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TV Meteorologists as Local Climate Change Educators

Edward Maibach, Bernadette Woods Placky, Joe Witte, Keith Seitter, Ned Gardiner, Teresa Myers, Sean Sublette, and Heidi Cullen

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Summary and Keywords

Global climate change is influencing the weather in every region of the United States, often in harmful ways. Yet, like people in many countries, most Americans view climate change as a threat that is distant in space (i.e., not here), time (i.e., not now), and species (i.e., not us). To manage risk and avoid harm, it is imperative that the public, professionals, and policy-makers make decisions with an informed understanding of our changing climate. In the United States, broadcast meteorologists are ideally positioned to educate Americans about the current and projected impacts of climate change in their community. They have tremendous reach, are trusted sources of climate information, and are highly skilled science communicators. When our project began in 2009, we learned that many U.S.-based TV weathercasters were potentially interested in reporting on climate change, but few actually were, citing significant barriers including a lack of time to prepare and air stories, and lack of access to high-quality content that can be rapidly used in their broadcasts, social media, and community presentations. To test the premise that TV weathercasters can be effective climate educators—if supported with high-quality localized climate communication content—in 2010 George Mason University, Climate Central, and WLTX-TV (Columbia, SC) developed and pilot-tested *Climate Matters*, a series of short on-air (and online) segments about the local impacts of climate change, delivered by the station's chief meteorologist. During the first year, more than a dozen stories aired. To formally evaluate *Climate Matters*, we conducted pre- and post-test surveys of local TV news viewers in Columbia. After one year, WLTX viewers had developed a more science-based understanding of climate change than viewers of other local news stations, confirming our premise that when TV weathercasters report on the local implications of climate change, their viewers learn. Through a series of expansions, including the addition of important new partners—the American Meteorological Society, National Aeronautical and Space Administration (NASA), National Oceanic and Atmospheric Administration (NOAA), and Yale University—*Climate Matters* has become a comprehensive nationwide climate communication resource program for American

broadcast meteorologists. As of March 2016, 313 local weathercasters nationwide (at 202 stations in 111 media markets) are participating in the program, receiving new content on a weekly basis. Some leaders in the World Meteorological Organization are now promoting the concept of “TV weather presenters as climate change communicators,” and collaborative discussions are underway with Climate Central. In this article, we review the theoretical basis of the program, detail its development and national scale-up, and conclude with insights for how to develop climate communication initiatives for other professional communities of practice in the U.S. and other countries.

Keywords: Climate change, communication, public education, broadcast meteorologists, TV weathercasters, evaluation

Introduction

Global climate change is influencing the weather in every region of the United States, often in harmful ways, and these impacts are projected to become more severe over the coming decades (Melillo, Richmond, & Yohe, 2014). Increases in extreme weather events, and changes in local climate, can have important consequences for human health and safety, agriculture, water resources, transportation, energy supplies, and the resilience of ecosystems. Yet, like people in many countries, most Americans view climate change as a psychologically distant threat—that is, a threat that is seen as distant in space (i.e., not here), time (i.e., not now) and species (i.e., not us) (Leiserowitz, 2005; Leiserowitz et al., October 2015).

Americans who don’t understand that climate change is already creating harmful consequences—in the US and in their community—are less likely to support societal responses to climate change and are less likely to take action themselves (Ding et al., 2011; Krosnick et al., 2006). Moreover, whether they recognize it or not, members of the public, policymakers, business managers, and other professionals make important climate-dependent planning decisions such as where to purchase a home, how to ensure the adequacy of water supplies, and how to power a manufacturing plant that is slated for renovation. To manage risk and avoid harm, it is imperative that such decisions be made with the best possible understanding of changing climatic conditions. Doing so requires an understanding of the fact that climate change is happening here, now, and to us. Climate change is impacting people and other living things, as well as to the ecosystems on which we all depend.

The focus of our project, therefore, is to promote increased understanding of the local impacts of climate variability and climate change, especially (but not limited to) changes

in local weather and related impacts. Such understanding is critical in helping people, organizations, and communities make informed decisions about how to limit or mitigate climate change, and especially how to prepare for, protect against, and adapt to climate change (NAS, 2010).

For a variety of reasons, as societal opinion-leaders, broadcast meteorologists are ideally positioned to educate Americans about the current and projected impacts of climate change in their community (Wilson, 2008):

- 1.** Weathercasters have tremendous reach: Local TV news remains a top news source for American adults, and more than half (58%) say they watch local news primarily for the weather forecast (Pew, 2013). Weathercasters' audiences are not only large, they are diverse, spanning all educational, income, and racial/ethnic groups (DeMuth et al., 2011; Lazo et al., 2009).
- 2.** Weathercasters are trusted sources of information about climate change, second only to climate scientists and more-or-less on par with "other kinds of scientists (i.e., not climate scientists)" (Leiserowitz et al., March 2015). Moreover, weather is not political; the public's perception of weathercasters as apolitical is key, allowing them to circumvent the political divisiveness often linked to climate change.
- 3.** Many weathercasters are scientists themselves, having trained in meteorology or other relevant sciences and are highly skilled science communicators (Henson, 2010). They are expert at appropriately simplifying complex scientific information for the benefit of the public.
- 4.** Most weathercasters say they are interested in informing their viewers about the local impacts of climate change, and that it is appropriate for them to do so (Maibach et al., 2015).
- 5.** When people understand that they have personally experienced climate change, they are more likely to take the issue seriously (Myers et al., 2012), and most people who feel they have personally experienced climate change cite changes in weather patterns and seasons in their community as the ways in which they have experienced it (Akerlof et al., 2012).
- 6.** Local TV weathercasters—who constitute the large majority of the approximately 2,100 professionals currently working in the field of broadcast meteorology in the United States—focus almost entirely on local weather and related issues, thereby creating a natural opportunity to teach viewers local relevance of global climate change.

