1.0 PROJECT TITLE

An Audience Segmentation Analysis of Connecticut Coastal Residents to Support Storm Preparedness

2.0 PRINCIPAL AND ASSOCIATIVE INVESTIGATORS

PI: Dr. Jennifer Marlon
School of Forestry & Environmental Studies
Yale University
195 Prospect Street, New Haven, CT 06511

Co-PI: Dr. Anthony Leiserowitz
Yale Project on Climate Change Communication
School of Forestry & Environmental Studies
Yale University
195 Prospect Street, New Haven, CT 06511

3.0 INTRODUCTION

Hurricane/Post-Tropical Cyclone Sandy was the largest hurricane on record in the U.S.; it affected an area home to over 100 million people, killed 147, cut power to 8.5 million customers, and caused over $60 billion in economic damages (NOAA/NWS 2013). Despite the enormous threat, the advance notice, and the remarkably accurate forecasts, confusion and poor choices were widespread among the public. A senior science writer noted on the one-year anniversary of the storm that "It has become frighteningly predictable what the research is going to say after every big storm: most people did not understand the threat. They knew the storm was coming, but they could not translate the avalanche of bulletins, advisories, watches, warnings, and opinions into a clear understanding of the threat to their home and their family" (Freeman 2013). A post-storm review concluded that progress in forecasting may have reached a point of diminishing returns, and that the critical need now is progress in risk communication. Indeed, research from post-disaster studies support this conclusion – people are often surprised by and unprepared for hazard ferocity or extent (King 2000), despite ever more detailed forecasts.

> *"The quality of the meteorology is so far ahead of the quality of threat communications in the U.S. that progress in forecasting is becoming less and less relevant."*
> *– The Weather Channel hurricane specialist Bryan Norcross*

Decades of research in public health (Hornik 2002), political science (Sosnik et al. 2006) and marketing (Kotler and Lee 2008), demonstrate that communication is most effective when it is informed by prior research on the specific communication dynamics at work. One of the first tenets of communication science is to "Know Thy Audience" and put their needs first (Slater 1995, Maibach et al. 2011). In the context of disaster preparedness, this requires gaining a deep understanding of the psychological, cultural and sociological factors that shape public responses

to hazards; these insights can then inform emergency managers' communication strategies (Guion et al. 2007). Further, audience segmentation is an analytical tool that identifies coherent, yet differentiated audiences within a population that each respond to messages in a different way. In the case of coastal storm preparedness and response, the key audience attributes of interest are hazard awareness and knowledge, risk perceptions, prior experience, and related behaviors and behavioral barriers (e.g., Sattler et al. 2000, Dash and Gladwin 2007, Spence et al. 2011, Stein et al. 2013).

3.1 Audience Segmentation

Audience segmentation has often been used in public health campaigns around issues such as smoking cessation to understand what people are doing (i.e., behaviors), and why (i.e., their motivations). Segmentation analysis is highly focused on promoting specific behaviors and identifying barriers to those behaviors, and thus produces results that can provide a strong basis for developing effective risk communication strategies (Guion et al. 2007). In the case of storm preparedness, one can envision a hypothetical spectrum of audience segments that range from a group representing the least prepared, most vulnerable, and least likely to respond appropriately, to a group representing the most prepared and most likely to respond appropriately and effectively. The audience segments will likely vary according to their levels of awareness and knowledge, personal experience, behaviors, resources, etc., but not in a linear fashion. A segmentation analysis will reveal who each of these audiences are, what they currently understand or misunderstand about coastal storm risks, whom they trust as information sources, where they get their news and information about coastal storms, and their past and future likelihood of taking preparedness or evacuation actions. Furthermore, the analysis will reveal which factors – risk perceptions, prior experiences, behavioral barriers, or something else – are most important in determining the storm-related decisions of each group.

Within the framework of the four-phase model of emergency management, which includes activities relating to 1) mitigation; 2) preparedness; 3) response; and 4) recovery (Mileti 1999), our proposed segmentation analysis focuses on phases 2 and 3 – preparedness and response behaviors. In order to understand audience needs, however, we will also include items relating to storm-related beliefs and knowledge, personal experience, and risk perceptions, as we have done previously for the issue of climate change (Maibach et al. 2011). Given the complexity of physical, personal, social, and cultural factors known to influence storm hazard risk perceptions, a broader set of measurements will allow us to incorporate information about how different segments of the population perceive storm risks, consider them personally relevant, and perceive their own ability to address those risks (i.e., their self-efficacy). It is known, for example, that improved planning is needed to evacuate the most vulnerable populations (Meredith et al. 2008, Reininger et al. 2013), but the segmentation analysis will allow us to understand the differences in risk perceptions that cut across such populations.

To illustrate the complexity of factors (e.g., information, perceptions, experience) that affect individual preparation decisions (Paton 2003), consider the following hypotheses about hurricane evacuations (Lindell et al. 2005). H1 proposes that residents prioritize sources in the order: local news media > national news media > peers > local authorities > Internet. In H2, the order is environmental cues > social cues > personal experience > evacuation impediments. H3 proposes that evacuation decisions are predicted by coastal proximity, building structure type (mobile home single family, multifamily), information sources, and (absence of) evacuation impediments. In H4, the time of day predicts evacuation decisions and timing, with higher rates

occurring in the morning if storm tracks are stable enough to provide adequate forewarning. H5 proposes that evacuation decisions are driven by travel and preparation time needed.

It is unlikely that these hypotheses or the factors they identify are mutually exclusive. Rather, the specific combination of factors most important to a particular person in a particular location and in response to a specific set of warnings during a given event can vary greatly because individuals interpret information and prior experience differently. Nonetheless, there are patterns in the interpretations and behaviors of population subgroups – driven not merely by demographics, but by psychological and socio-cultural factors. Most scientific research to date has analyzed factors such as knowledge, risk perceptions, geography, and experience as predictors of population behavior as a whole, or for particular demographically-defined groups (Spence et al. 2007a, West and Orr 2007, Spence et al. 2011, Sharma and Patt 2012, Stein et al. 2013, Villegas et al. 2013). Based on our prior research, however, we suggest that a more precise and useful approach to risk communication is to identify the distinct "interpretive communities" within the at-risk population as defined by their hazard awareness and knowledge, risk perceptions, prior experience, and related behaviors. For example, instead of communication strategies targeting unmarried African-American women between the ages of 25-35 (a very imprecise category, including many false positives and ignoring many individuals who simply don't fit these demographic criteria), our audience identification approach will identify the audiences made up of diverse individuals who nonetheless respond to coastal storm hazards in similar patterned ways.

This research project will build upon our prior work that developed a similar audience segmentation tool for the separate, but related issue of climate change, which has proven highly successful in supporting the design of effective communication and public engagement strategies across the United States. Our audience segmentation analysis for climate change produced what we call "*Global Warming's Six Americas*" – six distinct audiences within the American public that each respond to the issue in different ways (Figure 1) (Leiserowitz et al. 2013). The segments were defined using a national survey to identify different patterns in public climate change beliefs, risk perceptions, issue involvement, behaviors, and preferred societal responses. The audience segments form a spectrum ranging from the "Alarmed" to the "Dismissive", each exhibiting unique characteristics that shape the way they perceive the risks of climate change, interpret new information, and make decisions.

