6-1-2018

Farm service agency employee intentions to use weather and climate data in professional services

Rachel E. Schattman
USDA Forest Service

Gabrielle Roesch-Mcnally
USDA Forest Service

Sarah Wiener
USDA Forest Service

Meredith T. Niles
University of Vermont

David Y. Hollinger
USDA Forest Service

Recommended Citation

Schattman, R., Roesch-McNally, G., Wiener, S., Niles, M., & Hollinger, D. (2018). Farm service agency employee intentions to use weather and climate data in professional services. Renewable Agriculture and Food Systems, 33(3), 212-221. doi:10.1017/S1742170517000783

Renewable Agriculture and Food Systems

cambridge.org/raf

Themed Content: Ag/Food Systems and Climate Change

Cite this article: Schattman RE, Roesch-McNally G, Wiener S, Niles MT, Hollinger DY (2018). Farm service agency employee intentions to use weather and climate data in professional services. *Renewable Agriculture and Food Systems* **33**, 212–221. https://doi.org/10.1017/S1742170517000783

Received: 17 July 2017
Accepted: 10 December 2017
First published online: 20 February 2018

Key words:
Agriculture; climate change; FSA; risk

Author for correspondence:
Rachel E. Schattman, E-mail: rschattm@uvm.edu

Farm service agency employee intentions to use weather and climate data in professional services

Rachel E. Schattman[1], Gabrielle Roesch-McNally[2], Sarah Wiener[3], Meredith T. Niles[4] and David Y. Hollinger[5]

[1]USDA Forest Service/University of Vermont Extension, 140 Kennedy Drive, Suite 201, South Burlington, Vermont 05403, USA; [2]USDA Forest Service, 3200 SW Jefferson Street, Corvallis, OR 97331, USA; [3]USDA Forest Service, Southern Research Station, 920 Main Campus Drive, Suite 300, Raleigh, NC 27606, USA; [4]University of Vermont, Food Systems Program, Department of Nutrition and Food Sciences, 350 Carrigan Wing, Marsh Life Sciences Building, Burlington, Vermont 05405, USA and [5]USDA Forest Service, Northern Research Station, 271 Mast Road, Durham, NH 03824, USA.

Abstract

Agricultural service providers often work closely with producers, and are well positioned to include weather and climate change information in the services they provide. By doing so, they can help producers reduce risks due to climate variability and change. A national survey of United States Department of Agriculture Farm Service Agency (FSA) field staff ($n = 4621$) was conducted in 2016. The survey was designed to assess FSA employees' use of climate and weather-related data and explore their perspectives on climate change, attitudes toward adaptation and concerns regarding climate- and weather-driven risks. Two structural equation models were developed to explore relationships between these factors, and to predict respondents' willingness to integrate climate and weather data into their professional services in the future. The two models were compared with assess the relative influence of respondents' current use of weather and climate information. Findings suggest that respondents' perceptions of weather-related risk in combination with their personal observations of weather variability help predict whether an individual intends to use weather and climate information in the future. Importantly, climate change belief is not a significant predictor of this intention; however, the belief that producers will have to adapt to climate change in order to remain viable is. Surprisingly, whether or not an individual currently uses weather and climate information is not a good predictor of whether they intend to in the future. This suggests that there are opportunities to increase employee exposure and proficiency with weather and climate information to meet the needs of American farmers by helping them to reduce risk.

Introduction

Global climate change has diverse and varied regional impacts, evident today and forecast into the future (Noble et al., 2014), presenting challenges and opportunities for agricultural producers worldwide. Given that climate change is already affecting producers, utilizing weather and climate data can assist managers in capitalizing on new opportunities while reducing financial risks. Agricultural service providers play an important role in this context; public sector technical experts, extension professionals and private consultants all provide farmers with important information and services as they make production decisions and consider climate change.

Agricultural service providers operate across many organizations, including the USDA Farm Service Agency (FSA). The overarching mission of FSA is 'to equitably serve all farmers, ranchers and agricultural partners through the delivery of effective, efficient agricultural programs for all Americans' (USDA-FSA, 2017a). FSA administers disaster assistance through multiple programs, necessitating that employees interface with farmers and ranchers immediately following extreme climate and weather events. The Agency also supports the conservation of vulnerable agricultural lands with two programs containing incentives for: (a) the removal of ecologically sensitive agricultural land from production (through programs such as the Conservation Reserve Program, or CRP) and (b) conservation practices on active agricultural land (through programs such as the Continuous Conservation Reserve Program or C-CRP). Because of these core functions, in combination with their frequent and sustained contact with farmers and ranchers, FSA employees regularly deliver services that support the overlapping goals of conservation and climate-adaptation.

Considering the great impact that agricultural service providers have on agricultural communities across the USA, it is important to understand the factors that influence the intentions of these individuals to access and use climate-relevant information in their professional services. A rich body of research developed over the past decade focuses on climate change beliefs and risk perceptions of agricultural stakeholders, and if these beliefs lead to different behavioral outcomes. For our purposes, *climate belief* is a belief that the climate is changing in a manner sufficient to impact producer management decisions. A selection of research explores beliefs and risk perceptions among farmers (Niles et al., 2013; Prokopy et al., 2015a; Mase et al., 2016), extension professionals (Fraisse et al., 2009; Prokopy et al., 2015b; Campbell and Tomlinson, 2016) and climate scientists (Cook et al., 2016). While USDA employees are included in some of these studies as subsets of the populations of interest, there are no investigations that specifically target FSA employees, nor are there any that take a national approach to their assessment.

To address this gap, a nation-wide survey of FSA employees was conducted, targeting individuals who work directly with agricultural producers. In this paper, we explored two primary research questions. First, among FSA field staff, what is the relationship between climate and weather perceptions and current professional use of weather and climate data? Secondly, how well do FSA employees' beliefs and perceptions in these areas predict their willingness to integrate more climate and weather data into their professional services in the future? To answer these questions, we developed and compared several structural equation models (SEMs) that explore relationships between variables. Conducting these analyses enabled us to develop a broader understanding of how the variables may influence the intentions regarding use of climate and weather information in the future by FSA field staff, particularly in the context of a changing climate.

Background

FSA as an agricultural boundary organization

The majority (66%) of FSA employees are located in county and state offices around the USA. To meet their mission, FSA relies upon approximately 2500 peer-elected county committee members to help administer FSA programing (USDA-FSA, 2017b). Climate adaptation, specifically managing weather-related risks through insurance, disaster relief and conservation, is within the purview of FSA programing, meaning FSA employees are well situated to support agricultural communities as the climate continues to change.

Familiarity with climate science and use of climate and weather data, including forecasts and outlooks, are important duties carried out by members of some *boundary organizations* (Hu et al., 2006). Coined by Guston (1999), boundary organizations are those that serve as a conduit of information between stakeholder groups. Carr and Wilkerson (2005) further describe how these organizations facilitate the ability of groups to retain their cultural identity while learning about the perspectives of another group. Boundary organizations can also serve as tools toward what Jasanoff (1996) calls 'co-production of knowledge and social order' (1996, p. 393) or the actionability of science in both management and policy sectors. We suggest that, because of the common spaces inhabited by FSA programs and FSA county committees, FSA is an example of a boundary organization. Additionally, some farmer groups consider FSA employees a top source of soil and water conservation information (Tucker and Napier, 2002), and it is likely that FSA employees will interact with producers before, during and after important farm management decisions. Whether or not individuals within boundary organizations such as FSA have access to or familiarity with current climate and weather information may have implications for how they assist agricultural producers in addressing climate- and weather-related risks. Specifically, the appropriate use of climate forecasts is important for providing services related to a number of relevant agricultural decision-making processes.