Moreover, weather drives news; extreme weather drives heightened news coverage and viewer attention. Large numbers of Americans want to stay abreast of the weather, especially when extreme weather and climatic events are predicted or are occurring, and

during their aftermath. For example, flooding in and around Boulder Colorado in 2013 drove a ten-fold increase in web traffic and doubled the viewing audience at the local ABC affiliate (M. Nelson, Chief Meteorologist, KMGH, Denver, CO, personal communication, 2014); and in 2010, nearly 75% of Baltimore residents tuned to local TV news during a major snowstorm dubbed “Snowmageddon” (B. Placky, Meteorologist, WJZ-TV, Baltimore, MD, personal communication, 2014).

Many people rely upon broadcast meteorologists to interpret and respond to extreme weather events (Warner & Henson, 2001), which often generate strong emotional reactions, and which, in turn, can focus attention and support new learning (e.g., Slovic et al., 2004). Research shows that people are best able to manage their fears, acquire new knowledge, and improve future resilience to extreme weather when they have access to informational, emotional, and social support from family, friends, and experts (Ulmer, Sellnow, & Seeger, 2007).

Yet, until recently, relatively few broadcast meteorologists reported on climate change (Maibach et al., *IN PRESS*). Surveys showed that many weathercasters who were potentially interested in reporting on climate change experienced significant barriers to doing so, including a lack of time to prepare and air stories, lack of access to high-quality content that can be rapidly used in their broadcasts, social media and community presentations, and a lack of access to climate scientists for advice and interviews. Some also reported lack of support by station management, and viewers, as obstacles (Maibach et al., 2010, 2011).

We developed *Climate Matters* to reduce these barriers and to enlist America’s TV weathercasters as new, trusted sources for locally focused climate change education. *Climate Matters* has now become a comprehensive nationwide climate communication resource program for the American broadcast meteorology community. Through the *Climate Matters* program, we provide weathercasters with training in climate science, and with timely, broadcast-quality, localized materials about changing weather and climate patterns—and related consequences—so that they can effectively report on the local impacts of global climate change, thereby helping their viewers better understand our changing climate and how it is impacting their community. This vision of climate education is consistent with the National Academy of Sciences call for locally- and experientially-based climate education (NAS, 2010), and it aligns with the reality of how most people learn about weather and climate change (Leiserowitz et al., 2010).

In this article we review the development and current status of a nationwide resource for the broadcast meteorology community. We end the article by examining the *Climate Matters* experience for insights on how to develop effective climate communication

initiatives for other professional communities of practice in the U.S. and other countries. First, however, we review the theoretical, empirical, and practical basis that guided our development process.

Review of the Theoretical, Empirical and Practical Basis of *Climate Matters*

Over the past several decades, cognitive scientists have identified two parallel, interacting modes of information processing: a rational/analytical system; and an emotional/experiential system (Epstein, 1994). The rational/analytical system—the use of which requires considerable mental effort—is logical and deliberative, and it encodes reality in abstract symbols, words, and numbers such as the abstractions and statistics of climate science.

Nobel Prize-winning psychologist Daniel Kahneman (2011) calls this “System 2” and summarizes it as “thinking slow.” By contrast, the experiential/emotional system—the use of which requires no mental effort—is holistic and intuitive, and it encodes reality in concrete images, metaphors, and narratives linked in associative networks, often derived from repeated patterns of direct experience: Kahneman (2011) calls this “System 1” and summarizes it as “thinking fast.” “Experientially derived knowledge is often more compelling and more likely to influence behavior than is abstract knowledge” (Epstein, 1994). Likewise, vivid, concrete information has a greater influence on perceptions and inferences than does “pallid” (e.g., abstract and technical) information (Nisbett & Ross, 1980).

Helping people to connect the dots between their concrete local experience and their understanding of more abstract global processes encourages deeper engagement with climate change (Leiserowitz, 2006; Weber, 2010; Spence et al., 2011). People who learn about climate change through personal experience are more likely to engage with the issue (and seek more information) than people who learn about it merely through exposure to analytical (didactic) information (Leiserowitz, 2006; Weber, 2006, 2010; Marx et al., 2007; Rudman et al., 2013; Spence et al., 2011). Thus, our *Climate Matters* materials seek to teach people about climate change experientially—tapping into their “System 1” learning—in a manner that subsequently engages them analytically (“System 2”) as well.

Insights from studies of risk communication and public health campaigns have also informed our approach. Risk communication experts recognize that people have a strong tendency to simplify risk information—information that is often inherently complicated.

The most important aim of risk communication, therefore, is to help people simplify appropriately (Fischhoff, 1989). Our *Climate Matters* materials help broadcast meteorologists appropriately simplify the complexities of global climate change into simple, clear, fact-based insights about the ways in which weather, climate, and related-factors (e.g., spring bud bursts) in their community are being affected.