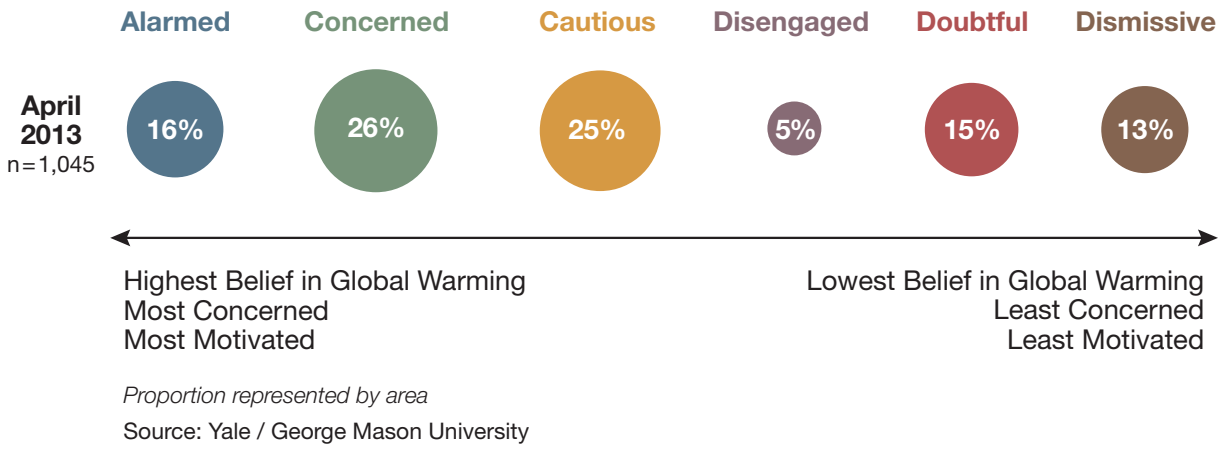

Figure 1. Global Warming's Six Americas, April 2013 (Leiserowitz et al. 2013).

The Alarmed are convinced climate change is happening, human-caused and an urgent threat. They are motivated to take personal action and strongly support a societal response. The Concerned also believe global warming is happening and human-caused, but perceive it as a threat distant in time and space, thus a lower action priority. The Cautious are paying attention, but have not yet made up their mind whether it's happening, human-caused, or a serious threat. The Disengaged report that they know little to nothing about the issue. The Doubtful don't believe it is happening, but that if it is, it is natural and there is nothing humans can do about it. Finally, the Dismissive are convinced it is not happening or human-caused and many claim it is a hoax driven by conspiracies of scientists, foreign governments, or liberal politicians.

Each of these groups responds to the issue of climate change in a very different way, and each requires a tailored engagement strategy. Our research has also found that they tend to rely on different media, trust different information sources, and exhibit different climate and energy-related behaviors. The insights generated by the "Six Americas" audience segmentation are informing the outreach, education, and risk communication strategies of federal, state and local governments and government agencies, formal and informal science educators, companies, and non-profit organizations across the United States.

A separate, but analogous segmentation focused specifically on coastal storm risks should have immediate and sustained value for emergency managers across a wide range of organizations because it will facilitate the identification, selection and engagement of target audiences that are the best fit for each organization's goals and resources (Smith 2009). Some organizations may be best situated to focus their efforts on a single target audience, whereas others will be more effective targeting multiple audiences. In general, campaigns that target well-defined audiences and tailor their materials accordingly are more likely to achieve their communication objectives than campaigns that do not (Noar et al. 2007, Maibach et al. 2011).

3. 2 The Role of Knowledge

The public's perception of risk from severe weather is a significant determinant of their response to an impending hurricane (Sattler et al. 2000, Lindell and Perry 2004, Dash and Gladwin 2007, Stein et al. 2013). However, public risk perceptions are often too low, particularly for storm surge (as opposed to wind speed) (Stein et al. 2013). For example, preliminary results from a survey after Hurricane Sandy, indicate that seventy-nine percent of coastal residents in New York and New Jersey said the impact of storm surge in their area was "more than they expected" (Gladwin et al. 2013).

Knowledge has long been assumed to be the primary determinant of public risk perceptions and behavior (Slovic 1987). Risk research has a long tradition of examining individual cognitive processes and investigating how people analyze risks and make decisions. The limited focus on factual knowledge, however, was often based upon a widespread assumption that people make rational, analytical decisions based upon all available information. Poor decisions were thus thought to reflect an "information deficit," and improving public decision-making thus merely required the provision of additional and higher-quality information. Many practitioners continue to base public communication strategies on this assumption and work hard to provide more information, with greater accuracy, more detail, and better uncertainty estimates.

To a large extent, a focus on improving public knowledge is warranted. Correct knowledge and beliefs about an impending storm event, including its type, severity, likely path, timing, and projected impacts, are critical for preparedness (Donahue 2012). For example, the Saffir-

Simpson scale is often misinterpreted as linear rather than exponential, and this misconception causes many to underestimate the risk of higher category hurricanes (Morss and Hayden 2010, Stewart 2011). Accurate knowledge of the nonlinearly increasing damage potential of hurricanes produced significantly greater self-reported likelihoods of evacuation in a study of 396 Gulf Coast residents than did information about the Saffir-Simpson scale alone (Stewart 2011). Similarly, research about the "cone of uncertainty" used to communicate the likely path of hurricanes is often misunderstood and affects risk perceptions (Broad et al. 2007, Villegas et al. 2013). To be used effectively, however, knowledge about storm risk must also be locally and personally relevant (Meredith et al. 2008).

Prior research has found that a "knowledge gap" often exists during hazard events because population subgroups with higher socioeconomic status tend to acquire information at a faster rate than those with lower status (Tichenor et al. 1970, Spence et al. 2011). Yet, the relationship between knowledge, socioeconomics, and risk perceptions is not straightforward. Spence et al. (2011) for example, found a narrowing knowledge gap in the wake of Hurricane Ike, and highlighted the importance of other influences, such as access to information, use of various media, trust in messengers, and community connectedness in other studies (2007b, 2008).

This study will assess coastal residents' correct and incorrect knowledge and understanding of coastal storm risks, including storm causes and consequences, critical vulnerabilities, and commonly used storm-related communication devices, such as the Saffir-Simpson scale, the "cone of uncertainty" and the difference between storm watches and warnings.

3.3 The Role of Trusted Information Sources and the Media

There is ample evidence showing that information coming from trusted (official) sources has a stronger influence on risk perceptions than other sources (Baker 1991). As a result, when NYC Mayor Bloomberg, a trusted official, played down the threat of Sandy with less than 48 hours to landfall, many New York residents likely downgraded their own perceptions of the risks. The messenger is often as important, if not more important, than the message itself.

In addition to official evacuation warnings, the news media play a key role in shaping risk perceptions and decision-making (Dow and Cutter 1998, 2002, Lindell et al. 2005). During extreme events, some individuals rely upon local broadcast meteorologists, others depend on statements from state or local government official, while others rely on trusted individuals within their own friendship and family networks. Information channels can range from the news media (television, radio, newspapers) to social media (Twitter, Facebook) to face-to-face conversations with neighbors. For a range of hazards, high social capital and community involvement with locally trusted individuals has been shown to increase hazard awareness and preparedness (Wright 2005, Bihari and Ryan 2012).