Theoretical background and variable selection

The motivating factors that activate behavior are not necessarily linear but modulated through beliefs and experiences, which can lead to support for climate adaptation or mitigation actions (Niles et al., 2013; van der Linden, 2014; Arbuckle et al., 2015). Structural equation modeling lends itself well to this type of analysis as it incorporates interactions between variables in its calculation of model fit. The factors considered in this study are climate belief, personal experience with extreme weather, perception of weather-related risk and the belief that producers will need to adapt to climate change in order to remain viable. It is widely accepted that many factors influence agricultural service providers' use of climate and weather-related information (Prokopy et al., 2013), therefore the theoretical underpinnings of our approach are derived from a number of studies. While previous research in the area of intention towards behavior change has sometimes coupled SEMs in tight alignment with theoretical models (e.g. Hansen et al. (2004)), this was not our approach. Rather, we sought to draw from several theoretical frameworks utilized in previous studies that help explain relationships between belief, perceptions of risk, experiences, intentions to act and behavior change. For example, Roesch-McNally et al. (2017) combined components of the Theory of Planned Behavior (Ajzen, 1991), the Reasoned Action Approach (Fishbein and Ajzen, 2010) and the Anatomy of Adaptation Typology (Smit et al., 2000) to examine the influence of farmers' perceptions of weather variability on their willingness to adopt specific conservation practices as a climate adaptation response. Other studies used to inform our selection of variables took a less formal approach to using theory to guide statistical models, as in Spence et al. (2011) in their use of Goal Setting Theory to address the role of personal experience of extreme events. Likewise, Haden et al. (2012) explored personal experiences with climate change and its relative influence on exposure to risk as a motivating driver of behavior change, using Construal Level Theory as the basis of their investigation. Though they are drawn from many different theoretical frames, the studies referenced above and many more all contribute to our understanding of how adaptive decisions are made, and illustrate relevant factors that describe agricultural service providers' intentions to use climate and weather information in service delivery with producers in the future. The findings thus are likely to inform service delivery to agricultural producers in the era of climate change.

Climate belief

According to Fishbein and Ajzen (2010), beliefs are a precursor to attitudes, which can ultimately lead to behavioral changes. It stands to reason that attitudes or the favorable or unfavorable appraisal of a specific behavior (Beedell and Rehman, 2000) also influence behavioral intentions (Bayard and Jolly, 2007). In the USA, much research conducted on the climate beliefs of agricultural advisors (and how these beliefs influence service provision) focuses on the Midwest (Prokopy et al., 2017).[1] In one such study, researchers found that agricultural advisors have varying degrees of willingness to discuss climate change with producers, and that willingness is often associated with program area (Haigh et al., 2015). The majority (74%) of extension professionals surveyed in the Midwest region believe that climate change is taking place, while 23% attributed the cause of modern climate change mostly to human activity (Prokopy et al., 2015b).

Attribution skepticism or the belief that recent climate change is not a consequence of human activities, is a barrier to discussions between advisors and producers about mitigation and adaptation practices. Several studies suggest that whether or not an individual believes in climate change and human attribution has implications for that individual's subsequent support of mitigation and adaption activities (Howden et al., 2007; Arbuckle et al., 2013a, b; Hyland et al., 2015; Chatrchyan et al., 2017). Agricultural advisors are more likely to believe in an anthropogenic cause of climate change if they perceive that unusual weather variability is occurring, and this belief influences their perspectives on agricultural adaptation (Mase et al., 2015). Further, advisors who believe in an anthropogenic role in climate change are more likely to make 'climate-conscious recommendations' to their clients and are more likely to agree that they should assist farmers in preparing for climate change (Mase and Prokopy, 2014; Chatrchyan et al., 2017, p. 13). Other research, however, challenges the degree to which climate change beliefs *or* the understanding of climate science translates into either risk perception or support for adaptation behavior. For example, normative influences such as political party and social group affiliation have been shown to influence behavioral intentions (Takahashi et al., 2016; Running et al., 2017). Furthermore, Niles et al. (2016) found that climate change belief was not a significant correlate of actual behavior changes at a farm level for climate mitigation and adaptation, only a driver of intention to change.

Personal experience with extreme weather

There is debate about the importance of personal experience with climate and weather-related events, specifically related to individuals' belief that climate change is occurring and intention to change their own behavior. While some research supports the association between climate change belief and personal experience with extreme weather events (Spence et al., 2011; Haden et al., 2012; Akerlof et al., 2013), other studies find personal experience with these events does not have significant influence (Saad, 2015; Carlton et al., 2016). The opposing findings in the above studies support the conclusion of Whitmarsh (2008), who finds that different weather events may have more or less influence on individuals' intentions and behavior depending on the type of weather and the severity of impacts. For example, personal experience with floods has relatively low association with levels of climate-concern compared with personal experience with air pollution, while Spence et al. (2011) show that personal experience with floods is associated with greater concern for climate impacts (Myers et al., 2013). Among agricultural producers, personal experience with crop loss can increase perceptions of climate-related risks (Menapace et al., 2015); however, other studies found that experience with major drought did not have significant impact on agricultural advisors' perceptions of risk or their attitudes about adaptation (Carlton et al., 2016).

[1]While FSA field staff are better described as agricultural service providers, there is overlap between advising and service provision. Both advisors and service providers offer management-related information to producers on a regular basis.

Perception of weather-related risk

Behavioral intentions are driven, in part, by perceptions of climate and weather-related risks (O'Conner et al., 1999; Zahran et al., 2006; Arbuckle et al., 2013b; Hyland et al., 2015). Some evidence suggests that an individuals' perception of the severity of climate risks is likely to outweigh the actual risks. This applies to individuals' willingness to support climate-friendly policies and other climate-oriented actions or initiatives (Arbuckle et al., 2015). Niles and Mueller (2016) found that perception of climate-related changes (and associated risk) are influenced by an individual's belief in climate change, their prior support for climate-related policy and the presence of practices that lessen the felt-impact of weather events (e.g. irrigation infrastructure). Political ideology can also be associated with risk perception, as well as support for climate adaptation and mitigation activities (Takahashi et al., 2016; Running et al., 2017). Kahan's (2015) distinction between scientific literacy around climate change and the influence that social networks have on individuals' belief and decision-making help to explain why access to scientific information is not the most important limitation when it comes to behavior change. Scientific literacy still plays a role, however, as Lemos et al. (2014b) show that agricultural service providers are more likely to provide producers with climate information when the service providers' concern about long-term risks of climate change for agriculture are high.

