge is related to concern about climate change, as well as acceptance of policy measures (Shi et al., 2015). Action-related knowledge can stimulate behavior change, whereas result-related knowledge (e.g., "for the next decades, the majority of climate scientists expect an increase in extreme events") negatively impacts willingness to change behaviors (Shi et al., 2015). It has been shown that causal knowledge of climate change (e.g., "climate change is mainly caused by human actions"), as opposed to general science knowledge (e.g., "$CO_2$ is a greenhouse gas") or action-related knowledge (e.g., "Turning off electric appliances when they're not being used can save energy"), relates to belief in climate change and behavioral intentions to mitigate against its effects (Bord, O'Connor, & Fisher, 2000; Shi et al., 2015). A study of the Swiss public found that while the public held misconceptions about climate change, knowledge relating to $CO_2$ had increased from earlier research (Tobler et al., 2012). Moreover, it has been suggested that knowledge of climate change can increase public concern independent of cultural worldviews (Shi et al., 2015).

Walsh and Tsurusaki (2014) argue that sociocultural learning theories can inform climate change education that supports understanding and concern about climate change. They also suggest that social controversies such as climate change can present unique learning opportunities through which the public can "increase their proficiency in important scientific practices and develop a greater understanding of how science relates to societal concerns" (Walsh & Tsurusaki, 2014, p. 262). Nevertheless, while appreciating the importance of alternative ways of knowing, whether or not people "believe" in climate change "doesn't measure what they know; it expresses who they are" (Kahan, 2015, p. 24).

## Politics and Political Ideologies

The politicization of climate change in countries of the Global North and increasingly countries of the Global South (see, e.g., Takahashi & Meisner, 2011; Lo, 2015) has contributed to alignment between public-political positioning and climate change beliefs. This has been particularly pronounced and well-documented in the United States (e.g., Weber & Stern, 2011; McCright & Dunlap, 2011B). McCright and Dunlap (2011A) provide a chronological journey through significant events including the 1990s work of the fossil fuel industry to debunk climate science, the Republican Revolution, the role of climate change in U.S. electoral processes, and the disintegration of climate change from the public agenda following 9/11 and the so-called war on terror. The interplay between political leaders, big (fossil fuel) business, and the mass media is significant, particularly in the United States, and the politicization of climate change and the divide between the Left and Right (e.g., Fielding, Head, Laffan, Western, & Hoegh-Guldberg, 2012) has

date: 08 April 2018

stimulated much academic interest in the implications of this for public belief in and concern about climate change (McCright & Dunlap, 2011A, 2011B; Hamilton, 2011; Hamilton & Stampone, 2013).

In the United States, since the late 1990s, public opinion has become increasingly polarized along political party lines (Weber & Stern, 2011). In 1997, the percentage of respondents perceiving the "effects of global warming to have already begun" was 52% for Democrats and 48% for Republicans. By 2010 this widened to 66% for Democrats and 32% for Republicans (McCright & Dunlap, 2011A). Drawing from 10 nationally-representative Gallup Polls from 2001 to 2010, McCright and Dunlap (2011A) report increasing ideological and partisan polarization in American climate change beliefs over the decade, with evidence of liberals and Democrats displaying greater concern about climate change than conservatives and Republicans. A "conservative, white male" effect was also identified, whereby conservative white males are more likely to take a position of climate change denial than other adults (McCright & Dunlap, 2011B).

Table 1. Changes in attitudes about global warming, 2015–2016, by political party identification.

|  | 2015 (%) | 2016 (%) | Change (% points) |
| --- | --- | --- | --- |
| Worried a great deal/fair amount about global warming |  |  |  |
| Republicans | 31 | 40 | +9 |
| Independents | 55 | 64 | +9 |
| Democrats | 78 | 84 | +6 |
| The effects of global warming have already begun |  |  |  |
| Republicans | 36 | 40 | +4 |
| Independents | 55 | 55 | 0 |
| Democrats | 72 | 77 | +5 |
| It will pose a serious threat to you in your lifetime |  |  |  |
| Republicans | 18 | 20 | +2 |
| Independents | 37 | 43 | +6 |

date: 08 April 2018

| | | | |
|---|---|---|---|
| Democrats | 53 | 58 | +5 |
| Increased temperatures are due to human activities | | | |
| Republican | 34 | 38 | +4 |
| Independents | 56 | 68 | +12 |
| Democrats | 74 | 85 | +11 |
| *Source*: Saad and Jones (2016). | | | |

Nevertheless, there is evidence to suggest that, across a number of points and among three political identities in the United States (Republican, Independent, and Democrat), concern about global warming is increasing (Saad & Jones, 2016, Table 1). Saad and Jones (2016) find that, to varying degrees, political partisans from all three groups are increasingly likely to perceive global warming to be anthropogenic, to have already begun, to pose a serious threat in the near term ("in your lifetime"), and to report being worried a great deal or a fair amount. Nevertheless, Republican respondents are still less likely to take these positions than Independents or Democrats; Table 1 shows that agreement that increased temperatures are due to human activities is at 85% for Democrats, 68% for Independents, and just 38% for Republicans. The degree of worry follows the same trend.

