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Broadcast Meteorologists' Views on Climate Change: A State-of-the-Community Review

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ABSTRACT

Broadcast meteorologists—highly skilled professionals who work at the intersection between climate scientists and the public—have considerable opportunity to educate their viewers about the local impacts of global climate change. Prior research has shown that, within the broadcast meteorology community, views of climate change have evolved rapidly over the past decade. Here, using data from three census surveys of U.S. broadcast meteorologists conducted annually between 2015 and 2017, is a comprehensive analysis of broadcast meteorologists' views about climate change. Specifically, this research describes weathercasters' beliefs about climate change and certainty in those beliefs, perceived causes of climate change, perceived scientific consensus and interest in learning more about climate change, belief that climate change is occurring (and the certainty of that belief), belief that climate change is human caused, perceptions of any local impacts of climate change, and perceptions of the solvability of climate change. Today's weathercaster community appears to be sharing the same viewpoints and outlooks as most climate scientists—in particular, that climate change is already affecting the United States and that present-day trends are largely a result of human activity.


1. Introduction

Helping Americans understand how climate change is affecting their community and the larger world around them is an important step toward enabling them to make informed decisions about how best to respond (Bain et al. 2016). At present, climate change is causing a range of impacts in every region of the United States (Hartmann et al. 2013; Academies of Science 2008; Melillo et al. 2014). At the international level, a majority of scientists and major scientific committees such as the Intergovernmental Panel on Climate Change (IPCC) and National Academies of Sciences, agree that

today's climate change is primarily due to human causes (Anderegg et al. 2010; Cook et al. 2013, 2016). The most recent IPCC report concluded that there is greater than 95% probability that anthropogenic greenhouse gas emissions have led to the most recent (past 50 years) warming of the planet (Hartmann et al. 2013). Accounting for peer-reviewed climate papers on global warming, 97% of those papers affirm that humans are factors causing climate change (Cook et al. 2013, 2016).

Although a majority of the American public (70%) believes that climate change is happening (Leiserowitz et al. 2017), most Americans downplay its importance, partially because they see it as a relatively “distant” threat in space, time, and species (Leiserowitz et al. 2017; Weber 2010). The viewpoint that climate change is “distant” leads to variances between the conclusions of the scientific community and the general public. This invariably leads to differences in the public's willingness to advocate for policies that will establish mitigation and adaptation efforts regarding climate change.

Closing the gap between public and scientific community understanding in climate change science not only can assist in creating higher degrees of willingness to

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mitigate and adapt to the harms of climate change but may also result in a greater understanding and acceptance of established science. For example, research shows that when members of the general public understand the scientific consensus about climate change, it acts as a “gateway belief” to understanding other dimensions of the issue and further engagement (van der Linden et al. 2015). With such understanding, it is of utmost importance to identify ways to effectively communicate the science of climate change to the general public through the appropriate medium and using appropriate messengers.

As an important source of weather information for many Americans (Miller et al. 2012), weathercasters are well positioned to help members of the public understand the local relevance of global climate change. Weathercasters 1) have frequent and persistent access to a diversity of American adults across multiple communication platforms (Wilson 2006; Daniels and Loggins 2010; Miller et al. 2012; Demuth et al. 2011; Lazo et al. 2009), 2) are trusted and sought-after sources for both weather and climate change information (Miller et al. 2006; Wilson 2008), and 3) have strong science communication skills (Woods Placky et al. 2016).

Television weathercasters have a primary role of forecasting and reporting local weather, but, given their knowledge of atmospheric science, they also have considerable potential to educate the public with regard to global climate change and its local implications and to do so with viewer trust (Woods Placky et al. 2016; Anderson et al. 2013; Bloodhart et al. 2015; Espinoza et al. 2012).

Understanding the weathercaster community and its present-day relationship with climate science is important when attempting to analyze and project the best avenues for engaging the public. This paper provides a synthesis and overview of what is known about American broadcast meteorologists’ current views on climate change. This is done through analysis of three nationwide surveys administered to a census of those working in broadcast meteorology in 2015, 2016, and 2017 (Maibach et al. 2015, 2016b, 2017).

2. Literature background

The effectiveness of weathercasters as climate educators is apparent in research. When weathercasters report on the local consequences of climate change, over time, their viewers gain a more accurate understanding of the problem (Zhao et al. 2014). This is important because when individuals become more aware and better understand climate change, their personal beliefs directly relate to their inclination to accept or reject the science of climate change (Roser-Renouf et al. 2014). Believing that

climate change is happening—and being certain of that belief—is one of several factors associated with greater climate change issue engagement and policy support (Ding et al. 2011; Krosnick et al. 2006).

In a field experiment conducted in Columbia, South Carolina, it was shown that when a television weathercaster made efforts to educate viewers about the local impacts of climate change, the station’s viewers’ understanding of climate change improved (Zhao et al. 2014). Bloodhart et al. (2015) found similar results where exposure to local television weather forecasts could increase viewer perceptions of extreme local weather, which thereby increased awareness about climate change–related impacts. These studies both indicate that when threats become local the personal threat distance of climate change decreases. Having personally experienced climate change, or being made aware of experiencing it, has the added benefit of removing the aforementioned “psychological distance” of the climate change topic, thus making it seem like a more personally relevant issue (van der Linden 2014). Relaying and highlighting this type of personal experience helps people develop more accurate perceptions of the risk (Weber 2016). Increased risk perceptions are linked with increased support for adopting mitigation action on climate change (Krosnick et al. 2006; Ding et al. 2011).