Belief that producers will need to adapt

While the need to adapt agricultural practices to changing climate conditions is a widely accepted concept among scientists and many policymakers (Noble et al., 2014), it is not universal, and research does not necessarily demonstrate that an agricultural producer's belief that climate adaptation is necessary will influence climate-adaptive behavior. Amongst producers, previous use or adoption of a practice or behavior can be a greater driver than belief in climate change or the need for adaption. For example, Roesch-McNally et al. (2017), show that a producer's current use of specific farm practices (e.g. no-till farming and tile drainage) is the primary factor in predicting future use of these same practices in response to projected climate impacts. Niles et al. (2016) found that the strongest drivers of both intention and implementation of adaptation practices were perceived capacity and perceived likelihood of success. Despite this, the need for institutions and organizations to support agricultural adaptation remains widely discussed (Raymond and Robinson, 2013), and there is evidence that producers and advisors agree on the efficacy of certain adaptation practices (Schattman et al., 2017). There is also evidence suggesting that agricultural advisors and farmers may form regional cultural cohorts, which functionally reinforce each other's world views, including those related to climate change adaptation (Prokopy et al., 2015b). Institutional support for climate-outreach and education can be a driver on agricultural advisors' willingness to discuss climate change with farmers (Lemos et al., 2014a), potentially shifting the views of their social group, including farmers.

Hypotheses

Based on the theoretical framing of our models and the evidence of prior research, we developed the following hypothesis:

H_1: Respondents' current use of climate and weather data will predict respondents' intentions to use such data in their future professional services.

H_2: Climate belief will have less influence on respondents' intentions to use climate and weather-related tools and information than those factors that measure perceptions of weather-related risk and personal experience with extreme weather events.

Methods

Sampling and survey administration

In fall, 2016, a team consisting of USDA Climate Hub collaborators from the US Forest Service, FSA and the University of Vermont developed a survey instrument for FSA field staff. Many survey questions were adapted, with permission, from the Survey of Agricultural Advisors developed by the U2U project (Prokopy et al., 2013, 2017). In November, the survey was tested by four agency staff in states in different regions of the country. Adjustments to the survey were made in response to feedback from these tests. Respondent email addresses and position titles were collected from the publicly available, online USDA Service Center directory. The survey was designed to target FSA staff in all US states and territories who work directly with agricultural land managers, therefore those individuals with job titles who were unlikely to fulfill this description were removed. Additionally, survey participants were asked early in the survey whether they work directly with land managers. Only those who reported that they did so were included in our analysis. The total number of FSA staff targeted for the survey was 10,614. Institutional Review Board approval was granted through The University of Vermont under an exempt status (IRB Approval Number CHRBSS: 17-0254).

Survey recruitment followed the tailored design method for online surveys (Dillman et al., 2008). FSA Deputy Administrators of Field Offices (DAFOs) in all states and territories were asked to send an introductory email to field staff explaining that the survey would be arriving by email. The first solicitation for survey participation was released three days later. Two follow-up reminders were sent one week apart. The survey was closed three weeks following the final solicitation. In total, 4621 people responded to the survey (42% response rate, calculated using RR4 methods from the American Association of Public Opinion Research). To conduct non-response bias tests, we used the wave analysis approach as described by Phillips et al. (2016). Respondents were divided into three groups based on if they responded to the first, second or third requests for participation. Responders to the third request were assumed to be representative of non-responders. We tested differences in demographic variables as well as responses to questions covering the topics of climate change belief, climate adaptation and on-farm greenhouse gas emission reductions. There was no significant difference between early and late responses to these questions. Respondents to the survey were disproportionately female (67 *vs* 26% male), white (86%) and non-Hispanic (87%), which does not differ significantly from the target population. The number of respondents in each state and territory reflected the population of the FSA workforce in those states and territories, as determined by reviewing the percentage of respondents in each state compared with the overall number of FSA employees targeted for our survey in each state. The average response rate by the state was 45%; the standard deviation was 14%.

The analysis presented in this paper utilizes five questions from the survey. Table 1 reports these questions, their variables, scales, means and standard deviations. Independent observed variables used in this analysis include *observed weather variability*, *perceived weather-related risk*, *belief that producers will need to adapt* and *climate belief*. We conducted a Kendell's Tau B (non-parametric test of association) to test respondents' perceived dependence on historical weather data or weather and climate forecasts. In addition, we utilized an independent latent variable (i.e. *current use of weather and climate information*) in our analysis, for which we provided eigenvalue, factor loadings and the Cronbach alpha score. This variable was determined using principal component factors, which indicated a single factor solution with factor loadings significantly greater than a cut-off of 0.40 (Osborne and Costello, 2005). To measure similar latent concepts represented in current use of weather and climate information, we created a scale to average responses (*current use of weather and climate information* = 0.93) (Clark and Watson, 1995), which had a Cronbach's alpha coefficient higher than 0.70, a generally accepted cut-off point for reliability (Nunnally, 1978). We identified an *intention to use weather and climate information* as an observed, dependent variable, which we used to measure respondents' intention either to continue the use of these resources in their professional service (if they already use them) or to adopt the use of these resources in the future.

Structural equation model

We utilized SEMs to assess the relationship between climate change experiences, belief, risk and adaptation perceptions, use of weather and climate information, and intention to use weather and climate information in the future. We developed two models to assess the variables that predict an FSA employee's intention to use weather and climate information with their farmer constituents. The first (model 1) was a conceptual model based on existing theory of climate experience and beliefs. The second (model 2) included a latent variable to assess the extent to which current use of weather and climate information is likely to predict intention to use such practices in the future. The comparison of the two models allowed us to test H_1 (whether or not respondents' current use of climate and weather information was associated with their intention to do so in the future). Both models allowed us to test H_2 (that climate belief has a lower relative influence on the dependent variable than those factors that measure perceptions of weather-related risk and personal experience with extreme weather events). Models were constructed and analyzed using Stata 13 structural equation modeling (StataCorp LLC, College Station, Texas). SEMs were estimated using maximum-likelihood estimations with missing values to avoid listwise deletions of responses and with bootstrap standard errors (n = 500). Model 2 was constructed first with a confirmatory factor analysis of the latent variable construct and observed variables (Table 1), which was confirmed by a Cronbach alpha test. The addition of the latent variable to model 2 was further assessed through modification indices to add additional covariances between observed variables. FIML (full information maximum-likelihood) estimates were used to run both models, which adjusts the likelihood function so that each case contributes information on the variables that were observed (Enders and Bandalos, 2001).

Results

Descriptive results

The majority (59%) of respondents agree or strongly agree that they have noticed more variable or unusual weather in their

Table 1. Model scales and variables with measures of reliability.

Variable	Question/statement	Scale	Mean	SD	Eigen value	Factor loadings	Cronbach alpha
Intention to use weather and climate information[a]	I would like climate or weather forecasts to inform the services I provide	Five-point scale (1 = strongly disagree, 5 = strongly agree)	3.21	0.832	–	–	–
Observed weather variability	In the past 5 years, I have noticed more variable/ unusual weather in my area	Five-point scale (1 = strongly disagree, 5 = strongly agree)	3.55	0.982	–	–	–
Perceived weather-related risk	Changes in weather patterns are hurting the producers in my service area	Five-point scale (1 = strongly disagree, 5 = strongly agree)	3.21	0.984	–	–	–
Belief that producers will need to adapt	To cope with increasing climate variability, changing farming practices is important for the long-term success of the producers in my service area	Five point scale (1 = strongly disagree, 5 = strongly agree)	3.52	0.921	–	–	–
Climate belief	Please select the statement that best reflects your beliefs about climate change	Five-point scale: 1 = less agreement with scientific consensus on climate change, 5 = greater agreement)	3.44	0.982	–	–	–
Current use of weather and climate information	In general, how dependent are you on the following types of weather information to do your job?	Four-point scale: 1 = not dependent, 4 = very dependent	2.21	0.015	5.01		0.93
	(1) Historical weather trends					0.790	
	(2) Weather data for the past 12 months					0.809	
	(3) Current weather conditions					0.865	
	(4) 1–7-day forecasts					0.843	
	(5) 8–14-day outlooks					0.873	
	(6) Monthly or seasonal outlooks					0.895	
	(7) Annual or longer term outlooks					0.837	