In a study of 32 countries, Zhou (2015) find that political orientation has a significant effect on environmental skepticism. For instance, political conservatives espoused greater levels of skepticism than liberals. Across a spectrum of political orientations, Zhou (2015, p. 75) report that "conservatives are most skeptical, followed by politically apathetic individuals and those with other leanings, while liberals are least skeptical." This finding confirms the importance of political ideologies beyond the United States. Similarly, research from Mostafa (2017) in six Islamic nations (Turkey, Egypt, Morocco, Jordan, Indonesia, and Malaysia), suggest that political orientation and religiosity are influential in determining public perceptions. Indeed, Mostafa (2017, p. 72) suggests that "the fact that political left orientation is positively linked to concern for global warming . . . might be explained by the fact that political ideologies are nowadays increasingly dispersed through globalization."

date: 08 April 2018

## Experiential Climate Change

Experiential learning has been shown to be an important feature in constructing beliefs of climate change (Myers, Maibach, Roser-Renouf, Akerlof, & Leiserowitz, 2013). It has been argued that slow action to mitigate climate change is the result of insufficient first-hand experiences of potential consequences (e.g., sea level rise, heat waves, etc.) (Spence, Poortinga, Butler, & Pidgeon, 2011). The impact weather can have on belief in climate change relates both to experiences of extreme events, or perceived climatic changes that may be interpreted as evidence for or against climate change (e.g., Brulle, Carmichael, & Jenkins, 2012; Hopkins, 2013), but also the role of day-of-surveying biases whereby the weather around the point of interview can contribute to different given responses (e.g., Hamilton & Stampone, 2013).

The proximization hypothesis suggests that increasing public willingness to take action and to support climate policy requires a perception that climate change is close in space and time. However, proximization is more complex than originally suggested, and it may result in positive effects, neutral effects, or negative effects (Brügger, Dessai, Devine-Wright, Morton, & Pidgeon, 2015). In other words, dependent on individual characteristics, highlighting proximal impacts of climate change may or may not result in increased belief in or concern about climate change. Interestingly, Hamilton and Stampone (2013) find that the effect of short-term weather on belief in anthropogenic climate change was most significant among individuals who identify as politically independent, rather than aligned with a political party.

In the United Kingdom there is a large body of research examining the effects of experiences of extreme events (e.g., flooding, drought) on perceptions of climate change. Spence et al. (2011) find that experiences of flooding in the United Kingdom contribute to greater climate change concern, with less uncertainty and perceptions that personal actions can contribute to climate change mitigation. Whitmarsh (2008) conducted a survey and interviews in the south of England and reported little difference between flood victims and unaffected participants. Experiences of air pollution, on the other hand, were reported to have a greater effect on perceptions of and behavioral responses to climate change (Whitmarsh, 2008). Reser, Bradley, and Ellul (2014), however, stress that while in many cases experience of climatic events can foster a more meaningful and contextualized understanding of climate change, "the nature and contexts of individual climate change encounters, the clarity of the constructs and validity of the measures being used for 'belief' and 'experience', and the transactional and phenomenological nature of climate change encounters" (p. 521) are often overlooked by simplified notions of "seeing" and "believing."

## Additional Country-Specific Factors

date: 08 April 2018

Country-specific factors including national prosperity (Schultz & Zelezny, 2003; Kemmelmeier, Krol, & Kim, 2002; Franzen & Meyer, 2010), media reporting (Brulle et al., 2012; Dumitrescu & Mughan, 2010), and political action (Brulle et al., 2012; Lorenzoni, Nicholson-Cole, & Whitmarsh, 2007) are reported to contribute to public concern about climate change (Shi et al., 2015). Despite this, there is also evidence of high-variances of climate change perceptions within the same country (e.g., Whitmarsh, 2011; Smith & Leiserowitz, 2012; Howe, Mildenberger, Marlon, & Leiserowitz, 2015). These differences were mapped for the United States to the county level by Howe et al. (2015), who find that the 63% national average of belief that climate change is occurring disguises high variability at the local level. Their study shows county-level estimates of climate change belief to range between 43% and 80%. This finding highlights the wide- ranging context in which climate communication and policy is received, enacted, or developed. This is important for many reasons, including the need for differentiated climate communication and context-specific policymaking. Moreover, there has been a move to examine engagement with different identities, moving beyond nationality; Running (2013) proposes "global citizen," "national citizen," "local community member," and "autonomous individual" as four ways through which attachment to place and climate concern can be examined that might better reflect the communication required to increase concern for climate change.

# Temporal and Spatial Variability in Climate Change Belief

Early work on the social dimensions of climate change traces back to the early 1990s (Jaeger, Dürrenberger, Kastenholz, & Truffer, 1993, Batterbury, 2008). While traditional studies examining climate change beliefs originated from psychology, there has been a growth in interest from other disciplines, including geography, anthropology, and history, which have often called for more grounded, place-based, localized research (e.g., Slocum, 2004; Hulme, 2008b; Bailey, 2008). It has been claimed that national and global polls can "lack the contextual information on what is happening in each country that might shed light on [their] outcomes" (Brechin, 2003, p. 121). Perhaps in response to this, detailed case studies that take the local contexts and realities seriously are becoming increasingly common (e.g., Patt & Schröter, 2008; Tucker, Eakin, & Castellanos, 2010; Bunce, Rosendo, & Brown, 2010; Hopkins, 2013; see Wolf & Moser, 2011, for a detailed review). Nevertheless, these, often small-scale, studies do not easily facilitate comparisons among countries, and are less able to provide an overview of public opinion about national mitigation and adaptation policies. Moreover, it has been argued that important methodological information (e.g., researcher positionality, social positions of key informants, etc.) can be lacking from qualitative research publications on global environmental change (Nielsen &

date: 08 April 2018

D'haen, 2014). Thus, in order to understand the complexities of social perceptions of climate change, a range of research approaches and methods are valuable.

