Is It Time to Move Away? How Hurricanes Affect Future Plans

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Using surveys and interviews in the aftermath of Hurricanes Matthew and Irma, we investigated people's reasons for living on the coast of Georgia, their expectations for the future, and their intentions to stay in place or migrate away from the coast. We found that age, income, and ethnicity all play small but significant roles in determining intention to migrate, but that more intangible elements such as changes in quality of life or lifestyle may be more important. Many residents indicated a preference for remaining close if they were to permanently leave their homes, and residents were more likely to indicate a preference for staying in place after Irma than after Matthew. Residents may have many reasons for becoming more reluctant to move – complacency borne out of repeated "near misses", increased awareness of the likely costs and inconvenience of re-location, or the realization that specific impacts are highly variable—making responses by coastal planners and managers more challenging.

Keywords: Hurricanes, sea-level rise, migration, managed retreat, adaptation, Matthew, Irma.

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Hurricane Matthew never made landfall in Georgia, but as it grazed the coast in October 2016, it brought substantial winds and storm surge to the state, including a new record tide level at Fort Pulaski (12.57 feet above Mean Lower Low Water [MLLW]). The storm killed three people in Georgia and caused more than $90 million in damage in that state alone (Wenk 2016). Among the coastal states of the U.S. Southeast, Georgia is somewhat unique in that the affects from hurricanes are relatively rare. While there is a large and growing body of literature on disaster-prone areas that are repeatedly subjected to extreme events, we were particularly interested in looking at Georgia because events like this less common. Through the twentieth century and into the twenty-first, Georgia has been frequently impacted by tropical storms and depressions, but has been missed by the more powerful storms affecting the region; Hurricane Matthew was the first named storm in over 100 years to significantly impact Southeast Georgia (National Weather Service 2019). Hurricane Matthew may have acted as a "wake up call" for residents who have never experienced hurricanes but who may be increasingly exposed to them in the future. Scientists expect that severe weather events will increase in intensity (Gutmann et al. 2018) and that their paths may shift with climate change (Garner et al. 2017). In line with those projections, scientists expect that Georgia will potentially see more storms and that the ones that do affect the state will be more dangerous (KC, Shepherd, and Gaither 2015). Indeed, coastal residents were subjected to the effects of another hurricane less than a year after Hurricane Matthew as Irma rolled through the state in September 2017. Generally speaking, Georgia coastal residents were fortunate each time, with the storm paths shifting enough to avoid the catastrophic damage forecast days before each event. However, they were both still very disruptive storms with loss of life and high economic costs; impacts were very uneven, with some residents suffering devastating losses. A growing body of literature discusses the likelihood of residents migrating away from threatened coastal areas and what their destinations might be (Aerts 2017; Davis et al. 2018; Hauer 2017). Some (e.g., Song and Peng 2018) have developed compelling models of migration designed to infer the preferences of residents from the behaviors they exhibit. Our goal is to examine the attitudes and beliefs that precede those behaviors, reasoning that where practical challenges intervene between a resident's intentions and their ability to migrate is precisely where policymakers and managers can intervene.

LITERATURE REVIEW

Human migration patterns are complex and driven by multiple, interconnected factors (Black et al. 2011a). Many scholars of migration have sought to understand what individual characteristics (e.g., age, income), event characteristics (e.g., loss of livelihood, level of damage), and policy environments (e.g., resettlement programs) are likely to influence migration. Scholars widely agree that environmental factors such as climate change or land

degradation can be important drivers, but there is little consensus concerning how and through what mechanisms the environment matters to migration (Black et al. 2011a; 2011b; Neumann et al. 2015; Piguet 2012). Black et al. (2011a) indicate that the effect of environmental drivers is highly dependent on political economic contexts. In other words, residents with different levels of social, political, and economic capital may respond differently to the same risks. A changing climate is likely to contribute additional complexity to patterns of migration (Adamo 2010; Black et al. 2011b). For example, in coastal areas of the continental U.S. the incremental effects of projected sea-level rise (SLR) may displace 4.2 million coastal residents (96,000 in Georgia alone) by 2050 (Fletcher et al. 2016; Hauer, Evans, and Mishra 2016). In addition, it is likely that storms will increase in severity under a changing climate (Gutmann et al. 2018), potentially driving out even more residents of coastal zones.

In trying to understand climate-driven migration away from coastal zones, most scholars have examined populations still in place, asking about their intentions to leave their homes. Bukvic, Smith, and Zhang (2015) studied willingness to relocate following Hurricane Sandy, focusing on demographic characteristics and other concerns affecting this willingness. Using 125 door-to-door surveys, they found that age, financial costs of living near the shoreline, and experiences with disaster and recovery affect willingness to relocate. Using results from the same survey, Bukvic et al. (2018) elaborated on proximity to the shoreline, finding that closeness to the shoreline had only a minor effect on willingness to relocate. Further, in another survey of 46 households affected by Hurricane Sandy, Bukvic and Owen (2017) concluded that personal health and safety were primary drivers in willingness to accept buyouts. Working in Australia, King et al. (2014) conducted a meta-analysis of four surveys that addressed willingness to relocate. These quantitative surveys were complemented by focus groups and interviews with community leaders and policy makers. King et al. (2014) conclude that family commitments, livelihood opportunities, financial constraints, and emotional ties are the primary factors that influence willingness to relocate.

Other scholars focus on displaced populations by examining determinants of intention to return to their homes. Fussell, Sastry, and Vanlandingham (2010) found that the level of damage sustained in Hurricane Katrina had a significant negative impact on an individual's willingness to return after displacement. Groen and Polivka (2010) took a different approach but also found a role for damage–this time in the evacuee's county of origin–in determining willingness to return after Katrina. Age and homeownership were also determined to be factors, with older residents and homeowners being more likely to return (Groen and Polivka 2010). Both studies found that black residents were less likely to return; however, the racial distinction disappeared after controlling for damage patterns. Baker et al. (2009) surveyed a small group of people displaced by Hurricanes Katrina and Rita and found that their subjective perceptions of hurricane strike risk (which were higher than scientific estimations) had a significant impact on intention to return.