SD, standard deviation.
Italics indicate sub-sections of a question (e.g. for 'Current use of weather and climate information' each question is italicized).
[a]Dependent variable.

locality. Respondents were less likely to agree that changing weather patterns cause harm to producers in their area (37% agree or strongly agree). The climate-related future impacts on agricultural production that respondents reported being either concerned or very concerned about included: longer dry periods and drought (65%), increased heat stress on crops (51%), increased weed pressure (50%), increased heat stress on livestock (47%), increased insect pressure (44%), higher incidence of crop disease (43%) and more frequent extreme rain events (41%). Over half of respondents (54%) agree or strongly agree that, in order to ensure long-term success, agricultural producers will need to adapt to climate variability by changing farming practices. Approximately one-third (34%) of respondents agreed or strongly agreed that they would like climate or weather forecasts to inform the services they provide (see Fig. 1).

The majority (77%) of respondents believe that climate change is occurring, while a minority of respondents (13%) attribute climate change primarily to human activities (the option most aligned with scientific consensus, see Cook et al. (2016)). A larger group (46%) of respondents believes that climate change is caused equally by human activities and environmental factors.

Respondents reported that they were more dependent on current weather conditions and 1–7-day forecasts than they were on either historical weather trends or longer-term outlooks. The Kendell's Tau B showed that use of any of these weather or climate data sets is correlated with every other data set (τ_B scores were between 0.453 and 0.889, all $P < 0.01$), meaning that individuals were either likely to use several or all these tools in their professional services, or none. To understand how FSA employees use climate and weather resources, respondents were asked to report the programmatic context in which they applied these resources, and the types of resources they use and are most familiar with. Program areas in which 30% or more of the respondents are using historical weather trends and/or forecasts in discussions with producers include: crop rotations/field assignments (32%), crop/variety choices (35%), purchasing crop insurance or enrolling in the Non-insured Crop Disaster Assistance Program or NAP (51%) and planting or harvesting schedules (42%).

Structural equation model

Model 1 (Fig. 2) utilized four observed variables: *observed weather variability, perceived weather-related risk, belief that producers will need to adapt* and *climate belief*. Model 2 (Fig. 3) incorporated a latent variable derived from respondents' current use of weather and climate information. Model 1 (χ^2/df = 1), had a CFI of

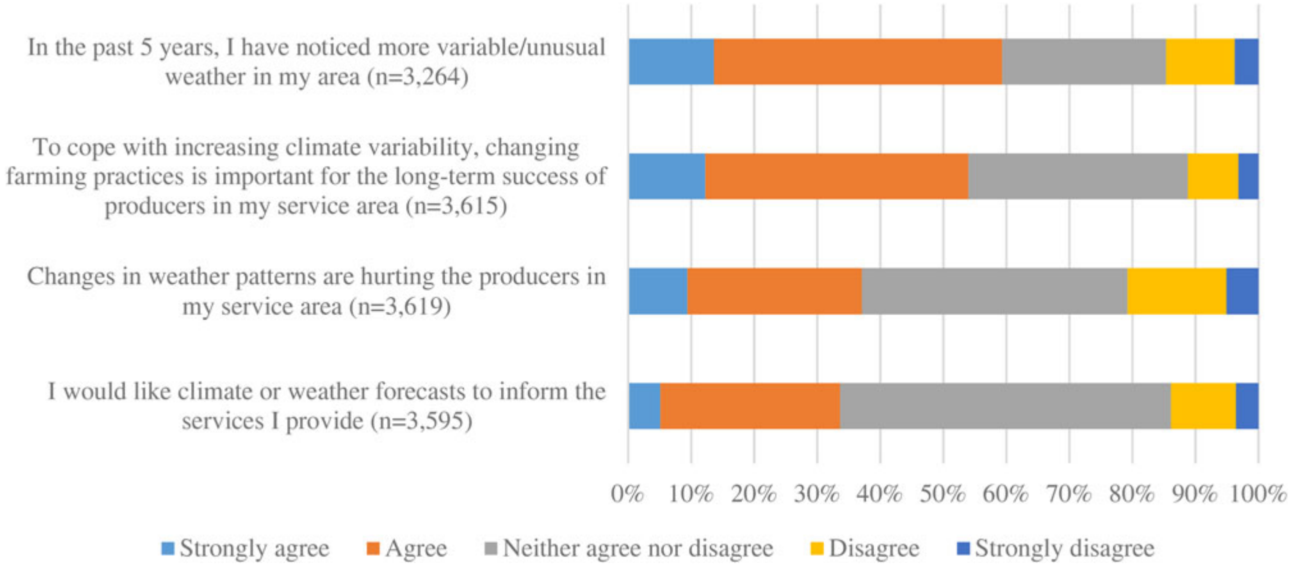

Fig. 1. Responses to questions leading to the observed variables used in SEM.

0.999 and a RMSEA of 0.034. Model 2 (χ^2/df = 37), had a CFI of 0.992 and a RMSEA of 0.043. While the model R^2 values and fit statistics show that they are both good models, Model 1 has a lower AIC score ($\Delta AIC = 48{,}583$; $\Delta BIC = 48{,}793$). Further, the additional complexity of the latent variable to Model 2 contributes only a marginal increase in the explained variability (R^2) of the dependent variable, from 0.229 to 0.291, suggesting that the latent variable only predicts about 6% of the variability in the dependent variable. Thus, the addition of the latent variable does not contribute greatly to our efforts to understand why FSA employees may or may not wish to use weather and climate data during service provision. This finding disproves H_1, which anticipated that the latent variable would enhance the model. In other words, whether or not an FSA employee currently uses weather and climate information in their professional services is not a good predictor of whether they intend to do so in the future. In the following section, as we investigate the influence of select variables, we will report statistics from model 1 unless specifically noted otherwise.

Climate belief

Overall the model predicts 19% of the variance for *climate belief* ($R^2 = 0.194$), with both *observed weather variability* ($\beta = 0.336$, $P < 0.001$) and *perceived weather risk* ($\beta = 0.141$, $P < 0.001$) positively associated with *climate belief*. Respondents who believed in climate change, and who were in greater agreement with the scientific consensus on its causes, were more likely to believe that on-farm adaptation is necessary in order for farms to remain viable in the future. However, the relative influence of climate belief in the model is low. This confirms H_2, which anticipated