The media landscape is rapidly changing today, however, with important effects on people's access, use, and trust. The Internet and The Weather Channel have grown substantially in importance as sources of information about storm risks relative to radio and television news over the past two decades (Emani and Kasperson 1996, Dow and Cutter 1998, Zimmerman 1999). Social media is now growing rapidly as well; it proved to be an effective means of reaching the public according to the NOAA/NWS post-Sandy Service Assessment report (NOAA/NWS 2013). Local offices picked up thousands of new followers during the event, and NWS Weather Forecast Offices, River Forecast Centers, and the National Centers for Environmental Prediction gained over 27,000 new Facebook likes, providing the potential to reach millions of other Facebook users. Such changes do not have consistent effects across the population, however.

There is evidence, for example, that reliance on traditional channels such as radio and television news increase with age, which may contribute to a generational knowledge gap (Spence et al. 2011).

Increasing awareness and knowledge through the development of clear forecasts, warnings, and projected impacts, and coordinating these messages in a coherent and consistent fashion across multiple communication channels is a significant challenge, yet a vitally important goal. Recent recommendations for centralizing and harmonizing risk communications so that expert information comes from a "single voice" (NOAA/NWS 2013) are intended to address the confusion that has arisen in the past from seemingly conflicting or contradictory messages from different sources. Due to the proliferation of new communication technologies in the past decade, however, even if official messages are centralized, the public no longer relies on a single source of official information about environmental hazards (Sorenson and Sorenson 2006). Moreover, even when official messages are harmonized, they must now be communicated across diverse channels that themselves affect the messages (e.g., television vs. Twitter vs. cell phones) (Demuth et al. 2012, Casteel and Downing 2013). Likewise, differences in audiences, contexts, timing, and geography further complicate risk communication.

To identify and assess the role of different trusted information sources in coastal storm risk perception, decision-making and behavior, this study will include measures of the information sources Connecticut coastal residents trust and rely upon during coastal storms, as well as their preferred information channels.

3.4 The Role of Personal Experience

Years of evidence from studies in psychology, medicine, communication, and behavioral economics demonstrate that knowledge, while critical, is insufficient to account for hazard risk perceptions or preparedness and mitigation behaviors (Kates 1971, Tierney et al. 2001). In fact, convergent findings from many studies suggest that experientially-derived knowledge is often more compelling and more likely to influence behavior than abstract knowledge (Epstein 1994). In addition, the importance of personal experience as an influence on subsequent risk perceptions and self-protective behaviors has been found across multiple risk domains including crime, health, and natural hazards. In each domain, personal experience of a hazard generally leads to a significant increase in risk perceptions of that hazard, including estimates of hazard frequencies, future likelihoods, seriousness, worry, and salience (Weinstein 1989). For example, personal experience with earthquakes and floods was found to increase their perceived seriousness (Kunreuther 1978) and burglary victims rated this crime as more frequent and reported higher levels of worry and unease (Hough 1985). Likewise, Norris and colleagues (Norris et al. 1999) found that four years after the experience of Hurricane Hugo, respondents from three impacted or "near miss" cities were more likely to believe that they would experience a disaster or be required to evacuate in the future than residents from a control city.

Direct experience, however, can sometimes lead to decreased risk perceptions. For example, Halpern-Felsher et al., (2001) and Lindell & Perry (2000) found that some people who survive a natural hazard subsequently perceive less risk and become less likely to prepare for the hazard or evacuate in the future. Similar results have been found in studies examining wildfire (McCaffrey 2004). Prior experience of a wildfire does not necessarily lead to increased wildfire risk perception, and even when there is increased risk perception it does not necessarily lead to protective action (Arvai et al. 2006, McGee et al. 2009). Some individuals that survive an extreme event conclude that it wasn't so bad and that they can handle any such event in the

future. The "gambler's fallacy" (Kahneman et al. 1982) can also lead to lower risk perceptions because some individuals conclude that "lightning only strikes once" – thus they are no longer at risk.

This study will investigate the role of personal experience of previous coastal storms (e.g., Sandy and Irene) in current levels of preparedness and intended future behaviors, including coastal evacuation.

4.0 GENERAL WORK PLAN AND MILESTONES

The hypotheses of this project are:

1) There exist distinct "interpretive communities" of coastal storm risk (i.e., target audiences) among Connecticut coastal residents that can be identified using segmentation analyses of public coastal storm knowledge and beliefs, risk perceptions, experiences, and behaviors.
2) The audience segments will be a stronger predictor of past, current, and intended future coastal storm behavior than standard socio-demographics, cultural or political factors.
3) Each audience segment will exhibit a unique pattern of coastal storm knowledge and beliefs, risk perceptions, and risk information attention, trust, preferred sources and channels, indicating the need for a tailored strategy to effectively reach each audience.

This project will complete four specific objectives:

1) Conduct a representative telephone survey of 1,000 to 1,200 coastal residents of Connecticut regarding their storm-related beliefs, risk perceptions, vulnerabilities, information sources, communication patterns, and preparedness and evacuation behaviors and barriers.
2) Provide topline descriptive results on coastal residents' storm-related beliefs, risk perceptions, vulnerabilities, information sources, communication patterns, and preparedness and evacuation behaviors and barriers, along with their demographic and socio-cultural characteristics.
3) Conduct a segmentation analysis of coastal residents' to identify diverse target audiences within the public requiring tailored communication and engagement strategies. This typology will help coastal storm risk communicators understand the different types and needs of these different audiences, as well as their specific abilities and vulnerabilities, understandings and misconceptions, and likely responses to future threats.
4) Share the results with the coastal storm preparedness and response community in Connecticut to inform their communication strategies.

4.1 Research Design and Sampling Plan

In the first three months of the project, we will work closely with NOAA, Sea Grant and Connecticut Governor Malloy's administration to design the study, construct the survey instrument, and precisely define the sampling region. The study will involve a representative telephone survey of 1000 to 1200 Connecticut residents living within 1 to 2 kilometers of the coastline and inland waterways. The exact number of respondents and distance from coastline will be determined after careful consideration of the towns and cities recently affected by the impacts from past storms and of the bids from the survey research firms. A minimum of 1000

respondents will result in a representative cross section of subjects in terms of gender, age, education, and ethnicity. By focusing on Connecticut residents as opposed to a broader regional sample that includes New York and New Jersey, our sample size will allow us to conduct statistical comparisons of particular subpopulations of interest that may provide new information about the elderly, individuals with and without evacuation experience, and Twitter users, for example.

4. 2 Instrument Design

The survey instrument will take approximately 25 minutes to complete and surveys will be conducted by telephone, including landline (60%) and cellphone users (40%). The survey will also be offered in Spanish for those respondents who prefer it. The survey will include measures of coastal storm knowledge and beliefs, risk perceptions, vulnerabilities, experience, and preparedness and evacuation behaviors and related barriers.

Knowledge & Beliefs

These items will assess public knowledge and understanding of appropriate preparations for coastal storms and storm surge, such as the importance of household emergency plans and a meeting location that all members know about, emergency supply kits and contents, knowledge of evacuation routes, and the importance of monitoring communications, as well as appropriate responses, such as compliance with community plans. These items will also assess public knowledge and understanding of important coastal storm characteristics like intensity, track, wind speed, wind field size, angle of approach, landfall location and timing, and interactions with tides, and understanding of storm-specific communication devices, such as knowledge of the Saffir-Simpson scale and what it means or the difference between storm watches and warnings.