Although it would be an important concern for policymakers, Findlay (2011) points out that scholars pay relatively little attention to determining the likely destinations of environmental migrants. Findlay (2011) uses an exploration of populations affected by drought and food insecurity to make this point, arguing that even in very harsh conditions most people will chose to remain in place and that those who do move will likely undertake very short distance relocation. Findlay argues that over the next 50 years we are likely to see amplification and modification of existing migration channels, but that we need more attention to migration destinations to fully understand how populations might shift. Black, Kniveton, and, Schmidt-Verkerk (2011c) begin to address this question by seeking to understand how and why existing migration flows may change due to climate change. They argue that how other factors interact with climate will be critical, emphasizing that in some cases climate change may actually result in a decrease in net migration. Hauer (2017) approaches the question of migrant destinations in the United States by combining estimates of the population at risk due to SLR with models of current migration systems to determine which counties are likely to receive in-migrants as a result of SLR. Hauer's work assumes amplification of existing migration routes and does not account for potential additional migration due to severe weather. Davis et al. (2018) focus on climate-driven migration in Bangladesh, modifying a diffusion-based model of mobility to estimate how many people might move and where they might go. Similarly to Hauer, they focus on migration triggered by direct inundation and argue that receiving areas will see increased demand for jobs, housing, and food. Black et al. (2011c), though, caution that lessons learned in one location may not hold for others. Hauer et al. (2020) underscore this complexity argument, agreeing that climate migration is multifaceted and anything but straightforward. They acknowledge that there are strong forces keeping populations in place and that the interplay of physical and social forces is difficult to untangle.

Some scholars and policymakers have begun to encourage voluntary migration as an appropriate adaptation to climate change (e.g., Black et al. 2011b; Elkin and Keenen 2018; Fatorić 2014). In some cases, entire communities are being moved from coastal zones. Rossi (2019) examines the cases of Isle de Jean Charles in Louisiana and Newtok in Alaska. Like many others, he emphasizes how difficult and complex such decisions and operations are, and he highlights the fact that such moves can separate populations from ancestral lands and cultural heritage. Similarly, Albert et al. (2018) point to enormous cost and complexity involved in finding land and resettling entire communities; for example, the government-led process of resettlement of Taro, the capital of Choiseul Province in the Solomon Islands, has been in planning for more than 20 years. Other approaches include encouraging individual migration through such policies as buyouts. Scholars, though, have urged caution, as buyouts and other methods of encouraging individual pre-emptive migration raise serious concerns for equity (Gibbs 2016; Marino 2018). It is important to note that relocation policies may both increase migration (Binger and Greer 2016; Bukvic et al. 2018) and leave behind a population with high vulnerability to environmental hazards (Black et al. 2011c; Findlay 2011). Furthermore, a comprehensive review found that buyout policies have not evolved and improved over time (Greer and Binder 2017).

In looking at this literature, what becomes clear is that the connection has not yet been made between attitudes, perceptions, and beliefs and subsequent migration decisions. If a projected 10 percent of Georgia coastal residents are displaced by sea level rise (Hauer et al. 2016) then it will be critical to know how their beliefs about climate-related change and their ability to respond will result in intentions to migrate that might be addressed in local and regional planning and management. Very few past studies, Weller, Baer, and Prochaska (2016) excepted, use the aftermath of hurricanes or other climate-related disasters to understand the complex ways in which these events affect attitudes, perceptions, and planned behaviors. Our approach uses a cross-disciplinary model that connects the formation of beliefs about SLR to expressed intentions to act, using both ethnographic and survey methods.

METHODS

This article focuses on how residents now look toward the future, one in which hurricanes may become the norm rather than the exception. Our study includes both a large-scale survey administered across all six Georgia coastal counties and in-depth interviews with residents of Chatham and McIntosh counties (Figure 1). Chatham County, home to Savannah, is by far the most populated of the six coastal counties, and McIntosh is the least populated. Chatham continues to grow, as populations in McIntosh decline. McIntosh has higher levels of poverty and lower education levels, though Chatham does exhibit marked inequality as well. Using these two locations, we examined first how Hurricane Matthew influenced the attitudes and planned adaptation behaviors of coastal residents, focusing specifically on migration away from the coast, and second, how repeated exposure (i.e., the occurrence of Hurricane Irma) further influenced those perceptions and planned behaviors.

Our approach to this research was two-fold, using in-depth ethnographic interviews and an internet-based region-wide survey to understand the influence of demographic variables on behavior as well as prior experience and attachment to community and place. In both the interviews and survey, we sought to understand how chronic stressors (e.g., incremental SLR) and acute shocks (e.g., more frequent damaging storms) might motivate people to migrate away. The region-wide survey of residents' adaptation plans and intentions to migrate was designed to examine the roles of geographic location, local social vulnerability, and flood-proneness in shaping attitudes and intentions. The development of both interview and survey components of our study was shaped by our interest in the cultural dimensions of climate change impacts and the ties that people have to their settings that go beyond physical and economic impacts.

In-depth interviews with residents of Chatham and McIntosh counties were designed to examine individual problem framing and strategies for responding to extreme weather events. We asked about rationales and motivations for their attitudes and behaviors during and after the storm. Following Matthew, we conducted 66 interviews with 72 residents. We selected interviewees for diversity in components of social vulnerability (e.g., age, ethnicity), evacuation status (mandatory, voluntary), and storm impacts. Fifty-six percent