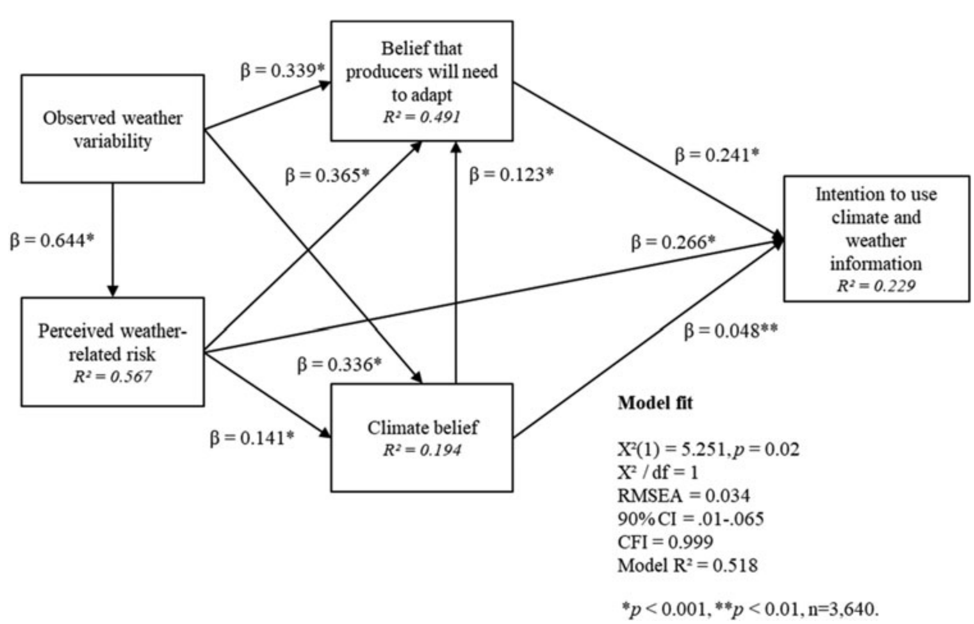

Fig. 2. Significant pathways in model 1 with standardized coefficients.

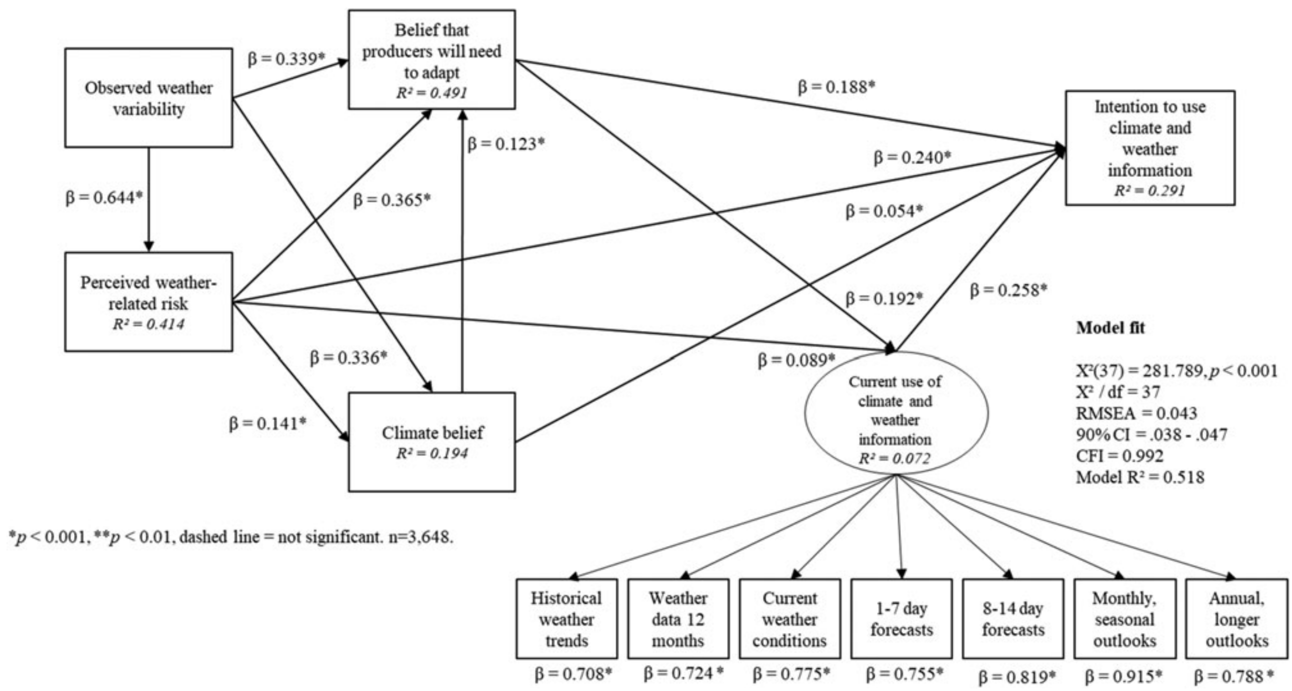

Fig. 3. Significant pathways in model 2 with latent variable and standardized coefficients. A full model including non-significant pathways can be found in the Supplementary Materials (Fig. S1).

that individuals' beliefs (associated with sense of self and social position) would have less influence than variables not associated with climate belief. In model 2, there was no significant relationship between *climate belief* and *current use of climate and weather data*.

Perceptions of weather-related risk and observed weather variability

The model predicts 57% of the variance for *perceptions of weather-related risk* ($R^2 = 0.567$). This variable has a strong positive influence on the *belief that producers will need to adapt* (β = 0.365, $P < 0.001$), *intention to use climate and weather information* (β = 0.266, $P < 0.001$) and *climate belief* (β = 0.141, $P < 0.001$). This implies that respondents who believe that changing weather patterns cause harm to producers in their area are more likely to believe in climate change, agree that adaptation is necessary, and intend to use weather and climate information in the future. This variable is highly correlated with *observed weather variability* (β = 0.644, $P < 0.01$). Respondents who reported noticing more variable weather in their region in the past 5 years are more likely to believe in climate change (β = 0.336, $P < 0.001$), believe that producers will need to adapt (β = 0.339, $P < 0.001$), and agree that variable weather is causing harm to producers in their area (β = 0.644, $P < 0.001$).

Belief that producers will need to adapt

The model predicts 49% of the variance for the *belief that producers will need to adapt* ($R^2 = 0.491$). This variable has a direct influence on *intention to use climate and weather information* in the future (β = 0.241, $P < 0.001$). In addition, *climate belief* had a positive effect on the *belief that producers will need to adapt* (β = 0.123, $P < 0.001$). While *climate belief* had a relatively weak direct influence on the dependent variable (β = 0.054, $P < 0.001$), the model suggests that the *climate belief* is moderated through the *belief that producers will need to adapt*. The finding that the latter variable explains more variation within the model and has a stronger association with the dependent variable than *climate belief* is unexpected because the statements that generated both variables include the term climate change, while other statements used less contested terms such as weather variability and weather forecasts.

Discussion

The results of the comparison between models 1 and 2, as well as the relatively stronger fit statistics in Model 1, illustrate three important findings. First, the latent variable included in model 2, which described respondents' current use of weather and climate information, did not lead to improved model fit. Model 2 describes an important relationship between respondents' current use of climate and weather information and their intention to do so in the future (β = 0.258, $P < 0.001$). However, the comparison between the two models implies that not using weather and climate data in the present may not be a barrier to doing so in the future, indicating potential opportunities to increase the awareness and the current use of weather and climate information amongst appropriate FSA field staff. Additionally, 34% of respondents reported that they would like to use climate and weather tools in the future. Therefore, we reject H_1, and find that respondents' current use of climate and weather data does not predict respondents' intentions to use such data in future professional services.