Risk perceptions and vulnerabilities

Using items previously tested nationally (Leiserowitz, 2004 – 2013) and new questions tailored for Connecticut, the questionnaire will measure perceived consequences of coastal storms using seven different dimensions of risk: i) human fatalities; ii) human illnesses; iii) harm to natural ecosystems (e.g., coastal wetlands); iv) present vs. future risk; v) personal vs. local vs. statewide impacts; vi) the likelihood, frequency and intensity of dangerous storm surges, breakdowns of local electricity, communication, and transportation systems, food and water shortages; and, vii) perceived self and local community resilience (ability to recover from a destructive storm). Based on evidence that general knowledge is a poor predictor of evacuation behavior, we will assess personal risk perceptions such as the perceived likelihood of one's own home flooding, which has been strongly linked to evacuation behavior in the past (Baker 1991).

Subjective experience of recent storms

Several dimensions of experience will be measured, including the recency, location, frequency, and severity (deaths, injuries, property damage) of prior storm impacts to individual respondents, their neighbors, friends and relatives, and their own and nearby communities. For respondents with past experiences of Irene and Sandy, we will ask about their experience and interpretations of those events, as well as the communications surrounding them, such as the Governor's statements, local evacuation orders, and media use.

Behavior and Behavioral Barriers:

The survey will include measures of past, present, and future coastal storm preparedness and response behaviors. Survey items will assess past behaviors in recent storms, including adequacy

of supplies, plans, transportation, evacuations, etc., and planned responses to future storms, including attitudes towards evacuation orders. The survey will also include measures of the psychological, economic, social, health, infrastructural, and geographic barriers to preparedness and evacuation behavior, including lack of knowledge, perceived invulnerabilities, financial constraints, divided household decision-making, and current infirmities, among others.

Other Measures:

Other measures will be developed and incorporated into the survey based on the needs and guidance of our collaborators. Likely measures include preferred channels of information (e.g., radio, television, cell phones, texting, the Internet, social media) and levels of trust in different messengers, such as state and local officials, local weathercasters, and friends and family. Demographics will be collected to characterize the population as a whole as well as the various audience segments in terms of gender, age, educational attainment, race/ethnicity, household income, pet ownership, length of current residence, geographic location, and similar variables. Measurements relating to social connectedness, such as membership in local organizations, networks, and community involvement may also be included.

4. 3 Survey Implementation

The Yale team will design the research study and develop the survey questionnaire. We will also obtain bids for the fielding of the survey from three high-quality research firms. The selected company will program the survey, conduct pre-tests, and field the final questionnaire. We will conduct all interviews by telephone using a combination of a random digit dial (RDD) landline (60%) and cell phone (40%) sample. If we find that RDD does not allow us the specificity we need regionally, we may use addressed-based sampling as an alternative. In either case, the sample will be drawn to be representative of the region of interest. Upon completion of the survey, the contracted firm will deliver the dataset, associated metadata, the survey response rate and weights to correct for any discrepancies between the sample and known Census parameters.

4.4 Data Analysis

First, we will use statistical software (i.e., SPSS, R) to generate topline results of all survey questions (means, modes, range, and standard deviations for knowledge, risk perception, experience, behavior, etc.) and crosstab results breaking the results down by gender, age, income, race/ethnicity, educational attainment, and geographic location.

Second, we will perform a Latent Class Analysis (LCA) with LatentGold 4.5 software (Magidson and Vermunt 2002b, Magidson and Vermunt 2002a) to test Hypothesis 1 – that there exist distinct "interpretive communities" of coastal storm risk (i.e., target audiences) among Connecticut coastal residents. LCA is a modeling technique for analyzing case-level data with the objective of identifying groups of respondents (segments, or latent classes) with similar characteristics. LCA assigns cases into clusters using model-based posterior membership probabilities estimated by maximum likelihood methods. One advantage of LCA as compared with more traditional clustering approaches like K-means is that it can handle nominal, ordinal, and continuous variables as well as any combination of these (Magidson and Vermunt 2002b). In addition, unlike cluster analysis, LCA is not highly sensitive to missing data. Respondents with 80% or more complete data on the selected variables will be included in the analysis.

We will compare the results from several alternative segmentation solutions, testing, for example, five, six, or seven segments. There is a trade-off between obtaining solutions that fit

particular segments well but provide a less-optimal global fit, and to guard to against this we will also run the estimation algorithm several times with varying starting parameters. By replicating model runs using random sets of start values (e.g., 5,000 times), we will ensure robust results and model stability across different choices of model segment solutions. We will provide model fit statistics for the alternative segment solutions as well.

Third, using multiple regression, we will test Hypothesis 2 – that the audience segments will be a stronger predictor of past, current, and intended future coastal storm behavior than standard socio-demographic, cultural, or political factors. We will construct several behavioral indices to use as dependent variables, using a combination of factor analysis and Cronbach's alpha. We will then regress these measures on our different independent variables, including the segmentations, socio-demographic, cultural, and political variables.

Fourth, we will test Hypothesis 3 – that each audience segment will exhibit a unique pattern of coastal storm knowledge and beliefs, risk perceptions, and risk information attention, trust, preferred sources and channels, indicating the need for a tailored strategy to effectively reach each audience. We will conduct a profile analysis of each segment, including their coastal storm knowledge and beliefs, risk perceptions, vulnerability, prior experience, behaviors and behavioral barriers, trusted information sources, and socio-demographic characteristics. Most prior studies have attempted to identify key factors that predict behavior across an entire diverse population. But this analysis should help us identify not only the distinct audiences within the broad population, but also the unique factors that drive coastal storm behavior for each group, providing a more accurate and detailed understanding of how to better reach and engage each type of person.

4. 5 Dissemination

We will author and disseminate at least 2 public reports on the results: A topline report on coastal residents' responses to coastal storm risks and a segmentation report identifying and profiling the distinct audiences we find within the coastal resident population. We then intend to author several peer-reviewed publications detailing the method, results, implications for coastal storm risk communication, and potential applications to other regions of the nation. In partnership with NOAA, Connecticut Sea Grant and Governor Malloy's administration, we will hold stakeholder briefings for state and local emergency responders on our findings and guidance for effective public communication strategies. In conjunction with each of the above products, we will also author press releases to engage state and local media in disseminating the results. We have conducted dozens of national, state and local surveys and have always experienced substantial media attention and coverage of the results. Finally, we will also disseminate the results through our own international networks of government officials, journalists, scientists, educators, and non-profit organizations, including over 3,000 direct email contacts and over 15,000 social media followers.

4. 6 Timeline

In months 1-3 we will work with our partners to design and test the survey instrument and obtain bids for fielding. The survey will be programmed, pre-tested and fielded in months 3 through 4. In months 4 through 5 we will clean the dataset and generate the topline and crosstab results. In months 6 through 9 we will conduct the multivariate and segmentation analyses. In months 10 to 12 we will author and release the public reports. Finally, in months 12 through 17

we will prepare our analyses, figures and findings for publication in the peer-reviewed literature and hold stakeholder briefings in Connecticut.

5.0 OUTCOMES

A key lesson learned from recent storm events in the Northeastern US is that public communication is a critical component of disaster preparedness, response and recovery. Most communication efforts strive to accomplish one of four goals: 1) simply comply with a mandate to distribute public education material; 2) actually inform and educate people; 3) alter people's opinion; and/or 4) change people's behavior, e.g., get them to do something they would not have otherwise done (Mileti and Sorensen 1990, Mileti et al. 2004). Our proposed work can support each of these goals, but is designed in particular to achieve goal four, by providing strategic guidance to emergency managers who must both communicate general information prior to and independent of any one specific event, but also issue warnings and recommended actions about specific storms prior to impact.

As described above, we will disseminate the results from the study through a combination of public reports, stakeholder briefings, media coverage, and scientific publications.