of interviewees were female, and 44 percent were male. The majority, 75 percent, identified as white, with 22 percent identifying as black or African American, and 3 percent as mixed raced. They ranged from 25 to 91 years old, with 47 percent below 65 and 53 percent above 65. Median household income was $50,000 and ranged from $0 to $400,000. Interviews covered migration histories, political economic contexts, storm experiences and attitudes, and adaptation possibilities. All interviews were recorded and transcribed for coding in Dedoose. Our coding approach was primarily deductive, and we based our initial codebook on the interview protocol's main themes. The codebook was refined as these themes became clearer. We used an inductive approach for a second wave of coding to capture any emergent issues or themes that were not foreseen during the initial research design.
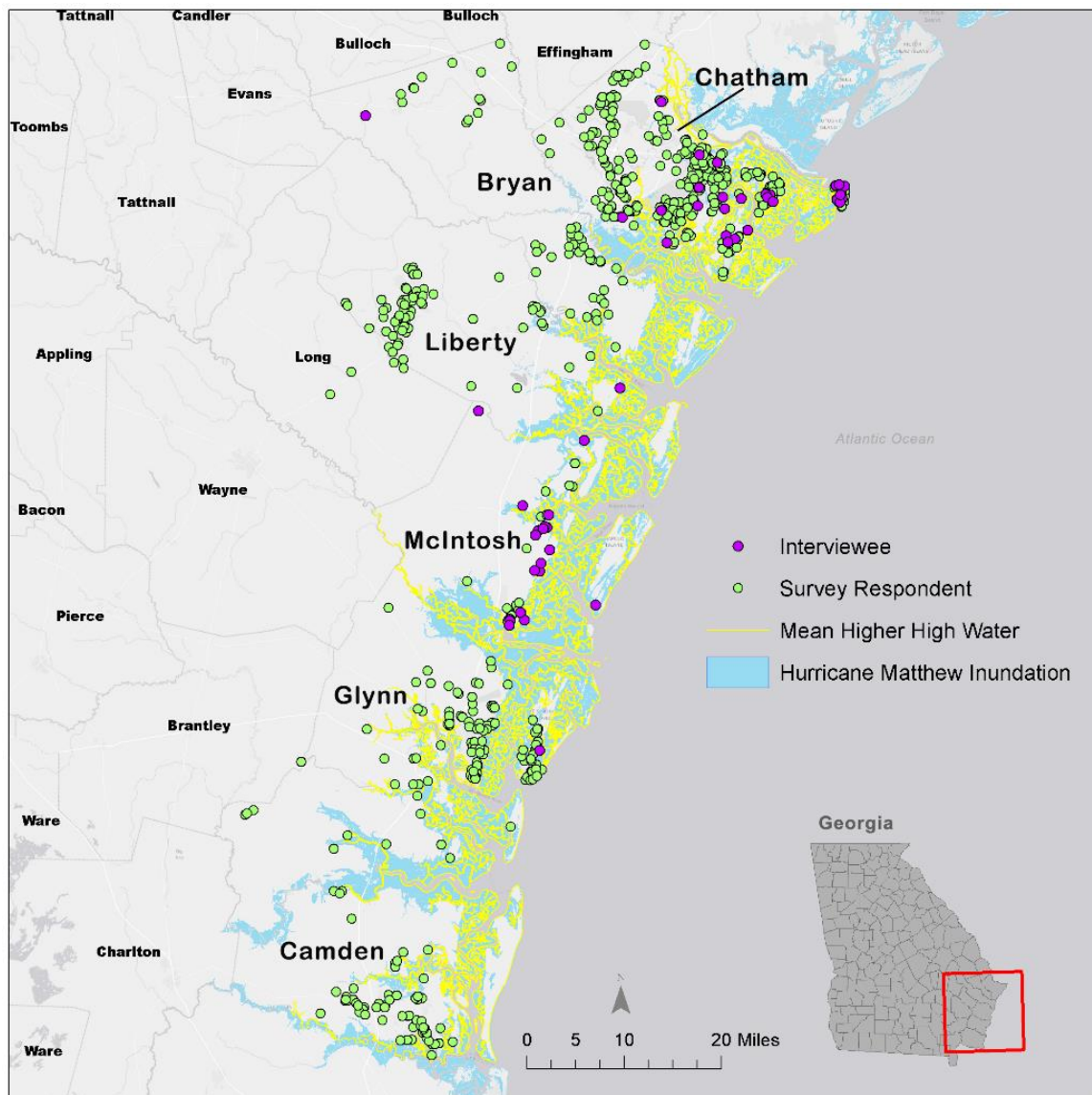
Note: The map prepared by Micah Taylor. Coastal Georgia, USA 31.489946° N, -81.499712° W. Esri, HERE, Garmin, ©OpenStreetMap Contributors, and the GIS user community. Accessed December 2018.

Figure 1. Interview and Survey Respondent Home Locations in Georgia Coastal Counties

The core of survey development was guided by Song and Peng's (2017) study of attitudes to relocation in response to sea level rise, Thomas et al.'s (2015) study of sea level change perceptions on the Severn Estuary in the U.K., Lu's (1999) investigation of inconsistencies in people's expressed intentions and actual migration behavior, and Wilmot's (2009) examination of migration intentions in the face of economic growth and change in the Rocky Mountain west. The 139 survey items explored residents' reasons for living on the coast, the kinds of changes that would cause them to consider migrating away and their intended future adaptation actions. An initial section asked about reasons for living at the coast, and what might cause people to consider moving away. A second section probed peoples' expectations for the future with respect to SLR and severe storm damage. A final section focused on attitudes, the influence of respected others, perceived self-efficacy, and intentions to migrate away from the coast or stay in place.

The initial survey was conducted via Qualtrics Panels, approximately six months after Hurricane Matthew. Internet panels are increasingly used in social science research for reasons of convenient access to a large population, cost and speed (Hays, Liu, and Kapteyn 2015). Chandler and Shapiro (2016) found hundreds of social science papers using Mechanical Turk for internet-based crowdsourced convenience samples. In our case we wanted to target coastal counties, and Qualtrics was able to offer us a sample geographically confined to Georgia coastal counties and weighted to match key demographic characteristics in the US Census. Our panel was broadly representative of the target population except for an over-representation of females in the sample (Table 1). Boas, Christenson, and Glick (2020) found a similar gender imbalance in their examination of Qualtrics panels but that otherwise good representativeness and sample diversity.

Table 1. Interview and Survey Respondents vs. Census Demographic Characteristics. US Census, 2017. American Community Survey, at Headwaters Economics, Headwaterseconomics.Org/Par.

	Total Population	% over 65	% Female	% White	% Black/ African American	% living in poverty	% without high school degree	% with Graduate degree
Georgia	10,310,371	12.3%	51.0%	59.8%	31.2%	17.8%	14.2%	30.4%
Georgia Coastal	539,319	13.3%	51.1%	58.7%	33.8%	17.3%	9.7%	23.9%
Interview	72	53.0%	56.0%	75.0%	22.0%	N/A	N/A	N/A
Survey	991	10.2%	69.1%	67.6%	20.0%	21.7%	3.4%	14.4%

Initial data collection was completed in March (interviews) and May (surveys) 2017. In the days preceding Hurricane Irma's landfall in Georgia (September 11, 2017), we made plans to return to the field. Because many respondents had emphasized in their interviews that their decisions were based in part on the perception that "we never get hit," we thought

it critical to return to examine how this repeated exposure might change attitudes and perceptions. Eighteen days after Hurricane Irma passed through, we were conducting interviews with 20 of our original 72 interviewees, 10 in each county. Participants in second interviews were people who had said in initial interviews that they were not considering moving and included variability in attitudes toward human-induced climate change. We also conducted a second survey post-Irma, which was initiated less than a month after the hurricane impact and completed in December. Of 201 responses, 175 met our quality criteria and were included in the analysis. Interviews were transcribed and coded using Dedoose web-based software.

We received 2,509 survey responses after Hurricane Matthew. Anticipating the potential for weak attentiveness (Hays et al. 2015) among respondents we filtered responses with obvious pattern responses, incomplete responses, and those showing completion in unreasonably short times. We also encountered many potential duplicates by examination of IP addresses of responses and out-of-area responses where a respondent may own two or more homes and only be part-time in our target region. Our rigorous data cleaning resulted in an analysis set of 991 responses. The median age of survey respondents after Hurricane Matthew was 35. The gender breakdown was 69 percent female, 31 percent male, and 68 percent identified as white, 20 percent black or African American, 5 percent Hispanic or Latino (Table 1). The median time residents had lived in their current home was 4.5 years; and the median time lived on the coast was 12.75 years. Fifty-seven percent of respondents had previously lived in areas subject to hurricanes. Data were analyzed using the JMP-Pro statistical analysis suite. We used Principal Component Analysis to reduce our large sets of variables to a smaller set of conceptually coherent components (Dunteman 1989). We subsequently used analysis of variance (ANOVA) to examine the influence of demographic locational and other variables on those components.