Although effective, the potential of broadcast meteorologists as local climate educators may be constrained by many factors, including their personal knowledge and views of climate change (Peters-Burton et al. 2014; Schweizer et al. 2014; Wilson 2012), their interest in reporting on climate change (Perkins et al. 2018), and their ability to report about climate change in a challenging news environment (Meldrum et al. 2017; Schweizer et al. 2014; Wilson 2009). It is therefore important to understand the climate change views of broadcast meteorologists. Understanding these views has been a topic of study for nearly two decades (Maibach et al. 2016a, 2011b; Meldrum et al. 2016, 2017; Wilson 2002) and the results have received considerable attention in the news media (Kaufman 2010; Homans 2010; Samenow 2016; Satterfield 2012).

Despite the consensus about the human contribution to present-day climate change in the scientific community, views regarding the causes of climate change in the public and among the weathercaster community have been more diverse (Maibach et al. 2010, 2011a; Perkins et al. 2018). In looking closer at weathercasters, prior research has found moderate rates of climate change skepticism among weathercasters, and climate change beliefs of weathercasters tracked more closely with those of the nonscientists (Wilson 2000, 2002). This said, weathercasters’ beliefs about climate change have

evolved rapidly, and in the last decade these views have become similar to those of climate scientists (Maibach et al. 2017). This is an important consideration because, as found by Peters-Burton et al. (2014), only those weathercasters who believed that climate change was happening and primarily due to human causes found it important to explain.

Any elements of “skepticism” might be rooted in the nature of the weathercaster’s job. As the broadcast meteorology community is more public facing than the climate science field, opinions and viewpoints of weathercasters tend to be more diverse and “public pleasing” with regard to the causes of climate change. This has put the weathercaster in a difficult position as over the past two decades public opinion about the causes of climate change has become increasingly polarized (Dunlap and McCright 2008). In addition, McCright and Dunlap (2011) and Wilson (2012) have found that personally held political beliefs can moderate and/or shape an individual’s views about the causes of climate change. Schweizer et al. (2014) found that weathercasters who believe climate change is happening were particularly sensitive to how polarizing the subject of climate change is and did not believe that discussions about human causes could or should be a central factor; rather, they preferred to report only on historical temperature records.

Many weathercasters do choose to educate their viewership on climate change topics. As found by Perkins et al. (2018), the topics reported on by weathercasters reflect a natural link between their personal interests in learning more about climate-related topics and their interest in presenting this knowledge to their viewership. Personal interest in presenting on air about varying climate topics is positively linked to the weathercaster’s engagement with climate change science outreach. Additionally, weathercasters’ broad science interests are shown to be predictors of engagement with climate change presentation.

In reviewing findings surrounding weathercasters, we must remind the reader that making direct comparisons between the broadcast meteorologist community and climate scientists is not an appropriate juxtaposition. Climate scientists and broadcast meteorologists, despite many similarities in training, personal motivation, and interests, are different career sectors with dissimilar motivations and public outreach goals. Opinions and findings regarding climate change between the two sectors should not be expected to be identical, and each has the potential to use its strengths to benefit the other. The two sectors are complementary, and not repetitive or competitive, and they can and do serve as symbiotic partners in

public education efforts with regard to atmospheric-science-related education to the public.

Data used in this study are a result of a grant funded by the National Science Foundation in which a census survey of all broadcast meteorologists currently working in the United States was fielded annually between 2015 and 2017 (Maibach et al. 2015, 2016b, 2017). As described below, much of the survey methodology remained constant from year to year—although we did not ask every question on every survey and we asked some questions in an open-ended manner on earlier surveys and then in a closed-ended manner in a later survey (based on the findings of the open-ended data). In the current paper we use the findings from these surveys to describe how, at present, weathercasters view the issue of climate change. Specifically, we describe weathercasters’ beliefs about climate change and certainty in those beliefs, perceived causes of climate change, perceived scientific consensus and interest in learning more about climate change, belief that climate change is occurring (and the certainty of that belief), belief that climate change is human caused, perceptions of any local impacts of climate change, and perceptions of the solvability of climate change. Our primary purpose is to display the most comprehensive representation possible of weathercasters’ views of climate change. In several instances, we will use variation in findings from across the three years of the survey to show that these views continue to evolve over time.

3. Methods and participants

On all three surveys (2015, 2016, and 2017), our team attempted to survey every person currently working in the broadcast meteorology field in the United States. In 2015, we used Cision, a commercial database of news professionals (<http://www.cision.com/us/pr-software/media-database>), to obtain an initial list of people currently working in broadcast meteorology; we then verified and updated that list by manually searching the websites of all local broadcast affiliate television stations, regional cable broadcast corporations, and national television stations. In 2016, we began the process with our 2015 list of weathercasters and repeated the manual verification process to update the list. In 2017, the same procedure was repeated to update the 2016 list. This process yielded contact information for a large number of weathercasters in each successive year: 2128 in 2015; 2226 in 2016; and 2325 in 2017. We contacted only weathercasters for whom we were able to find a valid e-mail address and who were working in English-speaking markets (the survey was not available in Spanish). Thus, our final

TABLE 1. Description of weathercasters participating in survey.

		2015	2016	2017
Gender	Male	77%	74%	75%
	Female	23%	26%	25%
Education	Bachelor of Science degree in meteorology/atmospheric science	64%	59%	65%
Additional professional credentials	AMS Certified Broadcast Meteorologist Seal	31%	31%	33%
	AMS Seal of Approval	37%	29%	32%
	NWA Seal of Approval	25%	19%	20%
	No seal of approval	32%	37%	36%
Job title	Chief meteorologist	40%	33%	35%
	Weekend meteorologist	18%	24%	23%
	Morning/noon/midday meteorologist	16%	22%	25%
Age group	18–29	23%	26%	28%
	30–39	27%	27%	24%
	40–49	23%	19%	21%
	50–59	18%	19%	19%
	60–69	9%	9%	9%
	70+	0%	0%	0%

sampling population was 2128 in 2015, 2100 in 2016, and 2224 in 2017.