5.1 Conveying the results

The results of this research will be shared with our regional and state-level collaborators at each stage of the project. A final report, executive summary and maps will be provided to NOAA Sea Grant, to the Connecticut Department of Emergency Services and Public Protection (CDESPP), and to the general public through the Yale Project on Climate Change Communication website (http://environment.yale.edu/climate-communication/). In addition, we will disseminate the report through our own international network, including representatives of a wide range of government offices and agencies, non-profit groups, and universities. In addition, our results will be disseminated to the scientific community through conference presentations and publications in journals such as Coastal Management, Global Environmental Change, Climatic Change, and Risk Analysis.

5.2 Significance and importance

Our research results will help guide the communication strategies of all state and local personnel responsible for coastal storm risk communication and those who direct emergency management to reduce casualties and losses. Recent analyses of how the National Weather Service forecasters at the National Hurricane Center and local weather forecast offices, local emergency managers, and local television and radio media create and convey hurricane risk information has revealed a great need to integrate social science knowledge to design and test messages with intended audiences (Demuth et al. 2012). A critical step in achieving this goal is to understand exactly who these target audiences are, and the different ways in which they are likely to perceive and act upon information communicated. Our analysis will provide key insights about the different audiences that interpret and respond to coastal storm risks in different ways, and the psychological, cultural and sociological factors that influence the risk perceptions, decision-making and storm-related behavior of these different audiences.

5.3 Evaluation

Evaluation of the segmentation analysis and tool includes consideration of the process (e.g., efficiency and cost-effectiveness of the segmentation analysis versus other approaches), its efficacy (e.g., the effectiveness and value of the results to coastal communities and future storm

response efforts), and its outcomes (e.g., whether the objectives were met and what insights can inform future communication efforts) (Salmon et al. 2003). Regarding the process, our research will assess the degree to which segmentation analyses provide strategically more useful information than is obtained from conventional approaches. A comprehensive evaluation of the long-term utility of the study findings for future storm response efforts will require a longer time frame than the constraints of the current study, however, our stakeholder collaborations will ensure that the study results inform and improve their strategic planning and outreach efforts for future storms. Regarding outcomes, we will provide metrics describing the representativeness, margins of error, and response rate of the telephone survey (Objective 1). Results from our topline descriptive analyses and segmentation analyses will be released as public reports. We will assess our success in dissemination using metrics such as number of website visitors, report downloads, social media analytics, mainstream media stories, stakeholder briefings held, and scientific papers published (Objectives 2 - 4).

6.0 COORDINATION

We will work with NOAA, CT Sea Grant, Governor Malloy's administration (see Letter of Support from Gov. Malloy), and Deputy Commissioner William P. Shea of the state Department of Emergency Services and Public Protection and the Homeland Security Division (see Letter of Support from Dep. Commissioner Shea) to ensure that our research design is informed by stakeholder needs, and that our outcomes will directly support coastal storm planning and communication strategies across the state of Connecticut. In particular, the Connecticut Department of Emergency Services and Public Protection plays a pivotal role in organizing the state response to all emergencies and natural hazards, including coastal storms. Our study results will provide specific information about their target audiences, their vulnerabilities, trusted sources and channels of storm information, and behavioral intentions that will directly support their emergency planning and communication efforts.

CDESPP and Governor Malloy's office, and Deputy Commissioner Shea have agreed to provide guidance throughout the survey design process and offer feedback on the analyses to ensure that the results will be useful to their planning and emergency management efforts. They will also review draft reports and facilitate dissemination of the results to the emergency management community in Connecticut.

Data Management and Access Plan

This project will produce a variety of data over the course of the study. The YPCCC has data management processes in place that are designed to effectively and efficiently receive, clean, process, manage, archive and share new datasets both among the research team and the wider community. Any data and metadata collected and created under NOAA (including Sea Grant) grants will be made visible, accessible, and independently understandable to general users, free of charge or at minimal cost, and in a timely manner (i.e., no later than 2 years after the data are collected).

Data from the proposed survey will include:

1) Quantitative data in its raw format from a representative survey of Connecticut coastal residents;
2) Quantitative data in a cleaned and standardized format from the same survey; and
3) Processed quantitative data from the audience segmentation analysis.

All survey data will be initially stored and analyzed as SPSS or csv files for use in the R statistical programming environment. Processed results from the segmentation analysis will be stored as Excel spreadsheet files and metadata will be stored as Microsoft Word files. Since these formats could become unreadable over time as software systems change, final versions of all datasets and documents will also be exported to and made available as ASCII and/or CSV data files, with accompanying command/syntax files, so future users will still be able to access the data, even if this proprietary software is no long supported. The raw survey data file will be cataloged in a single database, with accompanying metadata (e.g., filename, author, abstract, producer, geographic coverage, temporal period of collection, response rate, etc.) using Data Documentation Initiative standards.

The Connecticut survey dataset will be publicly released and archived 18 months after final versions are completed, to allow the research team time to publish initial results. All survey responses will be voluntary, anonymous, confidential, and unidentifiable. All results will be released only as aggregate statistics. Our research collaborators at the contracted survey research firm will remove all identifiers from the dataset before release to the rest of the research team. Survey datasets deposited in public archives will thus have no individually identifiable information attached. All archived survey data and accompanying metadata will be deposited and made publicly available through ICPSR at the University of Michigan.

Literature Cited

Arvai, J., R. Gregory, D. Ohlson, B. Blackwell, and R. Gray. 2006. Letdowns, wake-up calls, and constructed preferences: People's responses to fuel and wildfire risks. Journal of Forestry **104**:173-181.

Baker, E. J. 1991. Hurricane evacuation behavior. International Journal of Mass Emergencies and Disasters **9**:287-310.

Bihari, M. and R. Ryan. 2012. Influence of social capital on community preparedness for wildfires. Landscape and Urban Planning **106**:253-261.

Broad, K., A. Leiserowitz, J. Weinkle, and M. Steketee. 2007. Misinterpretations of the "Cone of Uncertainty" in Florida during the 2004 Hurricane Season. Bulletin of the American Meteorological Society **88**:651-667.

Casteel, M. and J. Downing. 2013. How Individuals Process NWS Weather Warning Messages on Their Cell Phones. Weather, Climate, and Society **5**:254-265.

Dash, N. and H. Gladwin. 2007. Evacuation Decision Making and Behavioral Responses: Individual and Household. Natural Hazards Review **8**:69-77.

Demuth, J. L., R. E. Morss, B. H. Morrow, and J. K. Lazo. 2012. Creation and Communication of Hurricane Risk Information. Bulletin of the American Meteorological Society **93**:1133-1145.

Donahue, A. 2012. Disaster risk perception, preferences, and preparedness. University of Connecticut, Department of Public Policy, West Hartford, Connecticut.

Dow, K. and S. L. Cutter. 1998. Crying wolf: Repeat responses to hurricane evacuation orders. Coastal Management **26**:237-252.

Dow, K. and S. L. Cutter. 2002. Emerging hurricane evacuation issues: Hurricanae Floyd and South Carolina. Natural Hazards Review **3**:12-18.

Emani, S. and J. X. Kasperson. 1996. Disaster communication via the information superhighway: data and observations on the 1995 hurricane season. International Journal of Mass Emergencies and Disasters **14**:321–342.

Epstein, S. 1994. Integration of the cognitive and the psychodynamic unconscious. American Psychologist **49**:709-724.