Where our surveys were able to efficiently examine the responses of a widely-distributed coastal population, in common with all surveys they cannot anticipate all useful lines of inquiry. Our parallel interviews were limited in how widely they could reach but were powerful means to investigate issues that were more nuanced or unanticipated. The complementarity of the two approaches allowed us to examine the complexities of people's decision-making priorities that make management of and preparation for coastal climate-related change especially challenging.

RESULTS

For the purposes of this article, we focus on several issues that may be of interest to emergency managers and city planning officials: (1) the non-migration adaptation measures people expressed intention to undertake, (2) who might choose to migrate away from the coast, (3) what the trigger will be to cause them to move, (4) where they might go, and (5) what we have learned about repeated exposure to extreme events.

Non-migration Adaptation Measures

Interviewees and survey respondents indicated that they are likely to undertake a variety of measures to prepare for future extreme storm events. The single largest response across both groups is that they will prepare in advance for evacuations in the future. Others indicated they would take protective measures such as clearing trees from property, buying generators, or buying smartphones. Approximately 50 percent of survey respondents indicated they would take such measures. These measures were geared toward minimizing damage to homes and to facilitating or avoiding evacuation or facilitating re-entry. When respondents expressed an intention to alter their plans or to undertake new adaptation measures, they almost always tied these decisions to their experiences of the storm:

> C25: We went to Statesboro, and in Statesboro, they also lost electricity. So, we didn't have any access to internet, TV, we had no idea when it was okay to come back. We had no way of knowing. I don't have a smart phone. We don't have smart phones. So, we basically sat there without electricity and waited for the storm to pass. The storm passed, and it became a beautiful day. So we said, 'OK, well, we're north, more north than Tybee, so Tybee's got to be great. Let's go!' We packed up the car and left. We got back here on Monday evening, and they wouldn't let us in here. They wouldn't let us on the island. So, we ended up spending two nights down in Savannah. It ended up costing us $500 because they charge you $29 a day to park both cars.

Of the 66 interviews conducted, 10 individuals or couples experienced major damage to their homes from Hurricane Matthew, indicating that their homes were made uninhabitable for a time and required extensive repairs. All of these were in Chatham County. These interviewees were more likely to indicate a preference for more aggressive adaptation measures. For example, at least one resident of Tybee Island plans to take advantage of a funding program that will cover a large portion of the cost of raising homes (C32). This program will still leave a substantial portion for the homeowner to pay, and as such will not be an option for all residents. Others are replacing ground floor drywall with beadboard that can be dried and reinstalled rather than torn out every time the home experiences flooding (C13). Still, others are removing all cabinets and using only open metal shelving, or using only indoor or outdoor furniture on the ground floor (C25).

**Migration away from the Coast**

Demographers have indicated that we should expect to see large numbers of residents leaving coastal areas over the next 30 years as a result of SLR (Fletcher et al. 2016; Hauer et al. 2016). Of our interviewees, approximately 38 percent said they would consider moving away if they were affected by climate-related changes, including both storms and SLR (Table 2).

Table 2. Interviewee Intentions to Stay or Move Away from the Coast

Interviewee Intentions	#	%
Will not consider moving	30	45.50%
Will consider moving if suffer catastrophic damage	11	16.70%
Will consider moving for mild to moderate climate-related changes	14	21.20%
Will consider moving for other personal reasons	11	16.70%
Total	66	

Survey respondents were also asked about their intentions for the future, encompassing potential adaptation responses ranging from storm and flood-proofing homes to relocation back to safer locations. For both post-Matthew and post-Irma respondents, more than 50 percent indicated they would storm and flood-proof their homes, 30 percent will stay where they are whatever happens. Like the interviewees, survey respondents indicated a range of responses to different "move away" options. Fewer than 20 percent would move back to where they came from, around 40 percent would move closer to family and friends if their home was at risk (Figures 2, and 3).
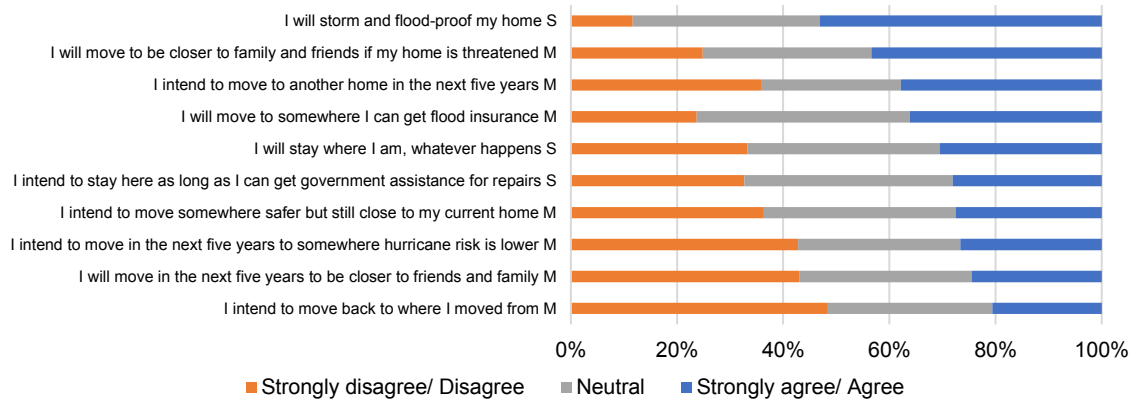
Note: Postscripts Indicate Component Groupings: M = Move Away, S = Stay In Place.

Figure 2. Actions Respondents Might Take in The Future (Post-Matthew Survey)
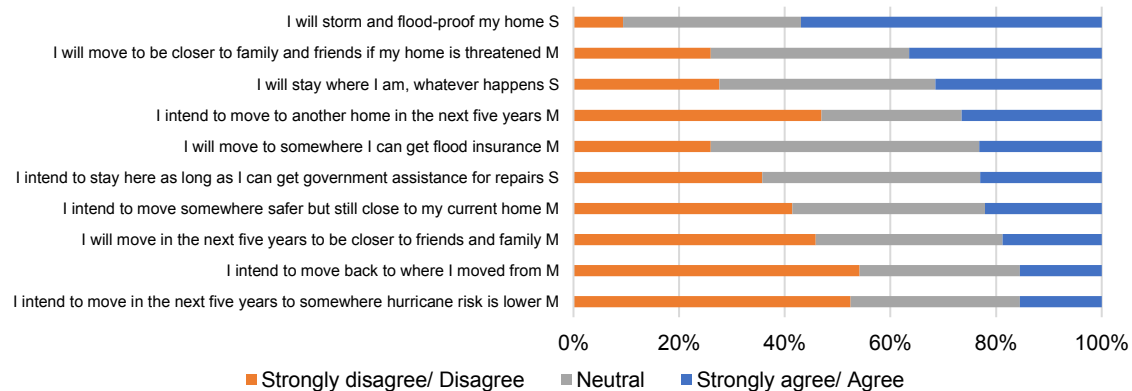
Note: Postscripts Indicate Component Groupings: M = Move Away, S = Stay In Place.