Research in countries of the Global South often focuses on community and household-scale adaptation to climate events (e.g., Jones & Boyd, 2011; Piya, Maharjan, & Joshi, 2013), frequently in a livelihoods context (e.g., Bunce et al., 2010; Islam, Sallu, Hubacek, & Paavola, 2014). This may be due to the threat climate change poses to communities relying on the climate for livelihood purposes (Lavrillier, 2013), particularly agriculturally dependent countries. Six continental regions are used here to examine national-scale climate change beliefs. The review is not exhaustive but rather indicative of the types of research dominating the field in these geographic regions. Research emerging from the Global South, and using qualitative, place-based approaches, has been purposely over-sampled in the review, and thus no claims are made relating to quantum of studies. Where possible, insights from large-scale national surveys have been coupled with small-scale, qualitative research findings.

## North America

Public perceptions of climate change vary across space and time. Recent research has suggested that temporal variability is affected by broad socioeconomic, political, and cultural shifts as well as physical phenomena (Capstick, Whitmarsh, Poortinga, Pidgeon, & Upham, 2015A). For instance, Scruggs and Benegal (2012) note the importance of the global financial crisis and subsequent recession, and poor labor market conditions, to explain a decline in the American public's concern about climate change. However, some of the earliest surveys of public concern about climate change in the United States date to the 1980s, and report an increase through that decade from 10% of people believing that the "greenhouse effect" is a "very serious problem," to 40% in 1989 (Dunlap, 1991). In the same study, 63% of Americans reported being greatly worried about global warming (Leiserowitz, 2005). This figure reduced to 50% in 1997/8, increased to 72% in 2000, and declined again in 2002 to 58% (Brewer, 2003; Saad & Jones, 2016). Concern peaked again in 2008, at 66%, before declining to 51% in 2011. In 2016, 64% of Americans worry a great deal or fair amount about climate change. There is less variability in the perceived causes of climate change, but current perceptions place belief of human causation at its highest rate in 15 years, at 65% (Saad & Jones, 2016).

Leiserowitz and colleagues at the Yale Project on Climate Change Communication have been instrumental in the development of research into public perceptions of climate change and climate risk, particularly in the United States, but also globally. Their work on "Global Warming's Six Americas" provided evidence of distinct types of public perceptions of climate change, which go beyond "belief" and "denial" (Leiserowitz et al., 2008; Maibach, Roser-Renouf, & Leiserowitz, 2009; Leiserowitz et al., 2013). This segmentation of the U.S. population, while still reliant on broad generalizations, provides

date: 08 April 2018

a more nuanced view of climate change belief, and may better inform climate change communication campaigns with targeted information for specific audiences.

date: 08 April 2018

## Europe

Across Europe, there is a long tradition of research examining climate change belief and broader perceptions of climate risk and policy responses (e.g., Darier & Schüle, 1999). This research dates at least as far back as 1991, when Löfstedt examined perceptions of climate change in the Swedish town of Umeå. A random sample of 100 Umeå residents participated in a telephone interview, and the findings suggest high awareness of the *greenhouse effect*, but low awareness of causes, consequences, and mitigative actions (Löfstedt, 1991).

Over the intervening 25 years, numerous studies and polls of public beliefs about climate change have since been conducted across the continent. In general, these studies reveal high awareness of and concern about the issue, though heterogeneity across countries and groups does exist. In the United Kingdom, for example, more than 99% of the surveyed population had heard of climate change and 56% of respondents who were aware of climate change stated that they know "a fair amount" about it, 10% reported knowing "a lot," and 29% know "just a little" (Whitmarsh, Seyfang, & O'Neill,. 2011). A separate series of surveys from 2005 (Poortinga et al., 2006) to 2014 (Capstick et al., 2015B) indicate an increase in British citizens' concern about climate change between the surveys in 2013 and 2014, but still lower levels of concern across the nine-year period. Moreover, Capstick et al. (2015B) find a decline in the number of respondents who stated they were very concerned about climate change, from 44% in 2005, to 28% in 2010, and 18% in 2014.

From 2005 to 2010, there was a reported increase in the number of people in the United Kingdom stating that the world's climate is not changing, from 4 to 15% (Corner et al., 2011), with similar trends also reported for Germany (Ratter, Philipp, & van Storch, 2012). Indeed, three cross-Europe surveys conducted in 2008 and 2009 report declines in the perceived seriousness of climate change (Eurobarometer, 2009). Studies in the United Kingdom have also provided evidence to suggest that climate change also has relatively low salience. This was reported by Lorenzoni, Nicholson-Cole, and Whitmarsh (2007) in their study of a sample of residents in Norwich, with climate change on the average ranking 8th most important to personal life of 12 environmental problems. In a European Union–wide survey, climate change was identified as the single most serious problem by 20%, behind poverty, hunger, and lack of drinking water (28%), for the world, and 51% identified climate change as "one of the world's most serious problems," with a seriousness rating of 7.5 on a ten-point scale (European Commission, 2011).