The surveys were administered online using Qualtrics survey software. Surveys were fielded for approximately 3 weeks in early January 2015, 2016, and 2017 (so as to complete the surveys before the start of the February “sweeps” when Nielson ratings are established); nonrespondents were sent up to five e-mail reminders, one or two times per week. In 2015, a total of 478 weathercasters responded to at least one question on the survey, yielding a response rate of 22.5%, and 378 completed the survey in its entirety, yielding a completion rate of 17.8%. In 2016, 646 completed at least one question, yielding a participation rate of 31.8%, and 593 completed the survey in its entirety, yielding a survey completion rate of 29.2%. In 2017, 486 completed at least one question, yielding a participation rate of 21.9%, and 404 completed the survey in its entirety, yielding a survey completion rate of 18.2%. Many respondents never opened a single e-mail message about the survey and therefore most likely did not know they had been invited to participate: In 2016, 1344 people (66.1% of our total sample) did not open any e-mail message associated with the survey; in 2017, 1701 people (76.6% of our total sample) did not open any e-mail message associated with the survey. It is unclear how many of these weathercasters choose not to participate, and how many did not see our e-mail invitations (possibly because they were captured by spam filters). The median time to complete the survey was 15 min in both 2015 and 2016, and 18 min in 2017.

Table 1 provides information with regard to differences across those polled in each year of the survey;

further detail is provided in the online supplemental material of this paper.

4. Context and findings

a. Climate change beliefs and belief certainty

From 2015 to 2017 in the yearly National Survey of Broadcast Meteorologists (Maibach et al. 2017, 2016b, 2015) there has been a stable but increasing percentage of weathercasters who believe that climate change is occurring, regardless of the cause. In all three years of the survey when asking weathercasters “regardless of the cause, do you think climate change is happening?” it was given context by referencing the American Meteorological Society (AMS) definition of climate change (AMS 2020):

Any systematic change in the long-term statistics of climate elements (such as temperature, pressure, or winds) sustained over several decades or longer. Climate change may be due to natural external forcings, such as changes in solar emission or slow changes in the earth’s orbital elements; natural internal processes of the climate system; or anthropogenic forcing.

Since 2015 (Fig. 1), at least 9 of every 10 members of the weathercaster community have indicated that climate change is occurring. That number has risen from 90% in 2015 to 95% in 2017. On the opposite viewpoint, the number of those who believe climate change is not occurring has decreased by one-half. In 2015 fewer than 1 in 20 (4%) believed climate change was not occurring—this decreased to 1 in 50 (2%) in 2017. The number of those who state that they do not know has also decreased in the past three

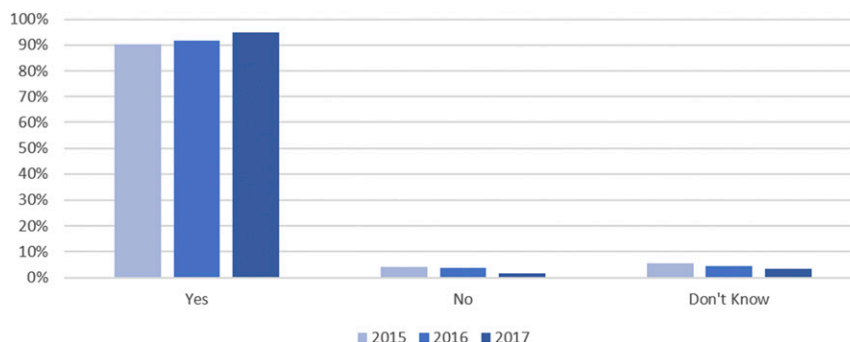


FIG. 1. Weathercasters' belief that climate change is occurring.

years—from 6% in 2015 to 3% in 2017. These results indicate that the weathercaster community has growing agreement that climate change, regardless of the cause, is occurring. Decreasing in proportion are those who do not believe it is occurring and those who are unsure.

Among those 95% who believe that climate change is occurring, belief certainty is strong. The percentage of weathercasters feeling either “very” or “extremely” sure in their belief that climate change is occurring has varied from 81% to 83% for the three years of the survey. The most recent results, however, indicate that those exhibiting the highest category of surety—“extremely” sure is the highest it has been in the three years of the survey—in 2017 nearly one-half (47%) believe that they are “extremely sure” climate change is occurring (Fig. 2).

We also measured the certainty in climate change disbelief—those 2%–4% of the community who did not believe that climate change was occurring. The level of certainty in disbelief was less than the certainty of belief for all years assessed. Those expressing certainty of disbelief as either “very” or “extremely” sure varied from 67% to 42%. This indicates that those who do not believe climate change is occurring

are less certain in their viewpoints than those who believe it is occurring.

b. Perceived scientific consensus

While there is considerable engagement between the climate science and broadcast meteorology communities, shared knowledge is not always fluid. To better grasp this concept, in both 2015 and 2017 we asked weathercasters to answer the following question: “To the best of your knowledge, what percentage of climate scientists think that human-caused climate change is happening?” In 2015 the mean response was 74.7% ($N = 384$), and in 2017 the mean response was 77.73% ($N = 465$). Despite weathercasters on average stating that approximately three-quarters of climate scientists think that human-caused climate is happening today, research by Cook et al. (2016) found that 97% of peer-reviewed papers on climate change affirm that human factors are causing climate change. This result shows a possible knowledge gap between the weathercaster community's understanding of the topic of climate change and the scientific community's actual findings.

c. Perceived causes of climate change

In all three years of the survey (2015–17), we asked those weathercasters who believed that climate change