Freeman, A. 2013. Experts Say Sandy Showed Limits of an Accurate Forecast. Climate Central.

Gladwin, H., B. H. Morrow, and J. Lazo. 2013. Communication and Understanding of Hurricane Sandy Storm Surge Forecast and Warning Information. Page Advance results communicated March 2013.

Guion, D. T., D. L. Scammon, and A. L. Borders. 2007. Weathering the storm: A social marketing perspective on disaster preparedness and response with lessons from Hurricane Katrina. Journal of Public Policy & Marketing **26**:20-32.

Halpern-Felsher, B. L., S. G. Millstein, J. M. Ellen, N. E. Adler, J. M. Tschann, and M. Biehl. 2001. The role of behavioral experience in judging risks. Health Psychology **20**.

Hornik, R. 2002. Public health communication: Evidence for behavior change. Lawrence Erlbaum Associates, Mahwah, NJ.

Hough, M. 1985. The impact of victimization: Findings from the British Crime Survey. Victimology **10**:488-497.

Kahneman, D., P. Slovic, and A. Tversky, editors. 1982. Judgment under uncertainty: Heuristics and biases. Cambridge University Press, New York.
Kates, R. W. 1971. Natural hazard in human ecological perspective: Hypotheses and models. Economic Geography **47**:438–451.
King, D. 2000. You're on Your Own: Community Vulnerability and the Need for Awareness and Education for Predicatable Natural Disasters. Journal of Contingencies and Crisis Management **8**:223-228.
Kotler, P. and N. Lee. 2008. Social marketing: Influencing behaviors for good. Sage, Los Angeles, CA.
Kunreuther, H. 1978. Disaster insurance protection: Public policy lessons. Wiley, New York.
Leiserowitz, A., E. Maibach, C. Roser-Renouf, G. Feinberg, and P. Howe. 2013. Climate change in the American mind: Americans' global warming beliefs and attitudes in April, 2013. Yale University and George Mason University, Yale Project on Climate Change Communication, New Haven, CT.
Lindell, M. and R. Perry. 2004. Communicating Environmental Risk in Multiethnic Communities. Sage, Thousand Oaks, CA.
Lindell, M. K., J.-C. Lu, and C. S. Prater. 2005. Household decision making and evacuation in response to Hurricane Lili. Natural Hazards Review **6**:171-179.
Lindell, M. K. and R. W. Perry. 2000. Household adjustment to earthquake hazard: A review of research. Sage Urban Studies Abstracts **28**.
Magidson, J. and J. K. Vermunt. 2002a. Latent class models. Pages 175–198 *in* D. Kaplan, editor. The Sage Handbook of Quantitative Methodology for the Social Sciences. Sage, Thousand Oaks, CA.
Magidson, J. and J. K. Vermunt. 2002b. Latent class models for clustering: A comparison with K-means. Canadian Journal of Marketing Research **20**:37–44.
Maibach, E. W., A. Leiserowitz, C. Roser-Renouf, and C. K. Mertz. 2011. Identifying Like-Minded Audiences for Global Warming Public Engagement Campaigns: An Audience Segmentation Analysis and Tool Development. PLoS ONE **6**.
McCaffrey, S. 2004. Thinking of wildfire as a natural hazard. Society & Natural Resources **17**:509-516.
McGee, T. K., B. L. McFarlane, and J. Varghese. 2009. An examination of the influence of hazard experience on wildfire risk perceptions and adoption of mitigation measures. Society & Natural Resources **22**:308 - 323.
Meredith, L. S., L. R. Shugarman, A. Chandra, S. L. Taylor, S. A. Stern, E. B. Beckjord, A. M. Parker, and T. Tanielian. 2008. Analysis of risk communication strategies and approaches with at-risk populations to enhance emergency preparedness, response, and recovery. Office of Disability, Aging and Long-Term Care Policy, Office of the Assistant Secretary for Planning and Evaluation, U.S. Department of Health and Human Services Contract #HHS-100-03-0010
Mileti, D. 1999. Disasters by Design: A Reassessment of Natural Hazards in the United States. Joseph Henry Press, Washington, DC.
Mileti, D. S., S. Nathe, P. Gori, M. Greene, and E. Lemersal. 2004. Public Hazards Communication and Education: The State of the Art.
Mileti, D. S. and J. H. Sorensen. 1990. Communication of Emergency Public Warnings: A Social Science Perspective and State-of-the-Art Assessment. Report ORNL-

6609 for the Federal Emergency Management Agency, Report ORNL-6609 for the Federal Emergency Management Agency, Oak Ridge, TN.
Morss, R. E. and M. H. Hayden. 2010. Storm Surge and "Certain Death": Interviews with Texas Coastal Residents following Hurricane Ike. Weather, Climate, and Society **2**:174-189.
NOAA/NWS. 2013. Hurricane/Post-Tropical Cyclone Sandy, October 22-29, 2012, Service Assessment. Silver Spring, Maryland.
Noar, S. M., C. N. Benac, and M. S. Harris. 2007. Does tailoring matter? Meta-analytic review of tailored print health behavior change interventions. Psychological Bulletin **133**:673-693.
Norris, F. H., T. Smith, and K. Kaniasty. 1999. Revisiting the experience-behavior hypothesis: The effects of hurricane Hugo on hazard preparedness and other self-protective acts. Basic and Applied Social Psychology **21**.
Paton, D. 2003. Disaster preparedness: a social-cognitive perspective. Disaster Prevention and Management **12**:210-216.
Reininger, B. M., S. A. Raja, A. S. Carrasco, Z. Chen, B. Adams, J. McCormick, and M. H. Rahbar. 2013. Intention to Comply With Mandatory Hurricane Evacuation Orders Among Persons Living Along a Coastal Area. Disaster Medicine and Public Health Preparedness **7**:46-54.
Salmon, C. T., L. A. Post, and R. E. Christensen. 2003. Mobilizing Public Will For Social Change. Communications Consortium Media Center, Michigan State University.
Sattler, D. N., C. F. Kaiser, and J. B. Hittner. 2000. Disaster Preparedness: Relationships Among Prior Experience, Personal Characteristics, and Distress1. Journal of Applied Social Psychology **30**:1396-1420.
Sharma, U. and A. Patt. 2012. Disaster warning response: the effects of different types of personal experience. Natural Hazards **60**:409-423.
Slater, M. 1995. Choosing audience segmentation strategies and methods for health communication. Pages 186–198 *in* E. Maibach and R. Parrott, editors. Designing health messages. Sage Publications, Los Angeles, CA.
Slovic, P. 1987. Perception of Risk. Science **236**:280-285.
Smith, R. 2009. Strategic planning for public relations. 3rd edition. Routledge, New York.
Sorenson, J. H. and B. V. Sorenson. 2006. Community Processes: Warning and Evacuation. Pages 183-199 *in* H. Rodriguez, E. L. Quarantelli, and R. R. Dynes, editors. Handbook of Disaster Research. Springer, New York.
Sosnik, D., M. Dowd, and R. Fournier. 2006. Applebee's America: How successful political, business, and religious leaders connect with the new American community. Simon & Schuster, New York, NY.
Spence, P. R., K. Lachlan, J. M. Burke, and M. W. Seeger. 2007a. Media use and information needs of the disabled during a natural disaster. Journal of Health Care for the Poor and Underserved **18**:394-404.
Spence, P. R., K. A. Lachlan, and J. Burke. 2007b. Adjusting to uncertainty: Coping strategies among the displaced after hurricane Katrina. Sociological Spectrum **27**:653-678.