Figure 3. Actions Respondents Might Take in The Future (Post-Irma Survey)

Principal Components Analysis (PCA, varimax) of the ten individual survey items above (Figures 2 and 3) was used to identify component groupings for further analysis. Using eigenvalues greater than 1.0 as grouping criteria revealed two components, *Move Away* and *Stay in Place*, for both post-Matthew and post-Irma responses. These components accounted for 53.79 percent of the variance post-Matthew (M) and 54.15 percent post-Irma (I). The internal consistency for each component was tested using Cronbach's Alpha. The values for the seven items in *Move Away* were 0.84 (M) and 0.87 (I), generally regarded as good (DeVellis 2017), and 0.54 (M) and 0.30 (I) in *Stay in Place.* The latter is a poor value but no weak items were identified based on examination of item-total correlations. Given these findings, these two constructs were used for subsequent analyses.

Who will move

The survey results show small but significant effects. Younger, less wealthy, and African American respondents were more likely to agree with statements expressing intention to move away (Table 3). One-way between-subjects ANOVAs were conducted to compare the effect of age on intentions to move away. The effect of age was significant at the level of $p < .001$ ($F_{3,987} = 33.61$), older people less likely to move away.

Table 3. Effect of Age on Agreement with Expressed Intentions to Move Away

Age category	N	Mean	Std. Error
18-24	195	0.94	0.38
25-44	443	0.23	0.25
45-64	252	-2.31	0.34
65+	101	-4.30	0.53

The effect of income was significant at the level of $p < .01$ ($F_{6,984} = 3.18$). Generally, those in higher income levels exhibit a lower intention to leave their homes to move to safer places (Table 4).

Table 4. Effect of Household Income on Agreement with Expressed Intentions to Move Away

Household income category	N	Mean	Std. Error
< $25,000	215	0.07	0.38
$25-35,000	152	0.07	0.45
$35-50,000	159	-1.14	0.44
$50-75,000	196	-0.57	0.40
$75-100,000	117	-1.44	0.51
$100-150,000	105	-1.70	0.54
> $150,000	47	-2.57	0.81

There was a significant effect of gender on intentions to stay; men were more likely to intend to stay in place ($F_{2,988}$ = 3.74, p < .05; see Table 5). However, while statistically significant, none of these effects were large. Evacuation behavior and ethnicity had larger effects. Those who had evacuated (M = 0.06, SD = 0.95) were more likely to be considering moving than those who stayed in place (M = -0.13, SD = 1.06; t_{642} = 2.35, p < .05). The effect of ethnicity was significant at the level of .0001 ($F_{7,983}$ = 4.47). African Americans expressed moderately greater intentions to move away (M = 0.29, SD = 1.01) than Whites (M = -0.12, SD = 0.98; t_{661} = 4.38, p < .001).

Table 5. Effect of Gender on Agreement with Expressed Intentions to Stay in Place

| Gender category	N	Mean	Std. Error
Female	685	0.35	0.08
Male	304	0.53	0.13
Did not report	2	-3.50	1.57

Interviewees, on the other hand, did not show any strong patterning of response based on ethnicity, gender, or age. As with the surveys, income does correlate with willingness to relocate. People of lesser means expressed more willingness to consider leaving the coast than did those in higher income groups. However, this should not be read as an indication that residents with lower income levels will leave in large numbers. Interviewees indicated that without significant assistance, they would be unable to move. These residents feel that they have neither the financial nor social capital to start a new life somewhere else. At the same time, these residents indicate also that they cannot afford to armor the property, raise it, or take other protective measures. So, the poorest residents may be left cobbling together small repairs each time they are affected, and they may also be least equipped to seek out FEMA funding.

Why people stay

People have many reasons for staying on the coast, related to lifestyle choices, family, and economic ties. Survey respondents were asked what was important in their choice to live on the coast including lifestyle, social and economic questions. For both post-Matthew and post-Irma respondents, more than 75-80 percent indicated that the area's natural beauty, pace of life, and affordability were important or very important to them (Figures 4 and 5). Financial reasons such as locating there for work were less important. PCA of post-Matthew responses to the eleven questions in Figure 4 revealed components *Lifestyle*, *Family Ties*, and *Job/Financial* that accounted for 63.46 percent of total variance. Cronbach's Alpha for the six items in *Lifestyle* was 0.85, generally regarded as good, and 0.72 for *Family Ties*, which is acceptable, indicating strong internal consistency in responses to these items. The 0.42 figure for *Job/Financial* is not acceptable, but no weak items were identified. PCA of the same items post-Irma revealed similar components *Lifestyle*, *Family Ties*, and *Job/Financial* that accounted for 61.31 percent of total variance. Cronbach's Alpha for the five items in *Lifestyle* was 0.82, good, 0.70 for *Family Ties*,
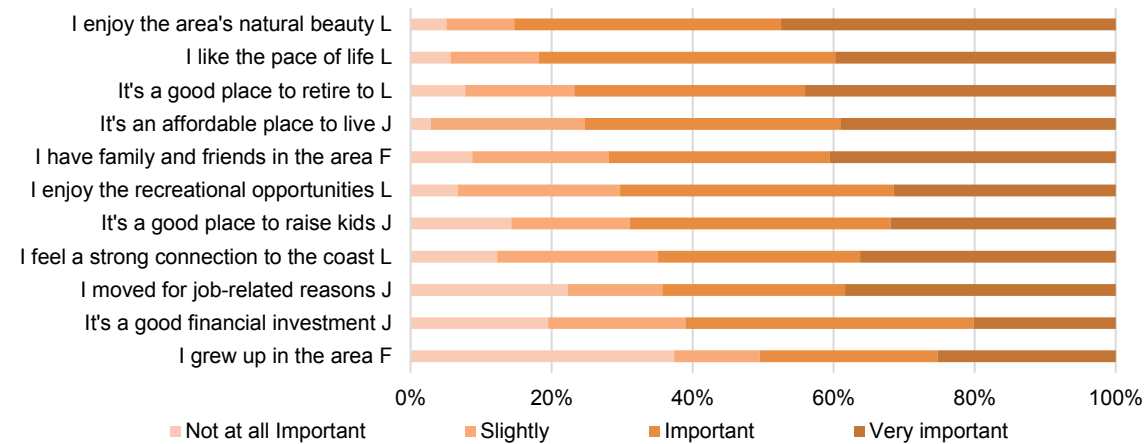
acceptable, and 0.62, poor, for *Job/Financial*. Survey responses to both surveys indicate similar consistent responses to lifestyle choices and family ties as primary shapers of people's ties to the coast.
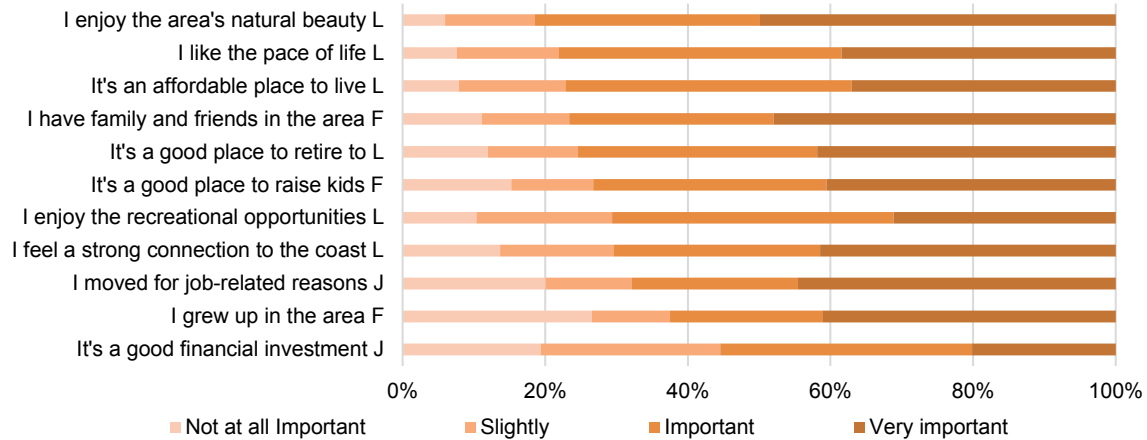
Note: Postscripts indicate component groupings L = Lifestyle, F = Family ties, J = Job/Financial.