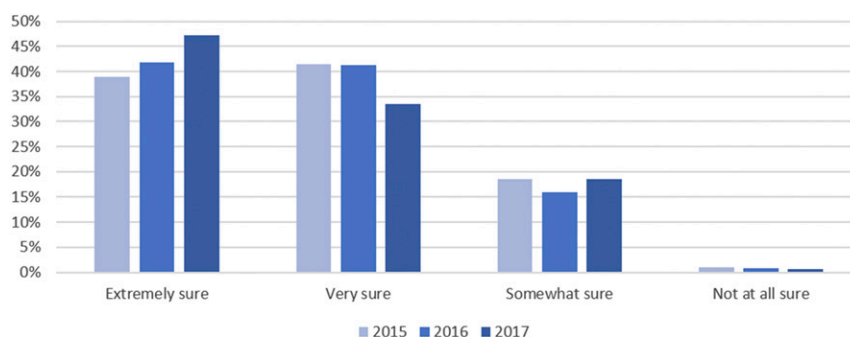


FIG. 2. Certainty in weathercasters' belief that climate change is occurring.

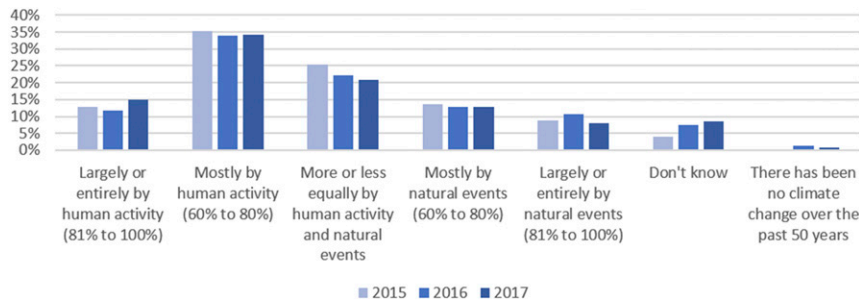


FIG. 3. Climate change attribution.

was occurring (90%–95% of the weathercaster community) “Do you think that the climate change that has occurred over the past 50 years has been caused. . .” As shown in Fig. 3, those who believed human (anthropogenic) causes to be the leading cause (60% or more) varied only slightly during the three years of the survey, with a minimum of 46% in 2016 to a maximum of 49% in 2017. Those who felt that the present climate change was “more or less equally” due to human (anthropogenic) and natural causes steadily decreased from 26% in 2015 to 21% in 2017. Those who believed that natural variation was the leading (more than 60%) cause of climate change varied from a minimum of 21% in 2017 to a maximum of 24% in 2016. Those expressing that they did not know increased from 4% in 2015 to 8% in 2017.

Given these results and how weathercaster opinions appear to have changed given previous results in the literature (Wilson 2000, 2002), we wanted to better understand any recent shifts that may have occurred in personal opinions regarding human-caused climate change. To do so, in 2016 we asked weathercasters “Has your opinion/position on climate change changed in the past five years?” While only 1 of every 5 (21%) stated that their position had changed, viewing recent opinion changes better illustrates how climate science and climate change is being interpreted within the weathercaster community. Of those who said that their opinion had changed ($n = 126$) we asked how it had changed. More than 8 of every 10 (82%) indicated that they were now more convinced that human-caused climate change is happening. These respondents cited reasons contributing to their change in opinion such as “new peer-reviewed climate science information” (62%), “the scientific community seems more certain” (49%), and “one or more climate scientists influenced me” (47%).

d. Climate change experience and risk perception

We asked several questions to see how weathercasters perceive climate change is impacting their local areas. In both 2016 and 2017 we asked weathercasters, “Has the local climate in your media market changed over the

past 50 years?” Results indicate an increasing trend in weathercasters observing that the local climate in their media market as changing. In 2017, more than 6 of every 10 (62%) indicated that they believe that the local climate in their media market has changed in the past 50 years. Only 2 of every 10 are either unsure (19%) or have not noticed a change (19%).

We followed this question with an assessment of the impacts resulting from the climate change. Those 62% respondents who noticed a change in their local climate were then asked to assess whether the impacts of climate change they have observed have been “harmful” or “beneficial” to their local media-market area. The modal categories for both 2016 and 2017 (Fig. 5) indicated that they found the impacts to have been “approximately equally mixed between harmful and beneficial.” This decreased from 6 of every 10 (60%) weathercasters in 2016 to only about one-half (49%) in 2017. However, this decrease is not one sided and seems to be a result of people now viewing impacts either as beneficial or harmful. Between 2016 and 2017 perceived harms and benefits both increased in proportion. Overall, in comparing whether people perceived more harms or benefits, in 2017 those indicating that harms outweighed benefits (39%) were more than 3 times those who perceived climate change benefits to outweigh harms (12%) (Fig. 4).

To better contextualize the perceived harms resulting from climate change that weathercasters have experienced, we asked weathercasters to describe the most harmful impact(s) resulting from climate change in their media market over the past 50 years. These responses were initiated in our 2016 survey as open-ended responses and were then grouped as thematic categories. The two most frequently mentioned harms from climate change were “increase in severe weather” and “harms to water resources,” with 39% and 34% of all respondents responding in a way that fit these categories. Increases in extreme heat (20%), sea level rise (16%), ecosystem imbalances (12%), harms to agriculture (10%), and harms to human health (10%) were all mentioned at least once for every 10 respondents.