Secondly, we clarified the role and level of importance that climate change belief plays in anticipating the intentions of FSA employees to use climate and weather data in the future. The majority (64%) of survey respondents believe that climate change is occurring. Fewer survey respondents (13%) correctly attributed the cause of modern climate change to human activities than the general population in the USA has in similar surveys (Howe et al., 2015). The Yale Climate Opinion polls (Marlon et al., 2016) report that 37% of US citizens agree that climate change is primarily caused by human activity. The 2016 Gallup Poll reported that 65% of US citizens believe that warming temperatures are the effect of human pollution (Saad and Jones, 2016). Although the results of these studies and our own are not directly comparable, noting the different outcomes is a useful exercise as we develop a better understanding of agricultural stakeholders as a subset of the US population. While earlier research shows that lesser degrees of climate skepticism are associated with pro-environmental behavior (Poortinga et al., 2011), Hornsey et al.'s research (2016) suggests that attribution skepticism may not be a barrier to climate-related pro-environmental behavior as previously assumed.

In support of this emerging framing of the relationship between climate skepticism and climate change related behavior or intentions, we found that whether or not an FSA employee accurately identifies the causes of climate change has less impact on their desire to use climate and weather data than other factors. Therefore, we accept H_2, and find that climate belief has less influence on FSA employees' intentions to use climate and weather-related tools and information than those factors that measure perceptions of weather-related risk and personal experience with extreme weather events. In addition, we found a non-significant relationship between climate change belief and current usage of climate and weather information. These findings provide valuable insights for those engaged in communication of climate science with non-scientific audiences. Beliefs, including *climate belief*, are strongly associated with an individual's social and cultural identity rather than their level of knowledge (Kahan, 2015). Our findings suggest that, as long as the topic of communication between scientific experts and land managers is related to adaptation, there is ample common ground available when discussing technical and applied approaches for climate change risk reduction.

While belief in climate change may not predict an individuals' intention to use climate and weather data in the future, it may signal other behaviors or belief systems that influence service provision. For example, belief about climate change and its underlying causes is associated with differing levels of support for climate mitigation policies (Niles et al., 2013; van der Linden et al., 2015) and variation between agricultural stakeholders' support for climate adaptation measures (Arbuckle et al., 2013b, 2014). In the context of agricultural service providers, attribution skepticism may not be an impediment to the use of climate and weather-related tools and resources. However, increasing access to scientifically grounded climate information may enable a broader understanding of climate change causes and consequences among some agricultural service providers, leading to more support for additional adaptation and mitigation activities.

Thirdly, we found that respondents' perceptions of weather-related risk and observed weather variability are highly correlated. As previously discussed, the role that personal experience plays in developing an individuals' sense of weather-related risks is explored (and questioned) in several studies. Our study supports the position articulated in Menapace et al. (2015), Spence et al. (2011) and Scannell and Gifford (2013), that observed weather variability (interpreted as personal experience with weather variability) and its close relationship with perceptions of weather-related risk influences the intentions of FSA employees to use climate and weather information in the future.

Our findings also echo research pertaining to several Midwestern US states, where it was shown that agricultural advisors were open to greater incorporation of weather and climate information into their services (Prokopy et al., 2013). With the likely opportunity that FSA field staff are open to increasing their professional use of climate and weather data, the question then becomes, *how?* It is important to recognize that not all climate and weather information is equally useful to agricultural service providers. Agricultural service providers will benefit the most from professional development opportunities that introduce them to information and resources that are (a) unfamiliar to them and (b) relevant to their customers' production decisions (Hayman et al., 2007).

Conclusion

Given the unique organizational structure of FSA, in combination with the importance of the services this agency provides to US producers, employees of this agency play an important role in providing information and support to land managers. Greater integration of weather and climate information into relevant FSA programs and services may be an opportunity for enhanced service provision and program efficacy. Findings from this study show that FSA respondents' perceptions of weather-related risk in combination with their personal observations of weather variability help predict if an individual is likely to use weather and climate information in the future. The belief that producers will have to adapt to climate change in order to remain viable is a significant predictor of whether respondents intend to use climate and weather information in the future, and there is a notable willingness on behalf of FSA field staff to do so. While important, climate belief has relatively less influence on respondents' intentions to use this information. Our study disproves the hypothesis that current use of weather and climate-related tools predicts respondents' intention to use these tools in their professional services in the future. Overall, our work implies that there are ample opportunities to increase employee exposure and proficiency with relevant sources of weather and climate information.

Supplementary material. The supplementary material for this article can be found at https://doi.org/10.1017/S1742170517000783.

Acknowledgements. USDA Climate Hubs leadership, staff and Executive Committee. FSA employees who contributed their time to reviewing the survey, providing feedback on survey questions and thoughtfully responding. We specifically would like to thank Rich Iovanna and Mary Carey for their assistance and consideration; two anonymous reviewers and the guest editor of this special issue.

References

Ajzen I (1991) The theory of planned behavior. *Organizational Behavior and Human Decision Processes* **50**(2), 179–211. doi: 10.1016/0749-5978(91)90020-T.

Akerlof K, Maibach EW, Fitzgerald D, Cedeno AY and Neuman A (2013) Do people "personally experience" global warming, and if so how, and does it matter? *Global Environmental Change* **23**(1), 81–91. doi: 10.1016/j.gloenvcha.2012.07.006.

Arbuckle JG, Haigh T, Hobbs J and Knoot T (2013a) Climate change beliefs, concerns, and attitudes toward adaptation and mitigation among farmers in the Midwestern United States. *Drought Mitigation Center Faculty Publications* **11**, 1–13.

Arbuckle JG, Morton LW and Hobbs J (2013b) Farmer beliefs and concerns about climate change and attitudes toward adaptation and mitigation: evidence from Iowa. *Climatic Change*, **118**(3–4), 551–563. doi: 10.1007/s10584-013-0700-0.

Arbuckle JG, Hobbs J, Loy A, Morton LW, Prokopy LS and Tyndall J (2014) Understanding corn belt farmer perspectives on climate change to inform engagement strategies for adaptation and mitigation. *Journal of Soil and Water Conservation* **69**(6), 505–516. doi: 10.2489/jswc.69.6.505.

Arbuckle JG, Morton LW and Hobbs J (2015) Understanding farmer perspectives on climate change adaptation and mitigation: the roles of trust in sources of climate information, climate change beliefs, and perceived risk. *Environment and Behavior* **47**(2), 205–234. doi: 10.1177/0013916513503832.

Bayard B and Jolly C (2007) Environmental behavior structure and socio-economic conditions of hillside farmers: a multiple-group structural equation modeling approach. *Ecological Economics* **62**, 433–440. doi: 10.1016/j.ecolecon.2006.07.004.

Beedell J and Rehman T (2000) Using social-psychology models to understand farmers' conservation behaviour. *Journal of Rural Studies* **16**, 117–127.

Campbell A and Tomlinson P (2016) Climate change challenges for extension educators: technical capacity and cultural attitudes. *Journal of Extension* **54** (6), 1–14.

Carlton JS, Mase AS, Knutson CL, Lemos MC, Haigh T, Todey DP and Prokopy LS (2016) The effects of extreme drought on climate change beliefs, risk perceptions, and adaptation attitudes. *Climatic Change* **135**(2), 211–226. doi: 10.1007/s10584-015-1561-5.

Carr A and Wilkinson R (2005) Beyond participation: boundary organizations as a new space for farmers and scientists to interact. *Society and Natural Resources* **18**(3), 255–265. doi: 10.1080/08941920590908123.

Chatrchyan AM, Erlebacher RC, Chaopricha NT, Chan J, Tobin D and Allred SB (2017) United States agricultural stakeholder views and decisions on climate change. *Wiley Interdisciplinary Reviews: Climate Change* **8**(5), 1–21. doi: 10.1002/wcc.469.