Spence, P. R., K. A. Lachlan, and J. Burke. 2008. Crisis preparation, media use, and information seeking: Patterns across Katrina evacuees and lessons learned for crisis communication. Journal of Emergency Management **6**:11-23.

Spence, P. R., K. A. Lachlan, and J. A. Burke. 2011. Differences in Crisis Knowledge Across Age, Race, and Socioeconomic Status During Hurricane Ike: A Field Test and Extension of the Knowledge Gap Hypothesis. Communication Theory **21**:261-278.

Stein, R., B. Buzcu-Guven, L. Dueñas-Osorio, D. Subramanian, and D. Kahle. 2013. How Risk Perceptions Influence Evacuations from Hurricanes and Compliance with Government Directives. Policy Studies Journal **41**:319-342.

Stewart, A. E. 2011. Gulf coast residents underestimate hurricane destructive potential. Weather, Climate, and Society **3**:116-127.

Tichenor, P. J., G. A. Donohue, and C. N. Olien. 1970. Mass media flow and differential growth in knowledge. Public Opinion Quarterly **34**:159–170.

Tierney, K., M. K. Lindell, and R. W. Perry. 2001. Facing the unexpected: Disaster preparedness and response in the United States. Joseph Henry Press, Washington, DC.

Villegas, J., C. Matyas, S. Srinivasan, I. Cahyanto, B. Thapa, and L. Pennington-Gray. 2013. Risk perception and evacuation decisions of Florida tourists under hurricane threats: a stated preference analysis. Natural Hazards **66**:97-116.

Weinstein, N. D. 1989. Effects of personal experience on self-protective behavior. Psychological Bulletin **105**:31-50.

West, D. M. and M. Orr. 2007. Race, gender, and communications in natural disasters. Policy Studies Journal **35**:569-586.

Wright, W. J. 2005. Significance of training, education and communication for awareness of potential hazards in managing natural disaster in Australia.

Zimmerman, C. 1999. In the eye of the storm - Floyd's lessons help sites brace for traffic spikes. Internet Week:1.

Project Timeline

Tasks / Activities / Milestones	Related Project Objective(s)	Funding Year 1												Funding Year 2											
		Beginning Month and Year: January 2014																							
		Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Month 10	Month 11	Month 12	Month 13	Month 14	Month 15	Month 16	Month 17	Month 18	Month 19	Month 20	Month 21	Month 22	Month 23	Month 24
Design study, construct survey instrument, and define sample region	1	X	X	X																					
Contract with survey research firm	1		X																						
Survey programming, pre-test & fielding	1			X	X																				
Clean dataset, generate topline and crosstab results	1				X	X																			
Contract with data analysis firm	2,3					X																			
Conduct multivariate data analysis and segmentation	2,3						X	X	X	X															
Graphics production and public report	2,3,4										X	X	X												
Scientific publications and presentations	2,3,4												X	X	X	X	X								
Stakeholder briefings in Connecticut	4												X	X	X	X	X								

JENNIFER R. MARLON

Associate Research Scientist
Yale School of Forestry and Environmental Studies

195 Prospect Street
New Haven, CT 06511 USA

Email: jennifer.marlon@yale.edu
Phone: 203-436-2598

PROFESSIONAL PREPARATION

2009	Ph.D., Geography, University of Oregon
2003	M.S., Geography, University of Oregon
1991	B.S., University at Albany, State University of New York

APPOINTMENTS

2012 – present	Associate Research Scientist, School of Forestry & Environmental Studies, Yale Project on Climate Change Communication, Yale University, New Haven, CT
2012 – 2013	Postdoctoral Research Associate, Botany, University of Wyoming, Laramie, WY
2010 – 2012	NSF Earth Sciences Postdoctoral Research Fellow, Dept. of Geography, University of Wisconsin-Madison, WI
2009 – 2010	Postdoctoral Research Associate, Dept. of Political Science, University of Oregon, OR
2005 – 2008	Research Assistant, Dept. of Political Science, University of Oregon, OR
2003 – 2004	Research Assistant, Dept. of Geography, University of Oregon, OR
2002	GIS Analyst, Benton County Community Development Program, Corvallis, OR
2000 – 2001	Instructor, Introduction to GIS, Dept. of Geography, University of Oregon

RESEARCH GRANTS & AWARDS

2013-2016	NSF Co-P.I. Award: "*Collaborative Research and NEON: MSB Category 2: PalEON – a PaleoEcological Observatory Network to assess terrestrial ecosystem models*" ($98,897)
2010-2012	NSF EAR Postdoctoral Fellowship Award: "*Understanding the coupled response of vegetation and fire to climatic variation since the Last Glacial Maximum*" ($170,000)
2008	University of Oregon Doctoral Research Fellowship: "*Fires of the past: syntheses from sedimentary charcoal data*" ($18,000)
2008	University Scholarship ($1800)
2007-2008	National Science Foundation: Doctoral Dissertation Improvement Grant: "*Global fire since the Last Glacial Maximum*" ($7585)
2007	National Science Foundation travel award for early-career scientists to attend the XVII INQUA Congress, Cairns, Australia ($2300)
2005-2006	University Scholarship ($1800)
2004	AAG Biogeography Specialty Group Award: Best Ph.D. Paper/Poster ($100)
2002-2003	University Scholarship ($1500)
2001-2002	University Scholarship ($2800)

PUBLICATIONS CLOSELY RELATED TO THE PROJECT

Marlon, J.R., Leiserowitz, A., and Feinberg, G. (2013) Scientific and Public Perspectives on Climate Change. Yale University. New Haven, CT: Yale Project on Climate Change Communication. http://environment.yale.edu/climate/notes/consensus.html.

Leiserowitz, A., Smith, N., **Marlon, J.R.** (2011). American Teens' Knowledge of Climate Change. Yale University. New Haven, CT: Yale Project on Climate Change Communication. http://environment.yale.edu/climate/news/american-teens-knowledge-of-climate-change/

Leiserowitz, A., Smith, N., **Marlon, J.R.** (2010). Americans' Knowledge of Climate Change. Yale University. New Haven, CT: Yale Project on Climate Change Communication. http://environment.yale.edu/climate/files/ClimateChangeKnowledge2010.pdf

OTHER SELECTED PUBLICATIONS

Marlon, J.R., Bartlein, P.J., Daniau, A-L., Harrison, S.P., Power, M.J., Tinner, W., Tracy, S. Global biomass burning: A synthesis and review of Holocene paleofire records and their controls (2013). *Quaternary Science Reviews* 65, 5-25.

Marlon, J.R., Bartlein, P.J., Long, C., Gavin, D.G., Anderson, R.S., Briles, C. Brown, K.J., Colombaroli, D., Hallett, D.J., Power, M.J., Scharf, E.A., Walsh, M.K. A long-term perspective on wildfires in the western U.S. (2012). *Proceedings of the National Academy of Sciences,* www.pnas.org/cgi/doi/10.1073/pnas.1112839109.

Goring, S., Williams, J.W., Blois, J.L., Jackson, S.T., Paciorek, C., Booth, R.K., Marlon, J.R., Blaauw, M., Christen, A. Deposition times in the northeastern United States during the Holocene: establishing valid priors for Bayesian age models (2012). Quaternary Science Reviews **48**, 54-60.

Harrison, S.P., **Marlon, J.R.** and Bartlein, P.J. (2010). Fire in the Earth system. In "Changing Climates, Earth Systems and Society." (J. Dodson, Ed.). International Year of Planet Earth. Springer, Dordrecht, The Netherlands.