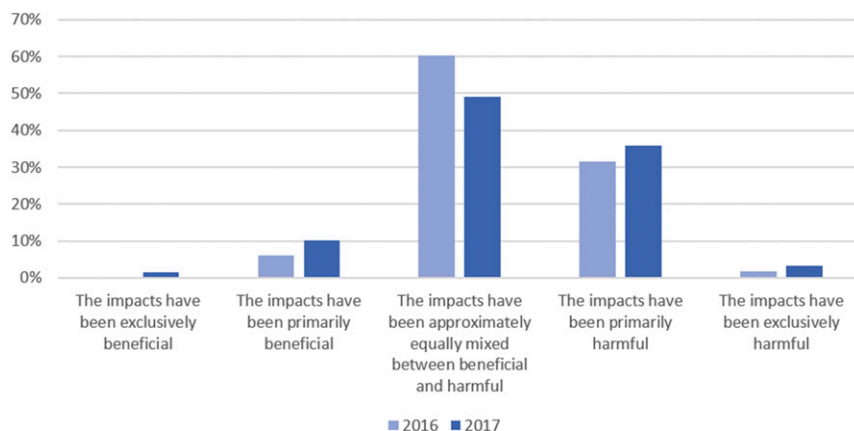


FIG. 4. Assessment of local impacts from climate change.

In 2017 we used the categories generated from the 2016 survey to create closed-ended questions to again understand perceived harmful impacts of climate change over the past 50 years. Although the absolute percentages are not directly comparable, the relative percentages between categories are worth noting. Nearly one-half of all respondents (Fig. 5) indicated that, “yes,” harm had occurred to agricultural resources (50%), seasonal cycles (48%), water resources (47%), and harm to ecosystems or forests (43%). Around 1 of every 3 weathercasters felt that coastal property (34%), human health (33%), infrastructure (31%) and tourism (29%) were harmed as a result of climate change in the past 50 years *although many weathercasters (ranging from 23% to 56%) indicated that they did not know whether these harmful impacts were occurring*. Across both 2016 and 2017, it

appears that the nature of the “harms” due to climate change over the past 50 years have been most apparent with regard to water resources, ecosystems, human health, and agriculture.

In 2016 and 2017, using the same methods, we also asked whether weathercasters perceived any benefits as a result of climate change over the past 50 years in their local market area. With the 2016 open-ended survey question, we found that about 1 of every 3 weathercasters who responded to this question observed benefits from milder seasons (34%), agriculture (23%), water resources (11%), and tourism and recreation (10%). In 2017 we created closed-ended questions to assess benefits. As seen in Fig. 6, we found that milder seasons (47%) were the most frequently observed benefit. This benefit was reported nearly 4 times more often than other benefits, which included benefits

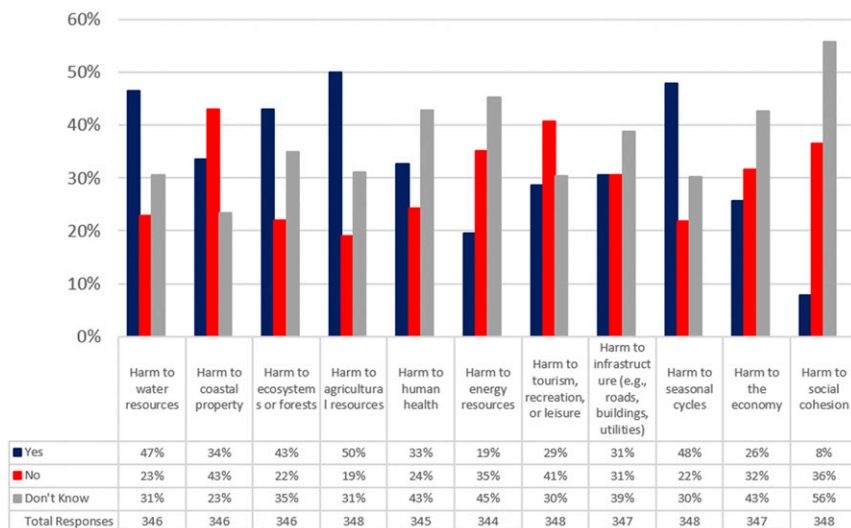


FIG. 5. Local harms attributed to climate change over the past 50 yr, from 2017 survey.

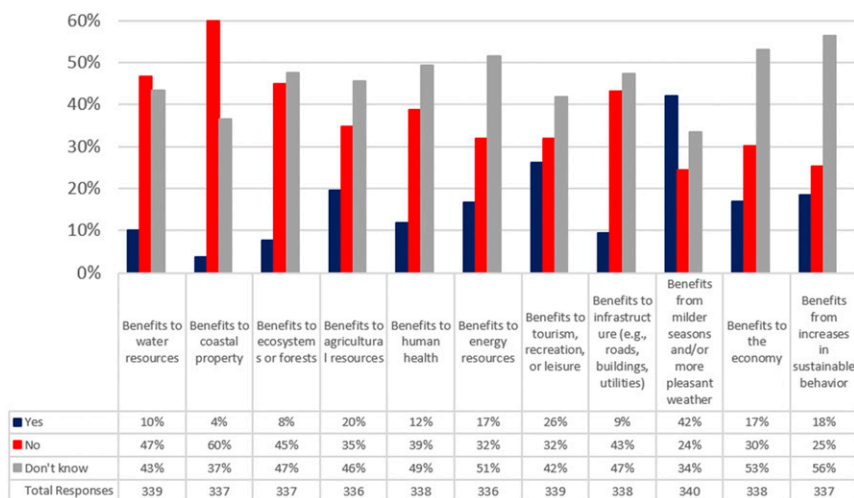


FIG. 6. Local benefits attributed to climate change over the past 50 yr, from 2017 survey.

to tourism (26%), agriculture (20%), sustainability initiatives (18%), energy resources (17%), and the economy (17%).

e. Climate change solutions

Perkins et al. (2018) pointed out, “An intuitive but important thought to keep in mind is that if people do not believe a problem is solvable, they are unlikely to spend time solving it.” In the context of weathercaster activities, it would follow that weathercasters who believe that climate change is both 1) a problem and 2) solvable will be those who will likely engage most with the topic. With this principle, we asked weathercasters about the expected outcomes of climate change mitigation efforts: “Over the next 50 years, to what extent can additional climate change be averted if mitigation measures are taken worldwide (i.e., substantially reducing emissions of carbon dioxide and other greenhouse gases)?” The modal category for every year was that a “moderate amount of additional climate change can be averted,” encompassing between 36% (2015) and

39% (2016) of those responding to the question. Those feeling “a small amount of additional climate change can be averted” encompassed between 31% (2017) and 35% (2015) of those responding. Those feeling that “almost no additional change can be averted” were consistently 13% of responses across all years. Those feeling that a “large amount” or “almost all” climate change can be averted accounted for less than 1 of every 5 respondents across all years (17% in 2017; 8% in 2015) (Fig. 7).