Figure 4. Reasons for Living in Coastal Georgia (Post-Matthew Survey)

Note: Postscripts indicate component groupings L = Lifestyle, F = Family ties, J = Job/Financial.

Figure 5. Reasons for Living in Coastal Georgia (Post-Irma Survey)

Interviews confirmed the influence of place attachment, with the excerpts below being representative of many who said they would not consider moving away from their homes. The first excerpt is from a life-long resident of the area:

> M10: I like the environment. There's no smog, there's no problem with breathing. Everything is fresh. Vegetables are fresh, seafood. And I know everybody, pretty much. There's not that many strangers around. People that you don't know. People you can't trust. That means a lot. Go knock on somebody's door and say who it is, and they open the door. Need some help, something might happen, it's kind of like a community thing. We've got two or three big churches. Everybody knows everybody. They try to help everybody. You find out about everybody.

The second excerpt is from a newer resident who retired to the coast:

> *Interviewer: So, before the storm, had you ever thought about moving away?*
> C13: For good? No. It took me my whole life to find this place. Are you kidding?
>
> *Interviewer: What about after the storm? Have you changed your mind at all?*
> C13: Nope. . . I love this place . . . I'm where I want to be. This is the place to live.

For many survey respondents' time spent living on the coast equates to time spent building friendships and raising families, so that stronger relationship is not surprising. In contrast, people of all ages and length of residence are attracted by the quality of life factors contributing to *Lifestyle*. There was a small effect of length of coastal residence on rated importance for *Lifestyle* factors as reasons for living on the coast at the level of $p < .01$ ($F_{1,740}$ =6.74), but a larger effect for *Family Ties* ($F_{1,740}$ = 163.84; $p < .001$). Similarly, previous hurricane experience was not an issue when thinking about the importance of *Lifestyle* but was negatively related to the importance of *Family Ties*. Those with no previous experience in an area prone to hurricanes ($M = 0.19$, $SD = 0.98$) expressing more importance for *Family Ties* than those with experience ($M = -0.25$, $SD = 0.97$; $t_{740} = 6.00$, $p < .001$). While this seems contradictory, that those with less experience of hurricanes would be more concerned about ties to family and friends, prior to Hurricane Matthew the Georgia coast had not sustained any direct hurricane damage since 1898, so that long-term residents largely had no previous experience to draw upon.

Why people will move

In the survey, three (of fourteen) items were identified as reasons for definitely or probably leaving the coast by 75 percent or more respondents after Matthew: Environmental pollution increases, SLR threatens your home, and Family and friends move away, demonstrating the mix of environmental and social considerations that impact decisions. In the post-Irma survey, there were only two items cited by more than 60 percent of respondents as reasons to move: SLR threatens your home, and Storm damage becomes more frequent. PCA of the fourteen questions in Figure 6 for post-Matthew data revealed three components associated with people's intentions to move: *Loss of Lifestyle*, *Job/Financial Change*, and *Loss of Family Ties*. Together, these accounted for 55.8 percent of total variance. Cronbach's Alpha for the six items in *Loss of Lifestyle* was 0.84, generally regarded as Good, and 0.82 for *Job/Financial*, also Good. 0.55 for *Loss of Family Ties* is not acceptable, although no weak items were identified based on examination of item-total correlations. PCA for post-Irma data revealed just two components achieving an eigenvalue > 1.0: *Loss of Lifestyle* and *Family/Financial*, which accounted for 55.3 percent of total variance. Cronbach's Alpha for the eight items in *Loss of Lifestyle* was 0.88, generally regarded as Good, and 0.83 for *Family/Financial*, also good and signs of strong internal agreement among survey respondents.

African Americans attached more importance ($M = 0.01$, $SD = 1.04$) to *Loss of Lifestyle* than whites ($M = -0.06$, $SD = 0.98$; $t_{661} = 6.00$, $p < .001$). No other demographic variables had effects on the importance of *Loss of Lifestyle*. Those who had evacuated for the storms found *Job/Financial Change* more important ($M = 0.06$, $SD = 0.96$) as a reason to move than those who stayed in place ($M = -0.14$, $SD = 1.06$; $t_{642} = 2.46$, $p = .01$). Age had a small negative effect on the importance of *Job/Financial Change* ($F_{3,738} = 6.62$; $p < .001$). African Americans attached more importance ($M = 0.18$, $SD = 0.98$) to *Job/Financial Change* than whites ($M = -0.07$, $SD = 0.99$; $t_{661} = 2.71$, $p < .01$). There were no other effects of demographic variables.