Beyond the obvious importance of “getting the message right,” public health communication experts have noted the equal importance of communicating the message with sufficient reach and frequency so that it will be received and considered (Hornik, 2002). Without sufficient reach (the proportion of target audience members who are exposed to the message) and frequency (the number of times they hear the message), audience members are unlikely to hear the message, consider it, discuss it, and begin to make informed decisions based on it. The most successful public health campaigns—success being defined as influencing population behavior—have typically featured “simple clear messages, that are repeated often, by a variety of trusted sources” (Maibach & Covello, 2016).

By design, *Climate Matters* materials are simple clear messages intended for multiple uses by broadcast meteorologists (i.e., on-air, online, in social media, and in community presentations) over time. Moreover, since weathercasters share *Climate Matters* materials with their viewers through social media and other forms of online communication, viewers often share the materials with their friends and family members. This secondary distribution of *Climate Matters* materials is crucially important, because surveys show that friends and family members are highly trusted source of climate change information—despite the fact that most Americans have very low rates of climate change knowledge (Leiserowitz, Smith, & Marlon, 2010).

Climate Matters is also informed by Fischhoff’s (2007) recommended approach to producing effective climate communication materials. Fischhoff argued that climate communication will be most effective when produced collaboratively by three distinct types of experts: climate scientists (who best understand the underlying science), decision/social scientists (who best understand how to present useful information in a usable manner), and communication practitioners (who best understand how to ensure that useful information reaches its intended audiences, repeatedly, at times when they are open to it).

George Mason University and Climate Central created *Climate Matters* specifically as a collaboration between climate scientists, communication scientists, and broadcast meteorologists. As described below, over time additional organizations joined the *Climate*

Matters collaboration—specifically, climate science organizations that are widely trusted by broadcast meteorologists—to help take the model to scale, nationwide.

Lastly, our approach is also based in social marketing techniques that seek to encourage behavior change by making the behavior being promoted *easy, fun, and popular* (Maibach, *IN PRESS*). Specifically, we are encouraging and enabling TV weathercasters to adopt a new behavior—i.e., educating viewers about the local relevance of climate change—by making the behavior *easier to perform* (e.g., by providing them with broadcast-ready materials, and with training on how to effectively use those materials), *more fun* (e.g., by building social support for the behavior among members of the broadcast community, by generating positive publicity for participating weathercasters, and by demonstrating positive audience reactions), and *more popular* (e.g., by rapidly growing the number of weathercasters who are performing the behavior).

History and Development of *Climate Matters*

The concept underlying the *Climate Matters* model came to senior broadcast meteorologist Joe Witte in late 2007—who at the time was working at WJLA, Washington, DC. Witte knew that TV weathercasters had many of the attributes that could make them highly effective climate educators (see above); he contacted communication scientist Ed Maibach (George Mason University) to discuss the potential to activate TV weathercasters as climate educators. In 2008, with new survey results in hand showing that TV weathercasters are highly trusted sources of information about climate change (Leiserowitz, Maibach, & Roser-Renouf, 2009), Witte and Maibach contacted climate scientist Heidi Cullen (Climate Central) to discuss developing a proposal to the U.S. National Science Foundation (NSF) to formally explore the potential of the concept. They and their colleagues wrote a successful NSF grant application (Award # DRL-0917566; Ed Maibach, principal investigator) which allowed them to conduct three research studies to develop and pilot test the concept of TV weathercasters as climate educators.

Initial NSF Research Support

Study #1: In 2009, Rowan, Witte, Maibach, and others—using a snowball sampling technique—identified and conducted in-depth interviews with 18 “early adopter” TV weathercasters who were already actively taking steps to educate their viewers about climate change (Rowan et al., *IN PRESS*). These early adopters were well-versed in and enthusiastic about climate science, and they understood the relevance of the changing

global climate to their local weather conditions. They felt the need to share this information with their viewers and were using a variety of opportunities—albeit almost entirely off-air opportunities (e.g., presentations to schools, community groups, and business audiences, and online and social media postings)—to educate the public. Above all else, the motivation driving these early adopters was the belief in their viewers' abilities to enjoy and benefit from science, especially locally relevant science.

Study #2: In 2010—to determine the extent of weathercasters' potential interest in educating viewers about climate change—Maibach, Wilson, and Witte surveyed broadcast meteorologists who were members of the American Meteorological Society (AMS) and the National Weather Association (NWA), the two professional associations that represent TV weathercasters and other meteorologists (n=571; response rate=42%; Maibach et al., 2010; Wilson, 2012). They learned that a majority of weathercasters (62%) have an interest in reporting on climate change, but most face barriers to doing so, including: lack of time in the newscast, lack of time for field reporting, scientific uncertainty about climate change, lack of management support, lack of access to appropriate visuals/graphics, lack of viewer support, lack of sufficient information on the topic, and lack of access to trusted scientific information.

The potential resources seen as most useful were greater access to climate scientists, and access to appropriate broadcast-quality graphics and animations. Another finding that proved important later in the development of *Climate Matters* was that a large majority of weathercasters trust state climatologists (85%), NWA (83%), NOAA/National Weather Service (82%), peer-reviewed journals (80%), AMS (79%), and climate scientists (73%) as sources of information about climate change.

Study #3: In 2010 and 2011—to test the premise that TV weathercasters can be effective climate educators—Maibach, Cullen, Witte, and colleagues partnered with WLTX (Columbia, SC) Chief Meteorologist Jim Gandy and News Director Marybeth Jacoby to identify, develop, and air a series of brief, localized climate change news segments. Members of the team—including climate scientists, communication scientists, and TV weathercasters—brainstormed story ideas that were subsequently researched (using NOAA and other data about Columbia) and iteratively developed into final scripts and supporting graphics. WLTX team members Gandy and Jacoby decided to brand the story series *Climate Matters*, thereby naming the program.