A complimentary question about the expected outcomes of climate change adaptation measures was also asked. In 2017 we asked, “Over the next 50 years, to what extent can harm from climate change be averted in the United States if adaptation measures (i.e., actions to reduce vulnerability) are taken?” As shown in Fig. 8, we found that 45% of respondents felt that a “moderate amount of harm can be averted.” This was followed by a “small amount” (26%) and a “large amount” (18%).

In the 2016 survey we assessed adaptation measures to climate change in varying segments including health, agriculture, freshwater supplies, transportation systems, and

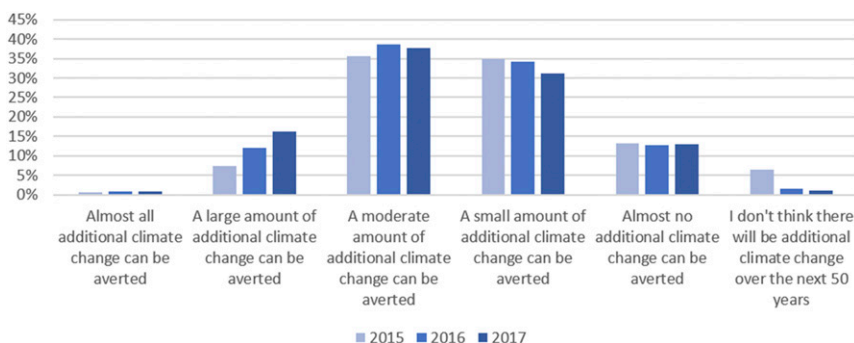


FIG. 7. Averting climate change with mitigation measures.

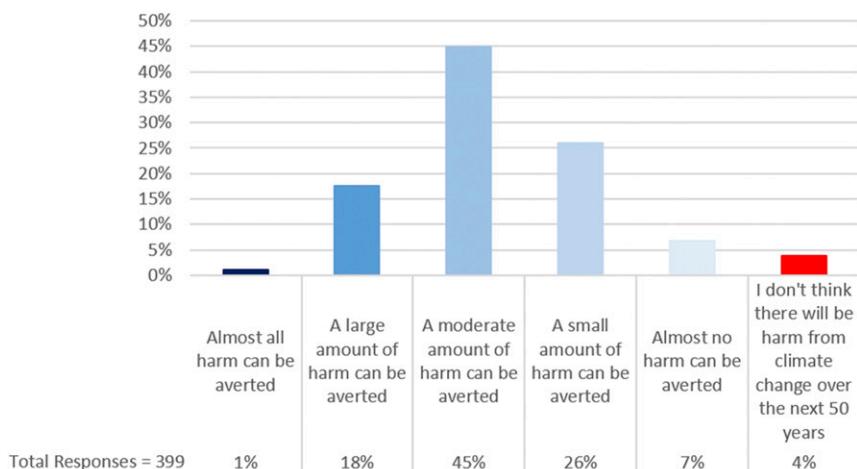


FIG. 8. Averting harms from climate change with adaptation measures, from 2017 survey.

homes and other buildings. As was found in the generic adaptation measure category from the 2017 survey, the modal response related to a “moderate amount” (of harm can be averted) where this level of protection fell between 26% for homes and buildings and 36% for agriculture. Given the context of this question as compared with the generic question, people tended to estimate higher degrees of adaptive capacity for individual sectors than for the whole of the potential impacts from climate change. This is seen where a “large amount” was at least the next largest category in all sector categories (20%–24%) followed by “small amount” (19%–22%) (Fig. 9).

f. Climate change knowledge and information seeking

In 2017 most (77%) weathercasters held some form of university accreditation in meteorology or related

sciences, but there is a limited amount of previous research about the amounts of climate literacy in the discipline. Peters-Burton et al. (2014) suggested that more work should be done to improve climate literacy in the community of television meteorologists. Climate literacy is difficult to accurately measure, however, because many people do not correctly estimate the amount of knowledge they possess on a subject.

With these caveats in mind, in 2017 we assessed personal assessment of knowledge by asking “How well do you understand the science of climate change?” Nearly 4 of every 10 (38%) respondents indicated “moderately well,” 1 of every 3 indicated “somewhat well” (30%), and around 1 of every 5 indicated “very well” (17%). Weathercasters reporting a low understanding of the science represented only 1 of every 7 with “slightly well” (14%) and “not well at all” (1%). Overall, it can be