More nuanced insights of climate change beliefs are depicted by Norgaard (2011), who uses ethnographical and interview data collected over 12 months while living in a rural community in western Norway from 2000–2001 to examine discourses of denial. This work highlights that elevated levels of knowledge about climate change and high levels of articulated concern are not sufficient to motivate engagement with climate change. Moreover, localized weather events with financial impacts on the local community (from

date: 08 April 2018

the delayed opening of a local ski area) did not result in action on climate change. Norgaard identifies this set of findings as reflecting a social organization of denial that kept climate change information "at arms" length" (2006). In their analysis of German discourses on climate change, Weingart, Engels, and Pansegrau (2000, p. 280) report that "scientists politicized the issue, politicians reduced the scientific complexities and uncertainties to $CO_2$ emissions reduction targets, and the media ignored the uncertainties and transformed them into a sequence of events leading to catastrophe and requiring immediate action," depicting the competing frames of climate change used in climate change communication.

## Central and South America

Very little empirical research has been conducted exploring climate change beliefs in the countries of Central and South America. To date, most published literature has been on a localized scale, offering a depth of place- and time-specific insights, valuable for the development of targeted communication and policy development, but less so for temporal or spatial comparability. For example, Paerregaard's (2013) research in Peru drew from anthropological traditions to show how climate change intersects with a range of other political, economic, and cultural changes being experienced by people in the Peruvian Andes. Importantly, this research presents evidence of an evolving worldview that situates human and nonhuman actors as co-habiting the earth. Paerregaard finds incongruence between competing worldviews, particularly as they relate to environmental change. A prevailing universal/particular paradigm dominates local understandings of the human-environment: "a realm of non-human beings superior to humans but nonetheless sensitive to their needs constitutes the universal" (p. 301).

Interestingly, Paerregaard (2013) provides evidence of climate change skepticism in Peru for reasons that differ substantially from skepticism in countries of the Global North:

> Andean people's reluctance to acknowledge that climate change is the outcome of human activities is based on a belief that nature and culture are inextricably tied together and that non-human forces play a critical role in the development of modern society. Their scepticism toward the global discourse on climate change is therefore based on a general critique of globalization and modernity which place them in a very different position, morally as well as politically, than climate skeptics in the developed world.

> (Paerregaard, 2013, p. 303)

This work is significant in raising awareness of the highly cultural and historically situated lens through which climate change discourses can be constructed or deconstructed.

date: 08 April 2018

## Geographies of Climate Change Belief

In Central America, Vignola, Klinsky, Tam, and McDaniels (2013) draw findings from a nationally representative sample ($n$ = 1,473) to examine public perceptions of climate change in Costa Rica. Nearly 60% of respondents were very concerned about climate change, and over 85% were either concerned or very concerned. Their research also indicates a strong belief that "humans are responsible for climate change," with 91.6% of respondents agreeing with this statement. Nevertheless, Vignola et al. (2013, p. 310) suggest that "human responsibility may be nested within larger constructs," because 75.6% also agreed that "climate change happens through the will of God." And while this translated into support for action, climate change was identified as the most important topic for discussion in the country by just 10.9% of respondents, below education (43.6%) and public safety (19.4%).

## Africa

African voices are often absent from international climate change discourse (Godfrey, Le Roux-Rutledge, Cooke, & Burton, 2010). Yet a high level of support for general environmental protection in low-income African countries has been reported (Israel, 2004), and "climate change is already determining the course of people's lives" in Africa (Godfrey et al., 2010). Research on climate change perceptions on the continent of Africa have often focused on rural or agricultural communities (e.g., Maddison, 2007; Patt & Schröter, 2008), largely due to their reliance on the local climate and agriculture-dependent economies (Godfrey et al., 2010). Public awareness of climate change terminology is often higher in urban centers; however, concepts are often misunderstood: for instance, the word *climate* is often not easily translatable into many local African languages (Godfrey et al., 2010).

Adelekan and Gbadegesin (2005) surveyed 453 residents of Ibadan, Nigeria. Sixty-four percent of their sample identify climate as a major factor affecting their socioeconomic activities, which could signify the importance of agriculture for local people and the national economy. There was a strong perception that the local climate was changing (91.6%), characterized by warmer climate (58%), a reduction in "rain days" (70%), and reductions in rainfall amounts (59.8%). Their study indicates awareness of the terms *global climate change* (68.7%), *greenhouse gases* (52.8%), and *global warming* (50.6%); however, the most oft-cited reason[2] for the changing climate (38.6%) was religious and superstitious reasons including "sin," "the world is coming to an end," "act of God," "delayed rainfall caused by witchdoctors," "due to shift from traditional worship," and "act of God due to man's activities" (Adelekan & Gbadegesin, 2005). Just 12.1% of the sample identify anthropogenic climate forcing.

Religiosity has emerged as a particularly important feature for many African countries (Godfrey et al., 2010), as well as across South America and Asia (e.g., Lavrillier, 2013; Mostafa, 2017). Religiosity can compete with science over "moral, epistemological, and ontological issues" (Gauchat, 2012, p. 171) and, consequently, religious individuals may

date: 08 April 2018

have lower levels of confidence in science (Gauchat, 2012), and often report skepticism over the authenticity of environmental risks (Leiserowitz, 2005). The importance of religious institutions suggests that faith leaders could be important actors in the communication of climate change in many African countries (Godfrey et al., 2010).