Clark LA and Watson D (1995) Constructing validity: basic issues in objective scale development. *Psychological Assessment* **7**(3), 309–319.

Cook J, Oreskes N, Doran PT, Anderegg WRL, Verheggen B, Maibach EW, Carlton JS, Lewandowsky S, Skuce AG, Green SA, Nuccitelli D, Jacobs P, Richardson M, Winkler B, Painting R and Rice K (2016) Consensus on consensus: a synthesis of consensus estimates on human-caused global warming. *Environmental Research Letters*, IOP Publishing **11**(4), 48002. doi: 10.1088/1748-9326/11/4/048002.

Dillman DA, Smyth JD and Christian LM (2008) *Internet, Mail, and Mixed-mode Surveys: The Tailored Design Method*, 2nd edn. Hoboken, NJ: John Wiley & Sons, Ltd. doi: 10.2307/41061275.

Enders CK and Bandalos DL (2001) The relative performance of full information maximum likelihood estimation for missing data in structural equation models. *Structural Equation Modeling: A Multisdisciplinary Journal* **8**(3), 430–457. doi: 10.1207/S15328007SEM0803.

Fishbein M and Ajzen I (2010) *Predicting and Changing Behavior: The Reasoned Action Approach*. New York: Taylor and Francis.

Fraisse CW, Breuer NE, Zierden D and Ingram KT (2009) From climate variability to climate change: challenges and opportunities to extension. *Journal of Extension* **47**(2), 1–10. doi: 10.1088/1755-1307/6/4/242015.

Guston D (1999) Stabilizing the boundary between U.S. politics and science. *Social Studies of Science* **29**(1), 87–111. doi: 10.1177/030631299029001004.

Haden VR, Niles MT, Lubell M, Perlman J and Jackson LE (2012) Global and local concerns: what attitudes and beliefs motivate farmers to mitigate and adapt to climate change? *PLoS ONE* **7**(12), 1–7. doi: 10.1371/journal.pone.0052882.

Haigh T, Morton LW, Lemos MC, Knutson C, Prokopy LS, Lo YJ and Angel J (2015) Agricultural advisors as climate information intermediaries: exploring differences in capacity to communicate climate. *Weather, Climate, and Society* **7**(1), 83–93. doi: 10.1175/WCAS-D-14-00015.1.

Hansen J, Marx S and Weber E (2004) The role of climate perceptions, expectations, and forecasts in farmer decision making: the Argentine Pampas and South Florida. *International Research Institute for Climate Predictions Technical Report*, pp. 1–142.

Hayman P, Crean J, Mullen J and Parton K (2007) How do probabilistic seasonal climate forecasts compare with other innovations that Australian farmers are encouraged to adopt? *Australian Journal of Agricultural Research*, **58**, 975–984.

Hornsey MJ, Fielding KS, Mcstay R, Reser JP and Bradley GL (2016) Are people high in skepticism about anthropogenic climate change necessarily resistant to influence? Some cause for optimism. *Environment and Behavior* **48**(7), 905–928. doi: 10.1177/0013916515574085.

Howden SM, Soussana J, Tubiello FN, Chhetri N, Dunlop M, Meinke H, Howden SM, Soussana J, Tubiello FN, Chhetrill N and Dunlop M (2007) Adapting agriculture to climate change. *Proceedings of the National Academy of Sciences of the United States of America* **104**(50), 19691–19696. doi: 10.1073/pnas.0701890104.

Howe PD, Mildenberger M, Marlon JR and Leiserowitz A (2015) Geographic variation in opinions on climate change at state and local scales in the USA. *Nature Climate Change* **5**, 596–603. doi: 10.1038/nclimate2583.

Hu Q, Zillig LMP, Lynne GD, Tomkins AJ, Waltman WJ, Hayes MJ, Hubbard KG, Artikov I, Hoffmann SJ and Wilhite DA (2006) Understanding farmer's forecast use from their beliefs, values, social norms, and perceived obstacles. *Journal of Applied Meteorology and Climatology* **45**(9), 1190–1201. doi: 10.1175/JAM2414.1.

Hyland JJ, Jones DL, Parkhill KA, Barnes AP and Williams AP (2015) Farmers' perceptions of climate change: identifying types. *Agriculture and Human Values*, Springer Netherlands **33**(2), 323–339. doi: 10.1007/s10460-015-9608-9.

Jasanoff S (1996) Beyond epistemology: relativism and engagement in the politics of science. *Social Studies of Science* **26**(2), 393–418. doi: 10.1177/030631296026002008.

Kahan D (2015) Climate-science communication and the measurement problem. *Political Psychology* **36**(S1), 1–43. doi: 10.1111/pops.12244.

Lemos MC, Kirchhoff CJ, Kalafatis SE, Scavia D and Rood RB (2014a) Moving climate information off the shelf: boundary chains and the role of RISAs as adaptive organizations. *Weather, Climate, and Society* **6**(2), 273–285. doi: 10.1175/WCAS-D-13-000441.

Lemos MC, Lo YJ, Kirchhoff C and Haigh T (2014b) Crop advisors as climate information brokers: building the capacity of us farmers to adapt to climate change. *Climate Risk Management* **4**, 32–42. doi: 10.1016/j.crm.2014.08.001.

Marlon J, Howe P, Mildenberger M and Leiserwitz A (2016) *Yale Climate Opinion Maps, U.S. 2016*. New Haven CT: Yale Program on Climate Change Communication.

Mase AS and Prokopy LS (2014) Unrealized potential: a review of perceptions and use of weather and climate information in agricultural decision making. *Weather, Climate, and Society* **6**(1), 47–61. doi: 10.1175/WCAS-D-12-00062.1.

Mase AS, Cho H and Prokopy LS (2015) Enhancing the social amplification of risk framework (SARF) by exploring trust, the availability heuristic, and agricultural advisors' belief in climate change. *Journal of Environmental Psychology* **41**, 166–176. doi: 10.1016/j.jenvp.2014.12.004.

Mase AS, Gramig BM and Prokopy LS (2016) Climate change beliefs, risk perceptions, and adaptation behavior among Midwestern U.S. crop farmers. *Climate Risk Management*, The Authors **15**, 8–17. doi: http://dx.doi.org/10.1016/j.crm.2016.11.004.

Menapace L, Colson G and Raffaelli R (2015) Climate change beliefs and perceptions of agricultural risks: an application of the exchangeability method. *Global Environmental Change*, Elsevier Ltd **35**, 70–81. doi: 10.1016/j.gloenvcha.2015.07.005.

Myers TA, Maibach EW, Roser-Renouf C, Akerlof K and Leiserowitz AA (2013) The relationship between personal experience and belief in the reality of global warming. *Nature Climate Change*, Nature Publishing Group **3**(4), 343–347. doi: 10.1038/nclimate1754.

Niles MT and Mueller ND (2016) Farmer perceptions of climate change: associations with observed temperature and precipitation trends, irrigation, and climate beliefs. *Global Environmental Change*, Elsevier Ltd **39**, 133–142. doi: 10.1016/j.gloenvcha.2016.05.002.

Niles MT, Lubell M and Haden VR (2013) Perceptions and responses to climate policy risks among California farmers. *Global Environmental Change*, Elsevier Ltd **23**(6), 1752–1760. doi: 10.1016/j.gloenvcha.2013.08.005.