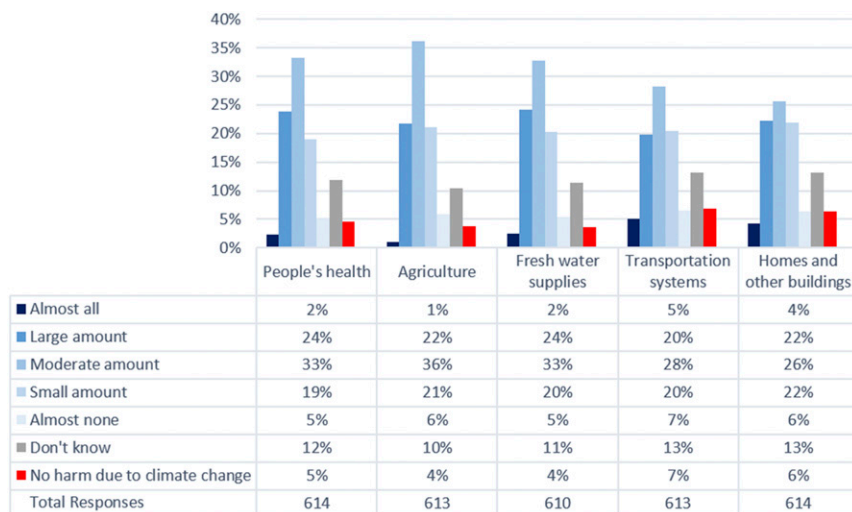


FIG. 9. Averting climate change with adaptation measures in specific sectors, from 2017 survey.

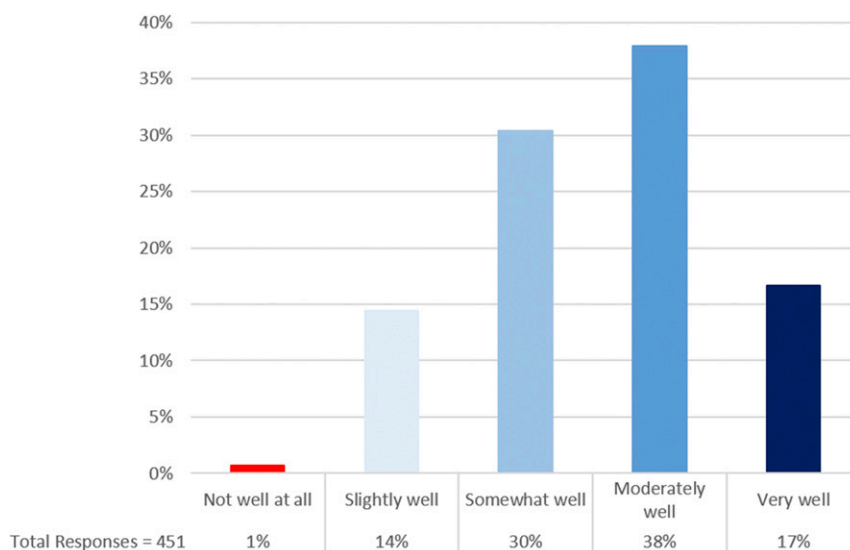


FIG. 10. Personal understanding of climate change science, from 2017 survey.

assumed from these results that most members of the weathercaster community feel that they understand the science of climate change at least somewhat well (Fig. 10).

g. Information seeking

In 2015, we asked all weathercasters, “Which, if any, of the following climate-related topics would you be interested in learning more about?” The purpose of this question was to better understand weathercasters’ desire to learn more about climate-related topics. More than one-half of all weathercasters expressed interest in learning more about 16 of 17 climate-related topics. The exception was “ocean acidification” (48.5% interested), which was likely due to the geographically specific nature of the topic. At least three-quarters of all weathercasters expressed interest in climate-related topics of seasonal patterns (89.3%), extreme precipitation (84.3%), extreme heat (83.2%), flooding (82.1%), droughts (80.7%), winter storms (79.7%), and human health impacts (74.9%).

To further explore engagement with climate change we assessed weathercaster views of the National Climate Assessment (NCA; Melillo et al. 2014). This report is produced by the U.S. government every four years to inform Congress, the president, and the nation about climate change in the United States. Because of its focus within the United States and its local discussion of climate change–related impacts, it provides a good resource to weathercasters who want to learn more about the topic. In 2015 we asked all weathercasters if they had heard of the NCA, if they had read any part of the NCA and how useful they found the NCA to be for

them. We found that three-quarters of weathercasters (74.6%) had heard of the NCA, and of those who had heard of it 8 of every 10 (79.6%) had read some of the findings. Of those reading the NCA, 6 of every 10 (58.9%) found it to be at least “moderately useful.”

One key link between this personal level of engagement and the public level of engagement through presentation is outreach on the topic. We assess this by looking deeper into engagement with the “Climate Matters” program. Climate Matters is produced by the Climate Central organization in association with NOAA, NASA, AMS, and George Mason University and helps television weathercasters report on climate change with free localized climate analyses, broadcast-ready visuals, peer-reviewed climate research, news, resources, and continuing education opportunities. Enrollment in this program has shown to have impacts on the amount and frequency of reporting on climate change and is positively related to the amount of knowledge weathercasters have regarding climate change. From 2015 to 2017, the percentage of weathercasters who have heard of this program has risen from 47% to 56%. In addition, of those who have heard of the program in 2017, 56% also receive materials from Climate Matters, and, of those who receive materials, 8 of every 10 (80%) use the materials.

5. Discussion

Review of the broadcast meteorologist community from 2015 to 2017 provides a perspective of views and opinions that reflects the most up-to-date analysis

regarding the topic of climate change. The weathercaster community has great potential to engage members of the general public on the local impacts of climate change and climate science with proven results for educating the public (Zhao et al. 2014). Educating the public on this topic may result in subsequent public action to help mitigate future human-caused climate change and provide intellectual capital that will drive innovations aimed at adaptations to climate change-related harms.

In the analysis of the current state of the weathercaster community, we have discovered several key factors worth particular note. Overall the current status of the weathercaster community shows, while climate change belief is not of the same consensus as climate scientists, there has been significant merging of beliefs between these complementary professions. Changes of opinion have been tied to increased engagement with peer-reviewed science. The change seen among weathercasters follows the same logic underscoring the need for increased public education on climate change science. Namely, exposure to facts and data generally results in increased issue engagement (Fischhoff 2007; Pidgeon and Fischhoff 2011; Myers et al. 2012; van der Linden 2014). Weathercasters with increased exposure appear to have increased their engagement and belief in the science. Specifically, 95% of the weathercaster community believes that climate change (as defined by AMS) is occurring and confidence of opinion in climate change belief is greater than confidence in climate change disbelief. Around one-half of all weathercasters believe that humans have caused the majority of climate change impacting society today, and 3 of every 4 believe humans have caused at least one-half of the climate change occurring today.