Asiyanbi (2015) contribute to the social perceptions literature through an examination of the climate change perceptions of the corporate middle class in Africa's second largest megacity, Lagos, Nigeria. From 104 respondents to an online survey, and 8 follow-up telephone interviews, Asiyanbi notes high awareness about climate change, with just over half reporting feeling "somewhat informed" and 24% identifying as "very well informed." These findings represent higher awareness than previously reported for general populations in Nigerian cities (e.g., Adelekan & Gbadegesin, 2005), potentially a feature of the highly educated sample (i.e., corporate middle class). Asiyanbi (2015) also finds climate change to be perceived as a risk to people in Nigeria (81%); however, when compared to other social and environmental problems, the percentage of respondents very concerned about climate change was just 33% compared to 81% for crime, 80% for political violence, and 63% for air pollution. Climate change ranked 17th out of 18 items in terms of concern. Nonetheless, the number of respondents "fairly concerned" was greater than for any other problem. This indicates a level of concern but highlights the way climate change competes with other more tangible and proximal issues for attention.

Many studies highlight the place-specific experiences of climate change in countries of the Global South. Using focus group and interview methods with 91 respondents across Tanzania and Mozambique, Bunce et al. (2010) find that climate variability and/or change is perceived as a clear threat to local livelihoods across both countries. Climate stressors interact with other non-climatic stressors (e.g., food and fuel prices, health and disease) to exacerbate vulnerability that was perceived by the respondents to be worsening. This finding was reiterated by Godfrey et al.'s (2010) research across ten African countries (Senegal, Ghana, Nigeria, Sudan, Ethiopia, Uganda, Kenya, DR Congo, Tanzania, and South Africa), with participants identifying crop failure, loss of livestock, food scarcity, and illness as concerns associated with the impacts of climate change.

date: 08 April 2018

## Asia

There is a growing body of literature on climate change beliefs across Asian countries. As with South America, much of the empirical research in Asian countries is qualitative in nature, acknowledging unique cultural determinants of climate change belief. Using semi-structured interviews across six villages in Eastern Tibet ($N = 90$), Byg and Salick (2009) find that all participants perceived changes related to climate change, yet reported large variations in perceptions of climatic changes and impacts even across small geographic areas. In general, however, experiences of declining amounts of snow and rain, reductions in the snowy season, glacial retreat, increased temperatures, and subsequent effects on agriculture (e.g., early planting and harvesting, crop yields, crop diseases) were reported. The causes of climate change were reported to be material (e.g., direct cause and effect: "decline in rainfall was due to tree felling" [p. 161]) and/or spiritual (e.g., the violation of taboos). Some participants attributed climate change to a combination of both material and spiritual causes, "for example, pollution by tourists was, in addition to its heat absorbing effect, also said to anger the mountain deities who therefore brought on climate change" (Byg & Salick, 2009, p. 161).

A 2004 survey conducted in Siberia found high levels of concern about local climate change (Crate, 2008), which threatened subsistence lifestyles. The research reports that concerns about climate change relate to the "sense of place" that is being threatened by warmer temperatures. It importantly shows that oft-framed "opportunities" from climate change that point to warming in northern latitudes are, in fact, overlooking the connectedness between climate and conceptualizations of home for people of these regions:

> One of the arguments of misinformed critics who deny urgency to act on global climate change is that Northern peoples are probably happy that their home temperatures are not so cold. This view is naive. Humans live in and thereby learn a sense of place in a homeland regardless of its physical conditions. They may grow to prefer different conditions, but their sense of place and perception of home are bound to the places where they spent their formative years. This is clear with Viliui Sakha elders, who often joke that the softening climate will bring them relief but in fact are fully aware that the climate regime their ancestors were used to is key to perpetuation of the subsistence of their people and the survival of local flora and fauna.

> (Crate, 2008, p. 580)

Lavrillier (2013) report that in Siberia, local people "see climate change as creating a major dysfunction of the environment that may lead to the impossibility of exploiting it with traditional economics" (p. 269) and find that climate change can either directly or indirectly contribute to the transformation of some important cultural rituals and the emergence of new practices. Lavrillier's paper reports on eight years of fieldwork

date: 08 April 2018

between 1994 and 2010 among Tungusic peoples in Yakutia, Kamchatka, and the regions of Amur and Khabarovsk in Siberia. Thus it presents unique place- and people-specific insights to the local perceptions and experiences of climate change, with Lavrillier stating that "the Tungus are very well placed to observe shifts in climate and the environment because their diverse economies depend on wild and domestic fauna, flora and the land" (p. 262). The research finds evidence of perceived climate change over several decades, with acceleration since the mid-2000s. This was particularly associated with warmer temperatures, and the reduced duration of the coldest period of the year. Similar to reports in other regions, climate change is perceived by the Tungusic people to be "signs from the spiritual entities" (p. 264). In terms of responses, Lavrillier suggests that "climate change may give rise to major modifications in the perception of people concerning the environment and of their economic and religious relationship with it" (p. 261).

In China, Lo (2015) examines the unique political context and particularly the political ambiguity in Chinese discourses on climate change using a Q methodology approach. Three key discourses were uncovered; prosaic environmentalism, cooperative economic optimism, and actor skepticism. These discourses were differentiated by degrees of concern about climate change and perceived agency by way of responses. And while Lo points to a constrained public sphere by way of explanation for the omission of a critical climate change discourse, it is argued that activism and informal political participation in China is linked to active Internet use, and therefore more critical discourses may emerge from social groups who actively engage in online communications.