Concurrently, to collect baseline evaluation data, a random digit dialing telephone survey was conducted of local TV news viewers in Columbia. Over the course of the next year, Gandy and Jacoby produced and aired 13 stories, and placed the stories on the WLTX website. The cumulative impact of this news coverage was evaluated with two viewer surveys at the end of the year—a panel survey (i.e., a recontact of baseline survey

participants) and a new cross-sectional survey. Both surveys found that, over the course of the year, WLTX viewers had learned more about climate change than viewers of competing stations, providing preliminary proof of principle for the *Climate Matters* concept (Zhao et al., 2014). A 4-minute video about the pilot test presents WLTX's perspective on the experience.

[This video cannot be viewed in PDF format. To view it, please go to the original web version of this chapter.]

The success of the initial *Climate Matters* pilot project garnered considerable positive media attention (e.g., Hutchins, 2013, *Columbia Journalism Review*; Malone, 2013, *Broadcasting and Cable*; and Ludden, 2013, *NPR Morning Edition*) and earned Jim Gandy the 2013 American Meteorological Society Award For Excellence in Science Reporting by a Broadcast Meteorologist. The AMS award committee stated: "Mr. Gandy received the award and recognition for pioneering efforts to educate viewers about climate change and explaining how it already affects them." This publicity was helpful in bringing the work to the attention of other TV weathercasters.

Expanding the Partnership

Early in 2010, NSF released a request for proposals (RFP) for its newly established Climate Change Education Partnership (CCEP) program. The CCEP program sought to:

... establish a coordinated national network of regionally- or thematically-based partnerships devoted to increasing the adoption of effective, high quality educational programs and resources related to the science of climate change and its impacts. Each CCEP is required to be of a large enough scale that it will have catalytic or transformative impact that cannot be achieved through other core NSF program awards.

Despite the fact that we had not yet proven the *Climate Matters* model, we felt the model was responsive to the RFP and submitted a proposal. Our CCEP Phase 1 planning grant to systematically study the potential for scaling up *Climate Matters* was awarded in fall 2010 (Award # DUE-10432351, Ed Maibach, principal investigator). This created the opportunity to expand the partnership to include a range of additional organizations that were well positioned to help TV weathercasters become effective local climate educators. The organizations that participated in this planning process included: the weathercasters' professional associations—AMS and NWA; the government climate science agencies most trusted by TV weathercasters—NOAA and NASA; the American Association of State Climatologists; and Yale University's Forum on Climate Change and the Media.

Through a detailed 18-month planning process, the partner organizations conducted: original research to verify the extent of potential weathercaster interest in embracing the role of climate change education; research to identify the climate change-related continuing education needs of working TV weathercasters; research to identify the climate change-related formal education needs of meteorology students in American universities; and activities intended to clarify and deescalate conflicts in the broadcast meteorology that had arisen over the issue of climate change (Schweizer et al., 2014). Although our Phase 2 proposal—to scale up *Climate Matters*—was not funded, the Phase 1 planning grant was pivotal in that it enabled critically important organizations to join the *Climate Matters* partnership and to systematically work through issues that could impede the project’s potential to be taken to scale nationwide.

Initial Scale-Up of the Program

After a series of discussions with a number of broadcast meteorologists in late 2011, with financial support from The Schmidt Family and Town Creek Foundations, in February 2012 Climate Central expanded the program to 10 broadcast meteorologists—each of whom worked in a different media market in various places around the country. Participating meteorologists received a weekly email that included localized climate change content produced from NOAA data and other peer-reviewed resources. These emails featured climate facts, images, and broadcast-ready graphics illustrating climate trends customized to each meteorologist’s market. An archive of *Climate Matters* materials was also developed, with links to the archive provided in each email. (See Appendix: Sample *Climate Matters* Graphics) All current and past *Climate Matters* materials are available online.

This initial scale-up demonstrated real demand within the broadcast community for climate data and information and provided Climate Central with an opportunity to assess the challenges associated with producing weekly, localized content for multiple meteorologists in multiple locations. Climate Central used this period to plan for the future staged growth of *Climate Matters* into a fully operational national program.

Additional Assessment of Scale-Up Potential: The Virginia Evaluation Project

In spring 2013, using remaining NSF CCEP planning funds and philanthropic funding, Mason and Climate Central launched a third pilot project: an 18-month statewide evaluation of *Climate Matters* in Virginia (in three test markets as compared to four

control markets). The aims of the project were twofold: (1) to determine what proportion of TV weathercasters who were invited to participate in *Climate Matters* would do so, and (2) to assess the impact of their participation on public understanding of climate change. To that end, three of Virginia's media markets were designed as test markets (Washington, DC/Northern Virginia; Richmond; Roanoke) and the state's other four media markets were designated control markets. Participating weathercasters received weekly emails containing information and one or more broadcast-, web-, and social media-ready graphics about a local (or in some cases a national or global) climate change impact—which was usually but not always related to weather or seasonal events (e.g., spring bud burst)—and/or a climate change projection.