Marlon, J.R., Bartlein, P.J., Walsh, M.K., Harrison, S.P., Brown, K.J., Edwards, M.E., Higuera, P.E., Power, M.J., Anderson, R.S., Briles, C., Brunelle, A., Carcaillet, C., Daniels, M., Hu, F.S., Lavoie, M., Long, C., Minckley, T., Richard, P.J.H., Shafer, D.S., Tinner, W., Umbanhowar, C.E. Jr. Wildfire responses to abrupt climate change in North America (2009). *Proceedings of the National Academy of Sciences* **106**(8) 2519-2524.

Marlon, J.R., Bartlein, P.J., Carcaillet, C., Gavin, D.G., Harrison, S.P., Higuera, P.E., Joos, F., Power, M.J., Prentice, I.C. (2008) Climate and human influences on global biomass burning over the past two millennia. *Nature Geoscience*. DOI:10.1038/ngeo313.

Marlon, J., Bartlein, P.J., and Whitlock, C. (2006). Fire-fuel-climate linkages in the northwestern United States during the Holocene. *The Holocene* **16**(8), 1059-1071.

Marlon, J.R., Patenaude, G., Barnes, B. (2010). Catalyzing interdisciplinary research on climate change. *EOS* **91**(34) 299.

Power, M.J., **Marlon, J.,** Ortiz, N., Bartlein, P.J., Harrison, S.P., et al. (2008). Changes in fire regimes since the Last Glacial Maximum: an assessment based on a global synthesis and analysis of charcoal data. *Climate Dynamics* 30, 887-987. DOI: 10.1007/s00382-007-0334-x.

COLLABORATORS & OTHER AFFILIATIONS

Collaborators: Robert Booth, Lehigh University; Kenneth Broad, Miami University; Kendrick Brown, Canadian Forest Service; Anne-Laure Daniau, University of Bordeaux; Michael Dietz, University of Illinois; Jacquelyn Gill, University of Wisconsin-Madison; Simon Goring, University of Wisconsin-Madison; Peter Howe, University of Utah; Anthony A. Leiserowitz, Yale University; Jason MacLachlan, Notre Dame; Matto Mildenberger, Yale University; Chris Paciorek, University of California Berkeley; Mitchell Power, University of Utah; Seth Rosenthal, Yale University; Connie Roser-Renouf, George Mason University; Megan K. Walsh, Central Washington University

Graduate and Postdoctoral Advisors: Patrick J. Bartlein, University of Oregon; Peter Crane, Yale University; Daniel Gavin, University of Oregon; W. Andrew Marcus, University of Oregon; Ronald B. Mitchell, University of Oregon; Cathy Whitlock, Montana State University; Susan Weiler, Whitman College; John Williams, University of Wisconsin, Madison.

Thesis Advisor & Postgraduate-Scholar Sponsor: None to date.

Anthony A. Leiserowitz

Research Scientist & Director, Yale Project on Climate Change Communication
School of Forestry & Environmental Studies
Yale University
195 Prospect Street

New Haven, CT 06511
(203) 432-4865 (office)
(203) 436-3400 (fax)
anthony.leiserowitz@yale.edu
http://environment.yale.edu/climate

Education

University of Oregon	Environmental Science, Studies and Policy	Ph.D. 2003
University of Oregon	Environmental Studies	M.S. 1998
Michigan State University	International Relations	B.A. 1990

Positions Held

2007 – present	Research Scientist & Director, Yale Project on Climate Change Communication: School of Forestry & Environmental Studies, Yale University.
2004 – 2009	Principal Investigator: Center for Research on Environmental Decisions, Columbia University.
2007	Consultant: School of Forestry & Environmental Studies, Yale University.
2003 – 2007	Research Scientist: Decision Research, Eugene, Oregon.
2003 – present	Courtesy Professor: Environmental Studies Program, University of Oregon.
2003 – 2004	Consultant: John F. Kennedy School of Government, Harvard University.
1999 – 2003	Research Assistant: Departments of Biology and Geography and the Environmental Studies Program, University of Oregon.
1998 – 2003	Instructor: Environmental Studies Program and Department of Geography, University of Oregon.
1997 – 2003	Graduate Teaching Fellow: Environmental Studies Program and Department of Geography, University of Oregon.
1995 – 1996	Executive Director: Michigan Museum of Surveying, Lansing, MI.
1991 – 1993	Education Coordinator: Aspen Global Change Institute, Aspen, CO.
1988 – 1990	Legislative Assistant: Michigan State Senator William Faust, Lansing, MI.

Peer-Reviewed Publications

Aldy, J., Kotchen, M., & Leiserowitz, A. (in review) Willingness to pay and political support for a U.S. national clean energy standard. *Nature Climate Change*.

Smith, N. & Leiserowitz, A. (in review) The role of emotions in global warming risk perceptions and policy preferences. *Risk Analysis.*

Smith, N. & Leiserowitz, A. (in review) American evangelicals and global warming. *Global Environmental Change*.

Maibach, E., Leiserowitz, A., Cobb, S., Shank, M., Cobb, K., & Gulledge, J. (in review) The legacy of "climategate:" Revitalizing or undermining climate science and policy? *Wiley Interdisciplinary Reviews: Climate Change*.

Kotchen, M., Boyle, K., & Leiserowitz, A. (in review) Policy-instrument choice and benefit estimates for climate change policy in the United States. *Journal of Policy Analysis and Management.*

Ding, D., Maibach, E., Zhao, X., Roser-Renouf, C. & Leiserowitz, A. (in press) Support for climate policy and societal action are linked to perceptions about scientific agreement. *Nature Climate Change*.

Feldman, L., Maibach, E., Roser-Renouf, C. & Leiserowitz, A. (in press) Climate on cable: The nature and impact of global warming coverage on Fox News, CNN, and MSNBC. *International Journal of Press/Politics.*

Smith, N. & Leiserowitz, A. (in press) The rise of global warming skepticism: Exploring affective image associations. *Risk Analysis.*

Mead, E., Rimal, R., Roser-Renouf, C., Flora, J., Maibach, E., & Leiserowitz, A. (in press) Information seeking about global climate change among parents and their adolescents: The role of risk perceptions and efficacy beliefs. *Atlantic Journal of Communication.*

Leiserowitz, A., Maibach, E., Roser-Renouf, C., Smith, N., & Dawson, E. (in press) Climategate, public opinion, and the loss of trust. *American Behavioral Scientist*.

Gorokhovich, Y. & Leiserowitz, A. (2011) Historical and future coastal changes in Northwest Alaska. *Journal of Coastal Research*. doi: 10.2112/JCOASTRES-D-11-00031.1

Nisbet, M., Maibach, E., & Leiserowitz, A. (2011) Framing peak petroleum as a human health issue: Audience research and participatory engagement. *American Journal of Public Health*, 101(9): 1620-1626.

Zhao, X., Leiserowitz, A., Maibach, E., & Roser-Renouf, C. (2011). Attention to science/environment news positively predicts and attention to political news negatively predicts global warming risk perceptions and policy support. *Journal of Communication*, 61: 713-731.

Maibach, E., Leiserowitz, A., Roser-Renouf, C., & Mertz, C.K. (2011) Identifying like-minded audiences for climate change public engagement campaigns: An audience segmentation analysis and tool development. *PLoS ONE* 6(3): e17571. doi:10.1371/journal.pone.0017571.