In Indonesia, high levels of belief in climate change, and perceptions of risk, have been reported. Bohensky, Smajgl, and Brewer (2013) present a large-scale survey of 6,310 households in two Indonesian regions and propose four steps of engagement with climate change: (1) observation, (2) risk perception, (3) reactive action, and (4) proactive action. They report a sequence pattern whereby each step was preceded by previous steps in 89.5% of households. Their study also shows that 81.9% of households had observed climate change, 70.7% perceived climate change as a risk, 38.9% were taking reactive action, and 28.2% were taking proactive action. Nevertheless, these findings may overlook some local and regional nuances. Indonesia and Malaysia were included in Mostafa's (2017) study of six countries with an Islamic majority population, and reports a positive relationship between religiosity and concern for climate change, leading the author to note "religious service leaders or 'influentials' should work with opinion leaders or 'legitimizers' in order to promote pro-environmental behaviors by making biospheric values more salient" (p. 72).

In India, public understandings of climate change are particularly important given the rapid growth in carbon dioxide emissions (PBL Netherlands Environmental Assessment Agency, 2016), and the vulnerability of large proportions of the population to extreme weather events. A study of 4,031 Indian adults (Thacker & Leiserowitz, 2012) finds high levels of belief that "global warming is happening" (72%), with the greatest levels of support from participants with higher educational attainment, and greatest uncertainty

date: 08 April 2018

from non-literate participants. Over half of the sample (56%) believes that mostly human activities were causing climate change, and 31% perceived mostly natural causes. A study of Indian climate policy elites (e.g., scientists, energy policy experts, government officials) concludes that "the primary shift in climate change discourses in India has been from a frame that externalized the climate change problem and solutions towards a 'co-benefits' approach, where policies aim to align climate change with domestic priorities of poverty alleviation and economic growth" (Thacker & Leiserowitz, 2014, p. 115).

## Australasia

The Australasia region is interesting insomuch as it includes developed and developing economies, a range of climatic zones, and a heterogeneous forecast for future climate impacts as well as variability in public beliefs about climate change. It has been reported that New Zealanders are broadly ambivalent toward climate change (Hopkins, Campbell-Hunt, Carter, Higham, & Rosin, 2015). Perhaps the earliest study of public perceptions of climate change draws from a survey of over 1,000 New Zealanders from 1990 (Bell, 1994). Bell reports high awareness of climate change, with 96% of the survey respondents having heard of "the greenhouse effect." Yet the causes of climate change were largely unknown by the survey respondents. More recent research has suggested that approximately half of the New Zealand population is seriously concerned about climate change (Horizon Research, 2014), and climate change is perceived to be an urgent "problem for now" (Horizon Poll, 2012; Horizon Research, 2014). New Zealanders appear to conceive climate change as a global rather than national concern (Hughey, Kerr, & Cullen, 2013), and there is evidence to suggest that New Zealanders perceive other countries to be responsible for action. There appears to be ongoing uncertainty around causality of climate change and the role of human attribution (Sibley & Kurz, 2013).

A longitudinal survey of Australians between 2010 and 2014 ($n$ = 17,493 across all five surveys, 4,999 completed two or more, 269 completed all five surveys) finds stable aggregated levels of opinion across the time frame. On average, 45.9% believe climate change is occurring, with anthropogenic causation, and 38.6% believe that the climate is changing due to natural fluctuations, 7.9% don't think the climate is changing, and 7.7% reported not knowing. The percentage of agreement that climate change is happening varied from 79.9% in 2010, to 76.6% in 2014. The 2011 Garnaut Climate Change Review analyzed 22 studies on Australians' views on climate change and found wide variations in the percentage of people who believe climate change is happening, from 83% to 53%, noting the effect of wording on question responses (Leviston et al., 2011). The percentage of Australians believing that climate change is happening and in anthropogenic causation declined in the three years from 2008 to 2010 (Leviston et al., 2011).

For islands of the South Pacific, the impacts of climate change are similar to those of other small island developing states (SIDS). However, the comparative size, remoteness, and archipelagic character of these islands can further exacerbate these risks (Nunn,

date: 08 April 2018

2009). Several studies have examined awareness and adaptability in the South Pacific, stressing the importance of awareness and local knowledge to increase adaptive capacity (e.g., McNamara & Prasad, 2014; McNamara, 2013), and earlier research has suggested that in the Pacific Islands, climate change is often viewed as a foreign construct that victimizes people of the Pacific Islands (Nunn, 2009). While the work of McNamara (2013) draws from a focus group with climate change practitioners rather than the public, it highlights the importance of making local sense of climate change in order to raise awareness to climate risks for Pacific Islands. McNamara also highlights the very different experiences and contexts across the Pacific Islands (e.g., Fiji, Kiribati, Solomon Islands, Tuvalu, and Vanuatu). Differences include the degrees to which the countries are reliant on natural resources, local cultures, overall levels of (perceived or experienced) vulnerability, and elevation. This research underscores the types of regional differences that can contribute to wide variance in perceptions of climate risk, and nuanced variations that need to be accounted for in climate change communication and the need for greater awareness-based activities as a component of adaptation planning.

Interviews conducted in two communities in the Rewa Delta, Fiji (Lata & Nunn, 2012) also reports substantial variation in awareness of climate change and human attribution. In the Vutia community, for instance, 50% had not heard of climate change; however, this was much lower, at 12.5%, in the Nausori community. The two communities differ in terms of population size, ethnic diversity, and transport connections, which may contribute to these large variances in knowledge of climate change. The majority of participants in both communities identified "divine will" as the cause of climate change. The Pacific Islands' strong Christian belief has been recognized as a barrier to climate action (Nunn, 2009). Furthermore, misinformation on climate change in the Pacific Islands has been associated with local media reporting of disaster narratives and extreme climate predictions (Nunn, 2009). To overcome this, Nunn (2009) highlights a number of locally relevant ways of communicating climate change to people of the South Pacific, including culturally relevant information sheets and community events.