This project was highly successful in terms of its first aim: 20 of the 47 TV weathercasters working in the three test markets enrolled as participants in *Climate Matters*, a 42% participation rate. Regrettably, the project was not successful in achieving its second aim. To evaluate viewer impact, we conducted a panel survey of local TV news viewers—at baseline (n=2,000; see Bloodhart et al., 2015), six months (n=1,001), and 18 months (n=750). The evaluation results have not yet been published, but in brief, we found that public understanding of climate change did not increase more in the test communities than in the control communities.

Two factors appear to have contributed to the lack of viewer impact. As compared to the prior several years, weather conditions across the state during the test period were largely uneventful, with mild temperatures and more rain than usual, but not to the extreme. Thus, the weather conditions encountered during the test period failed to create many climate change-related “news hooks.” In what environmental journalist Andy Revkin (2007) has called “the tyranny of the news,” there is a fundamental impediment to coverage of climate change in the news—“news is almost always something that happens that makes the world different today.” Without news hooks, important issues, including issues of enormous long-term importance like climate change, are unlikely to be covered in the news.

Perhaps more importantly, of the 20 participating weathercasters in the test markets, only a few used the *Climate Matters* materials on-air, and only infrequently; many of the others used the materials only online or in social media, while some didn't use the materials at all. The important lessons we took from this pilot project therefore were: (1) if offered the opportunity to participate in *Climate Matters*, large numbers of weathercasters will sign up to do so, but (2) signing up does not necessarily translate into use of the materials, especially not on-air. This experience strongly suggested the need to find additional ways of helping interested weathercasters to actually use *Climate Matters* materials, especially on-air.

Assessing Market Demand Nationwide

In 2013, more or less concurrent with the decision to implement the Virginia Project, with additional funding from private foundations (Robertson Foundation, Schmidt Family Foundation, ClimateWorks, and others) Climate Central set a goal of expanding the number of weathercasters participating in *Climate Matters* nationwide to 50. All participating weathercasters were provided with climate information and multimedia graphics—usually localized—on a weekly basis. Also concurrently, Climate Central was developing and releasing additional climate science and journalism projects (e.g., *The Age of Western Wildfires*, and an expansion of *Surging Seas*), which provided additional visibility for *Climate Matters*, created news hooks, and created more opportunities for interaction between weathercasters and climate scientists. Given the growing number of Spanish speakers and Spanish-language TV stations in the United States, in 2013 a Spanish-language version of *Climate Matters* was developed and continues to be offered. The Spanish translations are provided by NBC6 Chief Meteorologist (South Florida) and AMS Fellow, John Morales, under contract to Climate Central. Spanish language *Climate Matters* materials are archived at www.climatecentral.org/climate-matters-spanish-edition. In 2013, the *Climate Matters* team also offered a climate science workshop for broadcasters at the AMS Broadcast conference. Market demand for *Climate Matters* proved to be beyond expectations; by the end of 2013, over 100 weathercasters were participating in the program.

Evolution into a Broader Nationwide Program

With additional funding from the National Science Foundation (Award #DLR-1422431; Ed Maibach, principal investigator) and with continued major funding from the above-mentioned foundations and new funding from the Heising-Simons Foundation, *Climate Matters* has now evolved into a broad nationwide program (Placky et al., 2016). The goal for the current phase of the program is to grow the number of participating weathercasters to 300 by August 2017. In early 2016, we achieved this recruitment goal. As of March 2016, 313 local weathercasters nationwide are participating in the program, broadcasting from 202 stations in 111 (out of the 210) Nielsen Media Markets.

We continue to expand and refine the climate science—and climate communication—trainings that we offer members of the broadcast meteorology community.

In 2014 and 2015, we conducted several partial or full-day workshops and presented scientific papers at the AMS Broadcast Conferences and at the National Weather Association Annual Meetings. The faculty for these workshops included highly regarded climate scientists and some of the most prolific broadcast users of the *Climate Matters* materials. The objective of the workshops in 2014 was to provide weathercasters with the most current and relevant science on how global climate change is influencing local weather.

In 2015, we added an additional objective (based on the findings from the Virginia Evaluation Project): to enhance participating weathercaster's confidence and competence in airing stories about the local relevance of climate change—by exposing them to a range of examples by their peers who are airing such stories and by giving them the opportunity to practice producing stories with *Climate Matters* materials.

We have taken two additional steps to increase weathercaster's confidence and competence in airing climate stories. The *Climate Matters* Facebook page now features a growing number of video clips of weathercasters using *Climate Matters* materials on-air. The format of the weekly *Climate Matters* email to weathercasters has also been revised to include two video clips of weathercasters using the *Climate Matters* distributed the prior week. Both of these methods rely on peer modeling as a means to boost self-efficacy and increase skills (Bandura, 1986).

In an attempt to achieve several aims—to interact with TV weathercasters more frequently, to reach weathercasters who are unable to participate in the annual meetings hosted by their professional society, and to create a “climate-friendly” (i.e., low carbon) educational offering—in 2014 the *Climate Matters* team began hosting a series of 8 to 10 climate science webinars each year. Webinar topics have included the basics of climate change, as well as a range more specialized topics including tropical cyclones, climate models, and extreme event attribution. All events are can be accessed through an online archive.

The core staff of the *Climate Matters* team at Climate Central has also been expanded to include a second former broadcast meteorologist who is conducting direct outreach to the participating *Climate Matters* meteorologists—to encourage and enable them to use *Climate Matters* materials more frequently and more effectively. For example, when a region of the country is experiencing a weather trend that vividly illustrates climate change, Climate Central's outreach meteorologist will directly contact participating broadcasters in the region with advice—and graphics—on how to cover the story.