In the interviews, of those who said they would move for climate-related reasons, which we defined as SLR or an increase in severe storms, approximately 17 percent said they would move only if their homes were destroyed (Table 6). For those who would move for less catastrophic change ($n = 14$), the majority cited storms, rather than flooding, as the factor that would drive them to leave.

Table 6. Climate-related reasons for moving

| Of those willing to move for mild to moderate climate-related reasons	#
Primarily cite flooding	2
Primarily cite storms	9
Unclear/No specific trigger listed	3

This stands in some contrast to the survey results, in which respondents were more likely to agree that they would move if SLR threatened their homes than if storm damage became more frequent (see Figures 6 and 7). Though many interviewees indicated that the storms had no impact on their decision making that might not actually be the case. Interviewees who suffered major damage were much more likely than those who suffered no damage to consider moving away (Table 7).
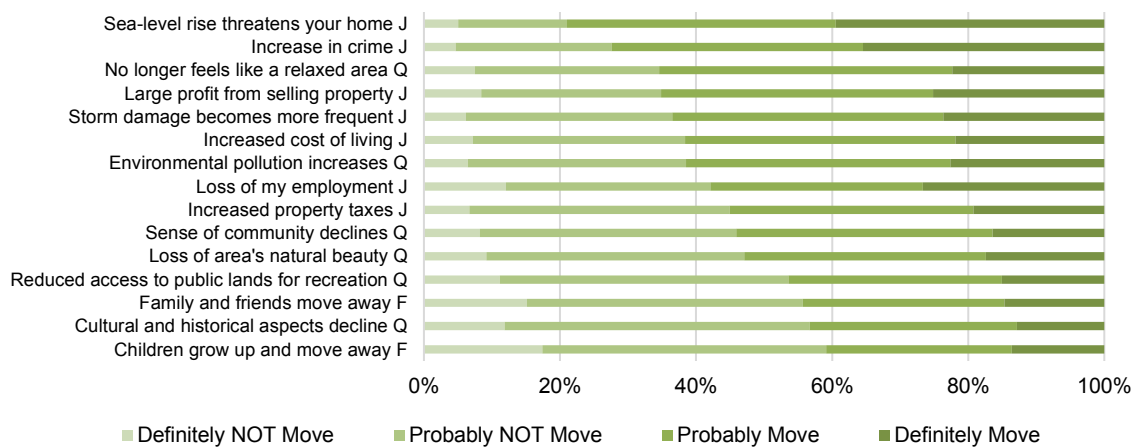
Note: Postscripts indicate component groupings: Q = Loss of lifestyle, J = Job/financial change, F = Lose family ties.
Figure 5. Considerations for Moving Away (Post-Matthew Survey)
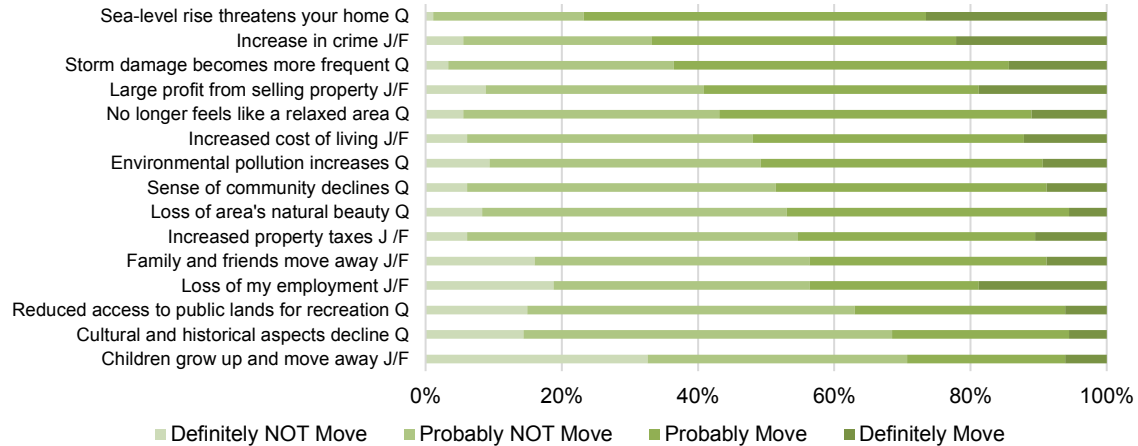
Note: Postscripts indicate component groupings: Q = Loss of lifestyle, J = Job/financial change, F = Lose family ties.

Figure 6. Considerations for Moving Away (Post-Matthew Survey)

Table 7. Attitudes toward Relocation as a Function of Damage Experienced in Hurricane Matthew

Attitude	Major (10)	Minor (21)	None (26)
Will not consider moving	20%	47.6%	53.8%
Will consider moving if suffer catastrophic damage	30%	19%	11.5%
Will consider moving for mild to moderate climate-related changes	40%	14.3%	19.2%
Will consider moving for other personal reasons	10%	19%	15.4%

Where they will move

It is challenging to determine where people will go if they move. The migration literature suggests that existing migration routes will simply be amplified (Findlay 2011; Hauer 2017), however our interview data questions that assumption. Of the 25 interviewees who indicated they would consider moving away for climate-related reasons, 11 said they would only consider moving slightly inland or to higher ground and would not consider moving away from the coast.

> C09: I tell you what. I have thought more about Tybee flooding and being very, very dangerous since this all happened. And it's made me think you know, in years to come, what's it going to be like? Because the water levels are different. The storms are different. And you start wondering. . . And it's made me very worried and more concerned. Of course, I may be dead and gone, because I'm just older, you know?
> *Interviewer: Have you thought about moving?*
>
> C09: Yeah. After this. In years to come, I mean if I'm fortunate enough to live a few more years, I probably would go to Savannah, or go to Wilmington Island at least.

Survey findings support the interview outcomes. Figures 2 and 3 indicate the survey findings regarding potential destinations. Potential destination ranged from "I intend to move back to where I moved from" with which only 18.2 percent of respondents agreed, 52.7 percent disagreed, to "I'll move closer to family and friends if my home is at risk" with which 42.8 percent agreed, 26.9 percent disagreed.

Repeated Experience of Storms

In the survey, we asked people both post-Matthew and post-Irma what their expectations were for how much SLR the region would experience 10 years, 20 years, and 50 years out. Respondents used a scale from -3 to 3, and Table 8 includes the mean for each time period. There was very little change in expectations, but for each time point, it went down after Irma. We also asked respondents how often they expected storms accompanied by flooding to occur. Again, after Irma, it went down.