# The Growth of Comparative Studies

There is a strong interest in comparative studies that examine cross-cultural climate change perceptions. However, for a variety of reasons, this has been largely limited to regional studies (e.g., EU—Eurobarometer, 2009) and the replication of established surveys in different countries (e.g., Spence, Venables, Pidgeon, Poortinga, & Demski, 2010 and Reser, Bradley, Glendon, Ellul, & Callaghan, 2012 with a UK survey replicated in Australia; the Hagen, Middel, & Pijawka, 2016 survey across Germany, Spain, the Netherlands, and the United Kingdom).

date: 08 April 2018

## Geographies of Climate Change Belief

In a comparative study between Britain and Australia strong similarities in climate change perceptions were articulated. Reser et al. (2012) reports that 74% of Australian respondents and 78% of British respondents believe "that the world's climate is changing," and 8% in both countries report "not knowing." They also note high levels of belief in human attribution, with 90% of Australian respondents and 89% of British respondents believing that "human activities were playing a causal role in climate change" (p. 12). Kvaløy, Finseraas, and Listhaug (2012) draw from the 2005–2009 world values survey to examine concern for global warming across 47 countries. After ranking these countries by mean values of concern for global warming, the authors reported no clear relationship between GDP per capita and concern for global warming.

Crona, Wutich, Brewis, and Gartin (2013) provide a comparative study of diverse rural (e.g., indigenous Fijian village) and urban (e.g., central London) sites in six countries: Fiji, Ecuador, New Zealand, Australia, United Kingdom, and the United States, adopting a non-probabilistic, purposive sampling designed to capture only local residents. Their research examined "if people within specific and diverse places share ideas about global climate change" (p. 519). Thus, through this multisite study, the authors highlight the "cultural knowledge" of climate change and find high levels of agreement in terms of the causes, signs, and consequences of climate change. Across all six sites, 90% of respondents agreed that pollution causes climate change, ranging from 93% in the United Kingdom to 86% in Ecuador. Crona et al. (2013) suggest that cultural consensus analysis can complement localized place-based studies of perceptions of climate change. This analysis allows for the identification of cross-cultural patterns in climate change conceptualizations. Therefore, they argue, their research "illustrates how comparative studies provide a way of linking perceptions at both local and global scales which can be important given the pervasive character of climate change and the growing demand for mitigation at both global and local levels" (p. 529).

Howe, Markowitz, Lee, Ko, and Leiserowitz (2013) conducted a large-scale comparative analysis to examine the relationship between subjective, personal experiences of climate change and perception of climate change in 89 countries (n = 91,073) across Africa, the Americas, Asia, and Europe in 2007–2008. They find that average annual national and local temperature anomalies were a significant predictor of perceptions of local warming, when both demographic differences and seasonal effects were controlled. The season during which the survey was conducted (i.e., warm or cool season) was also important; during months where the mean temperature was higher than the annual mean, respondents were 11–19% more likely to perceive increases in average temperatures than respondents surveyed during the cool season. A similar effect was found during the dry season, with respondents 10% more likely to report increases in average temperatures than those surveyed during the wet season. Howe et al. (2013) suggest that as local average temperatures increase with climate change, individuals may detect these changes through personal experience, as they appear to be detecting these changes with some accuracy.

date: 08 April 2018

## Geographies of Climate Change Belief

In 2015, Lee, Markowitz, Howe, Ko, and Leiserowitz published a study of 119 countries around the globe, providing one of the most comprehensive analyses of global perceptions of climate change, allowing for the first time a clear picture of how climate change perceptions (belief and risk perception) differ between countries. They find highly varied climate change awareness and risk perception in countries globally. Perhaps to be expected, countries of the Global North presented the highest levels of awareness, at over 90%. In countries including Egypt, Bangladesh, Nigeria, and India, on the other hand, over 65% of respondents had never heard of climate change (the data were collected in 2007–2008). Thus awareness of climate change is highly unevenly distributed across the globe. Yet of those aware of climate change, respondents from countries of the Global South were more likely to perceive climate change as a threat to them and their families. Lee et al. (2015) also report predictors of climate change risk perceptions and again found differences between countries. Globally, education level and belief about the cause of climate change were top-ranked predictors of climate change awareness and risk perception. The authors argue that "investing in primary and secondary education may be an effective tool to increase awareness and risk perceptions of climate change" (p. 1017).

Perhaps what emerges most clearly from this multidisciplinary and multi-scale body of research is the difficulty in integrating the unique and place-specific insights of climate change belief that develop out of qualitative research approaches with these large-scale surveys. Nationally representative samples provide an indication of population-scale perceptions of climate change, but this approach generalizes across populations and can overlook individual or social group nuances (Wolf & Moser, 2011). Similarly, nationality presents one approach to understanding the climate change beliefs of a particular group, based on collective experiences, understandings, and values (Running, 2013); yet a number of other approaches have also been used to examine societal subgroups, for instance by recreational activity or industry (e.g., Hopkins, 2013), and this approach has frequently been adopted in countries of the Global South (e.g., Tucker, Eakin, & Castellanos, 2010).