In addition, our team attempts to anticipate and prepare for newsworthy weather-climate stories—with data analysis and content production—before they break. This enables us to

provide participating weathercasters with timely, relevant information that would be infeasible for them to prepare on their own.

As the program has evolved, rates of use have been increasing. The number of on-air uses of *Climate Matters* materials grew substantially in 2015, totaling 491, which is a dramatic increase over use rates in 2013 and 2014 (n=22 and 109, respectively). On-line and social media use rate (blogs, Facebook and Twitter) also increased with 816 uses in 2015, as compared to 402 in 2014 and 141 in 2013. More generally, climate change reporting by TV weathercasters (including but not limited to reporting using *Climate Matters* materials) also grew sharply in 2015 as compared to 2014: on air coverage increased from 236 to 507 stories, and online and social media coverage increased from 753 to 1,241 posts.

Key Issues and Ongoing Evolution

Maximizing the scale-up of *Climate Matters* as a nationwide program requires progress on two aims: (1) recruiting all TV weathercasters who are currently interested in expanding their professional role to include educating their viewers about the local relevance of global climate change, and (2) increasing the reach and frequency of weathercaster-delivered climate education—on-air, and through online and social media—by providing participating weathercasters with the materials, education, and training they need to make this new role feasible in the context of their current job. As noted above, progress toward the first aim—i.e., recruitment—is ahead of schedule and outpacing our expectations, while progress on the second aim is accruing at a slower pace.

Increasing Reach and Frequency On-Air

Several of our primary strategies for accelerating progress toward the second aim are described above. These include diversifying the focus of the workshops to include more opportunities for peer modeling, practice, and feedback; featuring peer modeling examples on the Facebook page and in the weekly emails; increasing the frequency of our interaction with participating weathercasters via webinars; anticipating and preparing for newsworthy weather-climate stories before they break; and proactively engaging weathercasters with story suggestions when weather or climatic conditions in their market create a potential news hook.

Beginning in 2016, we are adding several additional strategies to promote greater use of *Climate Matters* materials. These include offering additional workshops in an effort to work more intensively with a larger number of weathercasters; convening a standing advisory committee of (demographically and geographically) diverse frequent on-air users of *Climate Matters* materials, to provide us—and their weathercaster peers—with insights about what climate education practices work best in the busy newsroom environment; and collaborating with the leading television news consulting company (SmithGeiger) to present *Climate Matters* to news directors and general managers of TV stations and to news media ownership groups.

This latter strategy—outreach to news directors, general managers, and ownership groups through news industry consultants—was an outgrowth of our recent national survey of TV weathercasters (Maibach et al., 2015) in which we learned that many weathercasters are reluctant to educate their viewers about climate change because they perceive a lack of support among members of their station management. About half (53%) of TV weathercasters feel their news director would support their decision to report on the local impacts of climate change on-air, but about 2 in 10 (18%) feel their news director would not be supportive, and about 3 in 10 (29%) are unsure (Maibach et al., 2015). This collaboration with industry consultants—who provide feedback and guidance to owners, management, news directors, and weather teams—should help to create more dialogue within stations as to the merits of presenting climate information as part of the weathercast, and will hopefully result in more climate coverage by broadcast meteorologists.

Lastly, also in response to a key finding from our most recent weathercaster survey—concerns about viewer reactions—we will be providing participating weathercasters with public opinion data from the Yale Climate Opinion Maps. These maps show current levels of 14 different indicators of public opinion about climate change at the state and county level. These maps are likely to be reassuring to most weathercasters, because the rate of overt climate denial—and related attitudes—is very low in nearly all American communities, yet is widely overestimated by most weathercasters (and members of the public).

Increasing Reach, Frequency, and Sharing Online and in Social Media

The business model of commercial television continues to evolve with a move toward mobile digital platforms. This offers weathercasters greater ability than ever to reach the public throughout the day, through non-broadcast channels. In turn, person-to-person sharing of this information—through social media—can greatly extend the reach and

frequency of *Climate Matters* materials that weathercasters post online and in their social media feeds. Indeed, recent research has shown that social media outreach by members of the local weather team increases on-air viewership as well (Geiger, 2016). We continue to refine *Climate Matters* products so as to take full advantage of the current migration of consumer media to mobile platforms.

The migration to digital mobile platforms was one of the driving forces behind the development of the Climate Central website, WXshift.com, which was launched in September 2015. By providing immediate weather and climate connection data on a local level, the site offers a full service climate science resource, helping to remove barriers to communication of climate science and support weathercasters by rapidly answering questions posed by their audience or managers. This is information that weathercasters can easily share through their social and online channels.

Evaluating the Impact of Climate Matters on Public Understanding of Climate Change

We will use a quasi-experimental “dose response” multiple time-series, nonequivalent groups design to assess the impact of *Climate Matters* (Cook & Campbell, 1979). This design will allow us to assess program impact by establishing a dose-response relationship, over time, between TV weathercaster adoption and use of *Climate Matters* materials (i.e., our independent variable [IV]) and changes in public understanding of climate change (i.e., our dependent variables [DVs]).

The IV (an estimate of “campaign” dose or exposure)—which will be measured at the media market level—is the degree to which participating weathercasters use *Climate Matters* materials (as ascertained both by self-report in an annual survey of weathercasters and by independent verification through monitoring of stories aired and social media posts). Use measures will be adjusted based on the weathercaster’s station’s market share. The unit of analysis is the media market.