Sharing local examples of climate change is important to facilitating understanding of climate change. If weathercasters have personal experience with climate change, they will have a higher likelihood of communicating this to their viewership. For both weathercasters and the general public, as van der Linden (2014) observes, the personal experience of climate change will remove or decrease the “psychological distance” of the topic and make it a more personally relevant issue. Our research indicates weathercasters do possess these experiences as, regarding personal experience with climate change, more than 6 of every 10 weathercasters believe that the local climate in their area has changed over the past 50 years; in addition, 4 of every 10 see the changes being more harmful than beneficial. Weber (2010, 2016) indicates that personal experiences similar to these are likely to be driving personal opinions on climate change; these, in turn, should be motivating factors for presenting on the topic (Perkins et al. 2018).

The nature of “solutions” is important in the context of climate change because if a problem is too difficult or

appears to be unsolvable, resource allocations are less likely to occur (Perkins et al. 2018). Climate change is a special type of problem that the IPCC (IPCC 2014) emphasizes as approaching a collective-action problem. Because of this characteristic, public education is increasingly important so people will know how they are impacted and how to respond (Abroms and Maibach 2008; Ding et al. 2011). Likewise, if weathercasters feel humankind can offer solutions, they are more likely to engage in this topic. Regarding solutions, most weathercasters believe a moderate amount of additional climate change can be averted by using mitigation measures worldwide; however, very few (fewer than 1 of every 5) believe that a “large amount” or “almost all” climate change can be averted, while nearly one-third believed only a “small amount” can be averted. Adaptation to climate change was similar in that weathercasters felt a “moderate amount of harm” could be averted given the adaptive capacity of society.

With regard to knowledge and information seeking, weathercasters appear to understand their important role in communicating climate science, albeit with some reservations. Weathercasters occupy an intermediary space between climate scientists and the general public and, though most are not formally trained as climate researchers, they do carry both knowledge and authority on topics related to the atmospheric sciences. The American Meteorological Society has advocated the weathercaster take the role as a “station scientist” since the 1990s (Henson 2010). The weathercaster as a climate change reporter is a newer evolution of their engagement with the public (Woods Placky et al. 2016). In an assessment of personal knowledge, we found 4 of every 10 are “moderately” confident and 3 of every 4 are at least “somewhat” confident in their ability to report effectively about climate change. Weathercasters also indicated high degrees of confidence in their personal understanding of the science of climate change. Meldrum et al. (2016) found that weathercasters self-identify as scientists, further establishing weathercasters’ likely comfort with the climate change topic. This comfort with climate change information might be related to active engagement with climate-related science and information seeking as weathercasters were shown to be actively engaging with reports such as the NCA, and programs such as Climate Matters. Weathercasters’ engagement with climate science and the increased ease of reporting on climate change topics can ultimately translate to increased reporting and more public access to climate science.

Assessing barriers to reporting on climate change encountered by weathercasters both personally and in the newsroom (Woods Placky et al. 2016; Perkins et al. 2018)

can inform programs such as Climate Matters and Climate without Borders to supply improved resources to weathercasters on this topic. In addition, special workshop courses within the National Weather Association (NWA) and AMS can be tailored to meet the needs and concerns of weathercasters as their jobs continue to evolve to include discussions on important global environmental topics.

The purpose of this applied research has been to provide an update to the current state of the weathercaster community as it relates to climate change. Understanding the trends of opinions and engagement with weathercasters since 2015 gives a better perspective on how this community has interacted and evolved (Maibach et al. 2017) with climate science. In addition, the context of this research provides a basis for future applied research using many of the theories highlighted in this manuscript. These theories have been shown to be applicable in both analysis of the public and the weathercaster community. This can allow for future research to establish better methods for public communication outreach and engagement that can continue to improve climate literacy within the society.

While potential future research questions are many, we select two questions emerging from this study that show immediate need and promise as the scientific community makes efforts to educate the general public on climate change. First, despite the well-known 97% consensus among climate scientists (Cook et al. 2016), weathercasters estimate that only 75% of peer-reviewed literature shows consensus among climate scientists with regard to the majority anthropogenic nature of climate change. Future research should look more closely into why weathercasters' understanding of climate change and climate science is different from that of the scientific community. Second, this research identified several impacts of climate change that weathercasters found as either harming their local area (Fig. 5) or benefitting (Fig. 6) their local area. Future research in the specific nature of the geography of these perceived impacts would be of particular use in understanding which parts of the United States are most seen to be harmed by climate change and how results from such a study would facilitate better understanding the geography of perceived harms and would allow public information campaigns to geographically target areas based on climate change topical relevancy.

6. Conclusions

This research serves as the most up-to-date and complete analysis of the broadcast meteorologist community

in the United States regarding opinions on climate change. It highlights how the members of the weathercaster community are continuing to evolve in their opinions about climate change and how these opinions, over time, are becoming closer to the findings of the climate science research community. Furthermore, weathercasters are identifying personally with climate change as they are witnessing local impacts of climate change in their communities. Weathercasters are also showing increasing willingness and comfort in sharing their climate science knowledge with their viewership, which ultimately results in improved climate literacy for the general public. Further understanding the opportunities and limitations when engaging with the weathercaster community on public climate change education will provide an excellent path forward for increasingly meaningful connections to be made between the general public and the scientific community.

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