## An Industry Population-Based Approach

Generalized population studies are useful for presenting aggregated perceptions, but more specific population characteristics offer alternative insights. Attention is now turned to the volume of literature pertaining to the perceptions and beliefs of farmers, a group with similar attributes, but that exists across spatial scales and experiences place and environment in localized ways. This literature is of interest for several reasons; first, farmers have received attention on a highly localized, place-specific basis, providing volumes of both quantitative and qualitative empirical material unavailable in many other contexts. Second, research into farmers is not geographically bounded, and it appears to be less biased toward countries of the Global North, offering unique qualitative insights

date: 08 April 2018

to climate change beliefs in the Global South, which are so frequently missed by nationally representative survey research.

Countries in sub-Saharan Africa are argued to be particularly vulnerable to climate change due to dependence on agriculture (Bryan et al., 2013) and relatively low adaptive capacity. In these communities, Bryan et al. (2013) find strong perceptions of increased average temperatures and decreased average precipitation over the past 20 years, and concluded that observation over time influences farmers' perceptions of climate change. Maddison (2007) explores the perceptions of climate change in Africa, with a specific focus on agriculturalists across 11 African countries. The purpose of the research was to examine the responses and adaptability of African farmers to climate change. Maddison finds spatial clustering of climate change perceptions whereby neighboring farmers told consistent stories of change, an important indication of social network dynamics. Maddison also reports perceptions of climatic change increasing with experience, and significant belief that temperatures had increased and precipitation declined.

Of the 84 farmers surveyed by Patt and Schröter (2008) in Mozambique, major changes in the climate was reported by 90% of respondents, with changes including temperature, cyclones, rainfall, soil moisture, and flooding. Eighty-four percent of participants thought these climatic changes would continue (either definitely continue [45%] or might continue [39%]). Similar to findings from Nigeria (Adelekan & Gbadegesin, 2005) and Fiji (Lata & Nunn, 2012), the roles of "Gods and ancestors," and particularly that "Gods and ancestors may be unhappy" was perceived to be the most probable cause of climate change, followed by "changes are just norms," then "local farming practices," and lastly "pollution from outside the community."

A survey of Great Plains farmers offers some of the first insights into perceptions of climate change (Diggs, 1991). In their survey of 432 agriculturalists, 78% of Colorado and 73% North Dakota farmers believed the climate is or possibly is, changing. In the North Dakota sample, which had experienced extreme drought, 55.8% thought droughts were becoming more frequent, while 64% of the Colorado sample (who had not experienced the same drought intensity) perceived drought to be occurring at the same frequency. The authors suggest that a comparison was being made between the farmers' own experiences and another source of information (e.g., media reporting, expert interpretations), and conclude that experiences of drought could reinforce, or polarize perceptions of climate change for farmers.

Similarly, Weber and Sonka (1994) conducted individual structured interviews with farmers in the United States in 1993. Collecting numerical, multiple-choice, and open-ended question data, they examined farming practices and perceptions of climate change. The authors report that 53% of farms did not expect a significant change to the climate. Of the remaining 47%, 19% expected a warmer climate, 2% a drier climate, 21% a warmer and drier climate, and 5% a more variable climate, in the future (Weber, 1997). As sources of climate change information, from a list of five sources, farmers who believed in climate change listed a greater number of influencing sources than those who did not believe in

date: 08 April 2018

climate change; they were also less likely to cite mass media, and more likely to cite agricultural newspapers. More recently, a study of agricultural stakeholders in the United States (Prokopy, Morton, Arbuckle, Mase, & Wilke, 2015) find significant differences between different stakeholder groups (e.g., educators, advisers, farmers). In a survey of 4,778 farmers, 8% agreed that "climate change is occurring and it is caused mostly by human actions," 33% agreed that climate change is occurring with equal human and natural causality, 25% perceived changes to be mostly natural, and 31% believed there was "insufficient evidence to know with certainty whether climate change is occurring or not." The remaining 3.5% did not perceive the climate to be changing. Taken together, this disparate body of research on farmers' perceptions of climate change highlights the heterogeneity that exists even within a group that shares many seemingly important experiences and identities.

# Conclusion

Historical conceptualizations of belief have been traced and some of the key factors contributing to climate change beliefs identified. The review of geographies of climate change belief around the world, while not exhaustive, does point to a range of large-scale surveys juxtaposed with place-based qualitative insights. These different approaches to examining climate change perceptions expose traditional methodological divides but collectively can enhance understandings of climate change belief. The review has signaled some gaps in the literature; there appears to be a largely rural focus of studies in countries of the Global South (e.g., Ayanwuyi et al., 2010; Ishaya & Abaje, 2008; Patt & Schröter, 2008), and with growing urbanization, climate change beliefs in urban places may offer some much-needed insights. The review has also indicated that a dominance of attention to countries of the Global North when it comes to climate change belief research may overlook important connections to place and belief systems; anthropological and qualitative approaches have provided evidence of entanglements of climate change belief with everyday realities, religion, and livelihoods (e.g., Norgaard, 2011). Taken as a whole, the continually evolving, growing, and diversifying international research on climate change beliefs highlights both the heterogeneity of those beliefs across groups and space as well as strong points of commonality, including the importance of personal experience with the climate (primarily via weather and extreme events) in shaping how individuals and communities are responding to this issue.

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date: 08 April 2018

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## Notes:

(1.) There is strong scientific consensus on the causes of climate change; however, there is less certainty on its consequences, and there are a diversity of opinions on actions to respond to climate change.

date: 08 April 2018

(2.) Open-ended responses to the question "Why do you think the climate is changing?"

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