The DVs (the indicators of our learning objectives, as identified above) have been measured twice yearly for the past three to six years (depending on the indicator) on the nationally representative *Climate Change in the American Mind* surveys conducted by Yale and George Mason University (n=1,000 to 1,250 per survey), and will continue to be measured twice yearly for the next two years.

We will use multi-level statistical modeling to estimate the dose-response relationship. Participants from the CCAM surveys will comprise “Level 1,” or the individual level; they will be grouped based on the media market in which they live, which will comprise “Level

2,” or the group level. To gain sufficient power for analyses, we will restrict analyses to media markets in which there are an average of 10 participants per year in all waves of the CCAM data collection; we estimate this to be 101 markets (the largest being NYC and the smallest being Altoona, PA), which is 49% of all media markets. This design gives us statistical power at the .80 level to detect a small campaign effect size ($d \approx .19$).

Insights for Other Nations and/or Other Specialized Communities of Practice

The most fundamental conclusion from decades of climate science research is that our global average temperature has risen in the industrial era and continues to rise. These increasing temperatures are, in turn, creating a range of harmful impacts on weather, water resources, coastal communities, agriculture, human health, transportation, and ecosystems (Mellilo et al., 2014; IPCC, 2014). Beyond the profound need for a global mitigation response that will limit the temperature increase to well below 2.0 °C above pre-industrial levels—ideally no more than 1.5°C, as per the recent United Nations COP21 meeting in Paris—adaptation has become an increasingly vital activity within all sectors of the economy and in all governments around the world, including the United States. Responding to the mitigation policy objectives promulgated at COP21—and the climate change adaptation needs of communities and businesses—may require new technical expertise by members of many professional communities, but will certainly require new ways of communicating, sharing knowledge, and making decisions involving diverse groups of professionals, including the public.

Our project, *Climate Matters*, is premised on our analysis (above) that suggests that TV weathercasters—a small, geographically dispersed, yet trusted community of practice—can collectively have a large impact on public understanding of current climate impacts and future climate risks, especially local impacts and risks. While weathercasters are not yet expressing their full potential as local climate educators, *Climate Matters* appears to be playing a positive role in moving their community of practice in the United States forward in this capacity.

As awareness of the program has grown among members of the international broadcast meteorology community, we have received requests to expand the program overseas. Indeed, some leaders in the World Meteorological Organization (WMO) are now promoting the concept of “TV weather presenters as climate change communicators,” and collaborative discussions are underway with Climate Central. WMO has also invited weathercasters from around the world to imagine “a weather report from the year 2050.”

Nearly two dozen weather teams from around the world have responded with video reports ranging in length from 2 to 14 minutes, which are now available for viewing on the WMO website and can be rebroadcast free of charge.

Moreover, the potential reach and influence of weathercasters is not limited to members of the public, but also includes members of myriad other important communities of practice including health professionals, agricultural extension agents, water managers, community planners, transportation officials, and perhaps most importantly, public policy makers. Weathercaster delivered public education about the connections between weather and climate change—perhaps especially in the aftermath of extreme weather events—is likely to be especially helpful to members of communities of practice whose work must consider and anticipate the effects of our changing climate, in order to be most effective and cost-effective.

More broadly, the approach we are taking in *Climate Matters* may have direct relevance to cultivating other important communities of practice as societal assets in responding to climate change. In brief, this approach includes: identifying an important community of practice; conducting research with members of the community to understand their potential as assets in helping individuals, organizations, and/or communities respond productively to climate change; and partnering with their professional societies and relevant government agencies to create, pilot-test, and scale-up the delivery of effective resources that will help them fully realize their potential as climate change mitigation and adaptation assets over the decades to come. Other relevant communities of practice may benefit from applying this approach; indeed, some already are benefiting.

For example, water managers are increasingly using climate information to make important operational decisions. Some of the nation's largest water utilities formed the Water Utility Climate Alliance (WUCA) to enhance climate change research and improve water management decision-making so as to ensure that water utilities are positioned to respond to climate change and protect their community's water supplies. One member, Tampa Bay Water, is using NOAA Climate Prediction Center climate outlooks to anticipate water shortages on a monthly to seasonal basis (see video). Other members, Denver Water and Southern Nevada Water Authority, are working with climate scientists to analyze the risks to its water users over decadal time scales (see video). In turn, both utilities are working with planners in seven Western states and the US Department of Interior to develop water infrastructure to cope with shortfalls that are anticipated to strike the basin on a routine basis in coming years.

Dozens of examples of climate planning and adaptation from around the nation—representing business, community, and local government decision-making processes—reveal that Americans are most receptive to learning about climate in the context of

decisions that they have to make. While planning decisions (e.g., for large infrastructure projects) rarely begin and end with discussions of climate, reliable data and up-to-date climatic information is essential, especially for large capital projects with lifetimes exceeding a decade, since climate change is likely to impact those projects within their designed life spans. Given the influence of changing climate conditions upon processes that affect humans on all time scales—from weeks (i.e., extreme events) to months (i.e., seasonal flux in precipitation or temperature influenced by ocean conditions that are, in turn, influenced by a warming atmosphere), to decades (i.e., large capital projects such as dams, bridges, and water purification facilities)—professionals in many seemingly disparate areas are realizing that it is important for them to consider climate change and to educate their stakeholders about climate change considerations, so they can better respond to climate challenges they face.