Niles MT, Dynes R and Brown M (2016) Farmer's intended and actual adoption of climate change mitigation and adaptation strategies. *Climatic Change*, **135**, 277–295. doi: 10.1007/s10584-015-1558-0.

Noble IR, Huq S, Anokhin YA, Carmin J, Goudou D, Lansigan FP, Osman-Elasha B and Villamizar A (2014) Climate change 2014: impacts, adaptation, and vulnerability. In Field CB, Barros VR, Dokken DJ, Mach KJ, Mastrandrea MD, Bilir TE, Chatterjee M, Ebi KL, Estrada YO, Genova RC, Girma B, Kissel ES, Levy AN, MacCracken S, Mastrandrea PR and

White LL (eds) *Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. New York, pp. 833–868. Available at http://www.ipcc.ch/pdf/assessment-report/ar5/wg2/WGIIAR5-Chap14_FINAL.pdf.

Nunnally JC (1978) *Pscyhometric Theory*, 2nd edn. New York: McGraw-Hill.

O'Conner RE, Bord RJ and Fischer A (1999) Risk perceptions, general environmental beliefs and willingness to address climate change. *Risk Analysis* **19**(3), 461–471.

Osborne JW and Costello AB (2005) Best practices in exploratory factor analysis: four recommendations for getting the most from your analysis. *Practical Assessment, Research and Evaluation* **10**(7), 1–9. Available at http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:Best+Practices+in+Exploratory+FActor+Analysis:+Four+Recommendations+For+Getting+the+Most+FRom+Your+Analysis#2%5Cnhttp://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:Best+practices+in+.

Phillips AW, Reddy S and Durning SJ (2016) Improving response rates and evaluating nonresponse bias in surveys: AMEE Guide No. 102. *Medical Teacher* **38**(3), 217–228. doi: 10.3109/0142159X.2015.1105945.

Poortinga W, Spence A, Whitmarsh L, Capstick S and Pidgeon NF (2011) Uncertain climate : an investigation into public scepticism about anthropogenic climate change. *Global Environmental Change*, Elsevier Ltd **21**(3), 1015–1024. doi: 10.1016/j.gloenvcha.2011.03.001.

Prokopy LS, Haigh T, Mase AS, Angel J, Hart C, Knutson C, Lemos MC, Lo Y-J, McGuire J, Morton LW, Perron J, Todey D and Widhalm M (2013) Agricultural advisors: a receptive audience for weather and climate information? *Weather, Climate, and Society* **5**(2), 162–167. doi: 10.1175/WCAS-D-12-00036.1.

Prokopy LS, Arbuckle JG, Barnes AP, Haden VR, Hogan A, Niles MT and Tyndall J (2015a) Farmers and climate change: a cross-national comparison of beliefs and risk perceptions in high-income countries. *Environmental Management*, Springer US **56**, 492–504. doi: 10.1007/s00267-015-0504-2.

Prokopy LS, Carlton JS, Arbuckle JG, Haigh T, Lemos MC, Mase AS, Babin N, Dunn M, Andresen J, Angel J, Hart C and Power R (2015b) Extension's role in disseminating information about climate change to agricultural stakeholders in the United States. *Climatic Change* **130**(2), 261–272. doi: 10.1007/s10584-015-1339-9.

Prokopy LS, Carlton JS, Haigh T, Lemos MC, Mase AS and Widhalm M (2017) Useful to usable: developing usable climate science for agriculture. *Climate Risk Management*. doi: 10.1016/j.crm.2016.10.004.

Raymond CM and Robinson GM (2013) Factors affecting rural landholders' adaptation to climate change: insights from formal institutions and communities of practice. *Global Environmental Change*, Elsevier Ltd **23**(1), 103–114. doi: 10.1016/j.gloenvcha.2012.11.004.

Roesch-McNally G, Arbuckle JG and Tyndall JC (2017) What would farmers do? Adaptation intentions under a Corn Belt climate change scenario. *Agriculture and Human Values* **32**(2), 333–346.

Running K, Burke J and Shipley K (2017) Perceptions of environmental change and climate concern among Idaho's farmers. *Society & Natural Resources*, Taylor & Francis **30**(6), 659–673. doi: 10.1080/08941920.2016.1239151.

Saad L (2015) *U.S. views on climate change stable after extreme winter*, *Gallup Poll Social Series: Environment*. Available at http://www.gallup.com/poll/182150/views-climate-change-stable-extreme-winter.aspx.

Saad L and Jones J (2016) *U.S. Concern About Global Warming at Eight-Year High*. Available at Gallup.com (Accessed June 30 2017).

Scannell L and Gifford R (2013) Personally relevant climate change: the role of place attachment and local versus global message framing in engagement. *Environment and Behavior* **45**(1), 60–85. doi: 10.1177/0013916511421196.

Schattman RE, Mendez VE, Merrill SC and Zia A (2017) A mixed methods approach to understanding farmer and agricultural advisor perceptions of climate change and adaptation in Vermont, United States. *Agroecology and Sustainable Food Systems* **24**(2), 121–148. doi: 10.1080/21683565.2017.1357667.

Smit B, Burton I, Klein RJT and Wang J (2000) An anatomy of adaptation to climate change and variability. *Climate Change* **45**(1), 223–251. doi: 10.1023/A:1005661622966.

Spence A, Poortinga W, Butler C and Pidgeon NF (2011) Perceptions of climate change and willingness to save energy related to flood experience. *Nature Climate Change*, Nature Publishing Group **1**(4), 46–49. doi: 10.1038/nclimate1059.

Takahashi B, Terracina-hartman MBC, Sopchak AR and Selfa T (2016) Climate change perceptions of NY state farmers: the role of risk perceptions and adaptive capacity. *Environmental Management*, Springer US **58**, 946–957. doi: 10.1007/s00267-016-0742-y.

Tucker M and Napier TL (2002) Preferred sources and channels of soil and water conservation information among farmers in three midwestern US watersheds. *Agriculture, Ecosystems & Environment* **92**, 297–313.

USDA-FSA (2017a) *Farm Service Agency mission and values*, *History and Mission*. Available at https://www.fsa.usda.gov/about-fsa/history-and-mission/index (Accessed 1 January 2017).

USDA-FSA (2017b) *USDA-FSA Organization and Structure*. Available at https://www.fsa.usda.gov/about-fsa/structure-and-organization/index (Accessed 1 January 2017).

van der Linden S (2014) On the relationship between personal experience, affect and risk perception: the case of climate change. *European Journal of Social Psychology* **44**(5), 430–440. doi: 10.1002/ejsp.2008.

van der Linden SL, Leiserowitz AA, Feinberg GD and Maibach EW (2015) The scientific consensus on climate change as a gateway belief: experimental evidence. *PLoS ONE* **10**(2), 1–8. doi: 10.1371/journal.pone.0118489.

Whitmarsh L (2008) Are flood victims more concerned about climate change than other people? The role of direct experience in risk perception and behavioural response. *Journal of Risk Research* **11**(3), 351–374. doi: 10.1080/13669870701552235.

Zahran S, Brody SD, Grover H, Vedlitz A, Zahran S, Brody SD, Grover H, Vedlitz A, Brody SD and Grover H (2006) Climate change vulnerability and policy support. *Society & Natural Resources* **19**(9), 771–789. doi: 10.1080/08941920600835528.