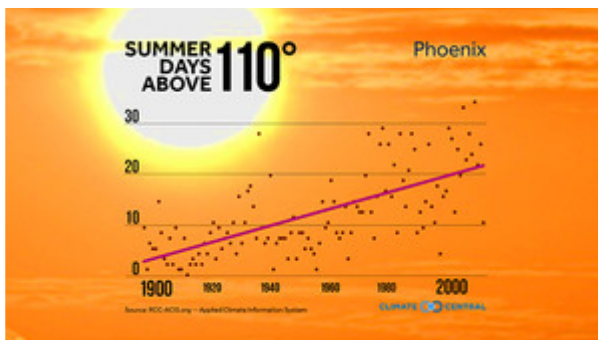
The new agreement to emerge from the COP21 meeting in Paris reiterates the need for both climate science and its communication to strengthen in the coming years. The agreement invites the IPCC to provide a special report in 2018 on the impacts of global warming of 1.5°C above pre-industrial levels. As the IPCC does not regularly interact with the public about its reports, it is imperative that a communication bridge exist between the technical information provided by the IPCC and a non-technical audience. In addition, the agreement indicates, “Parties shall cooperate in taking measures, as appropriate, to enhance climate change education, training, public awareness, public participation and public access to information.” The relevance of *Climate Matters* is heightened with this new agreement.

Climate Matters has honed an approach to supporting a community of practice—TV weathercasters, all of whom share an interest in public safety and weather education—in helping members of their broader community understand and respond appropriately to climate change. Our approach emphasizes strong partnerships among universities, NGOs, professional societies, and government agencies, as well as identifying and overcoming the barriers to the innovative professional practices being promoted. Our approach has also consciously taken steps to de-escalate the acrimony that has all too often accompanied discussions about climate change in America: participation is voluntary; the focus is strictly on promoting a better understanding of the science, not on discussing or attempting to influence policy; participants are allowed to use the program’s resources any way they see fit; and all members of the community of practice are treated with respect, regardless of their views about climate change. Other professional organizations may wish to employ these approaches in their efforts to help their stakeholders better understand climate challenges and opportunities.

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Appendix: Sample Climate Matters Graphics



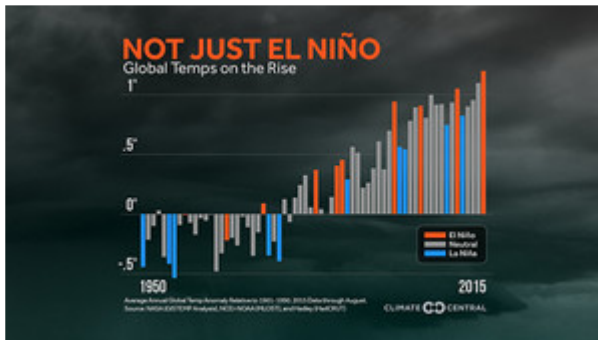
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Figure 1. Historic trend showing the increase of extremely hot days in Phoenix.



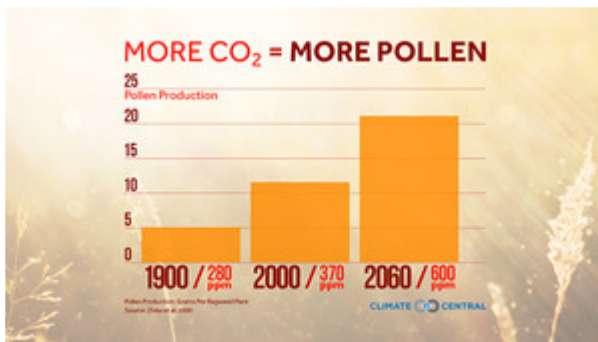
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Figure 2. Graphic illustrating which of the four seasons is warming at the fastest rate for each state. This Climate Matters analysis was released along with each state's individual warming trends for all four seasons.



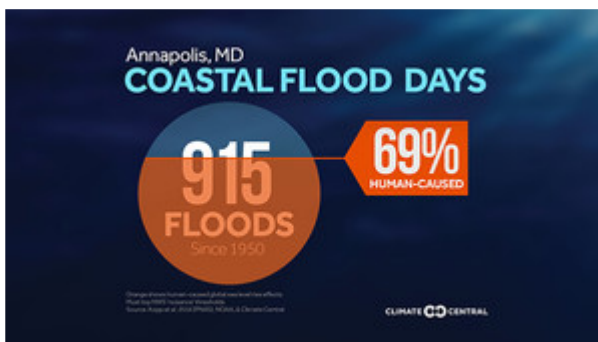
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Figure 3. Increasing global temperature anomalies, highlighted by their El Niño, La Niña, or neutral year.



Click to view larger

Figure 4. Pollen on the rise with increasing atmospheric carbon dioxide levels.



Click to view larger

Figure 5. Graphic showing the number of coastal flood days (based on the NOAA definition of “nuisance flooding”) in Annapolis, MD since 1950 that can be attributed to human-caused climate change.

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Edward Maibach

Center for Climate Change Communication, George Mason University

Bernadette Woods Placky

Climate Central

Joe Witte

National Aeronautics and Space Administration, Goddard Spaceflight Center

Keith Seitter

American Meteorological Society

Ned Gardiner

National Oceanic and Atmospheric Administration

Teresa Myers

Center for Climate Change Communication, George Mason University

Sean Sublette

Climate Central, Inc.

Heidi Cullen

Climate Central