Table 8. Expectations for Sea-level Rise (SLR) and Storms with Flooding over Three Time Periods

Amount SLR	10 years	20 years	50 years
After Matthew	0.73	1.07	1.51
After Irma	0.69	0.87	1.32
Frequent storms with flooding			
After Matthew	0.75	1.05	1.43
After Irma	0.65	0.94	1.29

Similarly, their concern about how SLR would impact the region, and them personally, also went down (see Table 9).

Table 9. Concern about the Effects of Sea-level Rise (SLR)

Concern about SLR impact on region	Mean expressed concern
After Matthew	0.39
After Irma	0.35
Concern about SLR impact personally	
After Matthew	0.21
After Irma	0.1

Concern about the impact of damaging storms showed very little movement, with a slight uptick in personal concern after Irma (see Table 10).

Table 10. Concern about Storm Effects

Concern about storm impact on region	Mean expressed concern
After Matthew	0.73
After Irma	0.72
Concern about storm impact personally	
After Matthew	0.66
After Irma	0.69

Similarly, very few interviewees expressed changes in opinion or perception about future storm impacts or SLR. Informant M32 was one of the only informants to express additional concern after Hurricane Irma: "Normally, I always felt very smug about hurricanes because they didn't come here. The gulf stream took them to North Carolina. And that's not happening." In contrast, many others expressed satisfaction that they were 'learning' or getting into a 'routine' with hurricane preparations or felt as though their low levels of concern were validated by the mild impacts they experienced in Matthew and Irma:

> M21: Well, we'll just be like Florida now. We'll hunker down a couple times a year, and maybe we'll evacuate every couple of years, but they do it, so can we.

> CO4: Irma was a non-event. Matthew was a little worse, but Irma was essentially a non-event. We really are protected here in Georgia.

These findings were also supported by survey responses. We examined survey respondent's intentions to move from the coast or to stay by how long they had lived on the coast, whether they had experienced other hurricanes, and whether they evacuated for Hurricane Matthew. One-way between-subjects ANOVAs of these effects on intentions to move away revealed a significant negative effect of time lived at the coast on intentions to *Move Away* at the level of $p < .001$ ($F_{5,985} = 4.95$). There were no significant effects of past hurricane experience or evacuation behavior on intentions to *Move Away*, though they were significant for intentions to *Stay-in-Place*. The main effects of these same components on intentions to *Stay-in-Place* were significant for time at the coast. Long-term residents were more likely to stay at the level of $p < .05$ ($F_{7,983} = 2.57$). Those with past hurricane experience were more likely to stay at the level of $p < .001$ ($F_{1,989} = 8.09$), and those who did not evacuate were more likely to stay at the level of $p < .001$ ($F_{3,987} = 4.69$)

DISCUSSION

In making decisions on how to respond to storm threats, people drew heavily on past experience. When deciding whether to evacuate and how to prepare their homes for Hurricane Matthew, that meant referring to their storm experiences elsewhere, if they had them, or to their experiences of storms many years ago. In responding to the threat of Irma, Matthew experiences factored heavily into behavior, this was particularly evident when people discussed their positive and negative experiences of evacuating for the storm. Though participants largely indicated that their storm experiences had little to no effect on their planned behaviors in regards to migration away from the coast, it appears as though the damage their homes sustained may indeed play a role. This is consistent with the findings of Groen and Polivka (2010) after Hurricane Katrina. The apparent contradiction

we observed in the stated and actual influence of prior experience underscores just how difficult it is to determine who might choose to migrate away from the coast and why.

Fewer survey respondents and interviewees than expected expressed a desire or intention to move away from the coast in anticipation of SLR or severe storms. Commonly-measured demographic variables had little effect on planned migration behaviors, and several population sub-groups exhibited in-group variability. For example, our interview data suggest that retirees may behave differently than others in the same age cohort, supported by survey data indicating that the upper-income and more educated are less likely to migrate in the face of coastal change. More difficult to measure factors such as job obligations, family ties, and lifestyle benefits may be more important in determining migration behavior than are demographic variables. The factors that we identified as particularly salient differ somewhat from those identified by in other studies discussed above, underscoring Black et al.'s (2011c) caution that it may be difficult to use data from one area to make inferences about what drivers may be important in another.

Our data suggest that where climate migrants choose to go may alter, rather than amplify, previously observed migration patterns. Both survey respondents and interview participants indicated a preference for staying near the coast, leading us to believe we may see a substantial amount of within-area migration (Findlay 2011), which is contrary to assumptions currently made by modelers of climate-driven migration (Hauer 2017). For many of our interviewees, the most attractive option would be to move only slightly farther inland or to higher elevations, remaining within the same towns and cities. This could potentially have large impacts for both infrastructure and equity, as we must confront questions of changing development patterns and densities and consider potential impacts on emergency services, housing, and schools, among other services. Modeling efforts also need to address storms, in addition to sea level rise, as a driver of migration.

Perhaps most concerning, our data indicate that rather than receiving a "wake up call" from Hurricanes Matthew and Irma to motivate either increased preparation or migration, people may have been lulled into a false sense of security by their ability to ride out these storms. Visual comparisons of our Figures 2 and 3, 4 and 5, and 6 and 7 indicate that almost all indicators suggest that post-Irma people are less inclined to move, value more the factors that keep them on the coast, and are less motivated to move by potential loss or erosion of those values. Post-Irma, survey respondents reported that they are more likely to stay-in-place in the future, though they were less assured that government support will be there to help them stay. In addition to more people post-Irma reporting that they would stay-in-place, the numbers of those responding neutrally (neither agreeing nor disagreeing with statements about expected migration) increases by nearly ten percentage points between our two surveys, which may be an indication that "wait and see" is now becoming the prevailing sentiment. Participants indicated that they had fared well during Matthew and Irma and that they had gained confidence for future storms. While a sense of empowerment

is certainly not negative, the assumption that future storms will follow the pattern of their predecessors is. It appears as though many people are not evaluating storms as individual events based on information provided by authoritative sources but rather are comparing them to past events that may have had different trajectories or intensities.

CONCLUSIONS

Our research reinforces previous conclusions that environmental determinants of migration are difficult to separate from other drivers, but it also clarifies some points and raises important new questions. It is becoming clearer that climate migrants may behave differently than other migrants, and that different components of what might be termed climate-related drivers (e.g., drought, SLR, severe storms) will likely produce different effects and act differently upon different people. This work indicates that those with lower incomes, younger people, and ethnic minorities may be more motivated to move away from the coast, but also that they may have more difficulty actually doing so. This raises serious concerns for equity in the region. It is also important to note that we observed significant intra-group variability within some categories of age and income. There is an opportunity to delve more deeply into how reasons for living on the coast influence intentions to stay or leave, focusing on sub-population groups such as retirees, those with ocean-related livelihoods, or those with generational ties to a place. Furthermore, the finding that many climate migrants may choose to remain close to their homes needs further investigation and subsequent communication to policymakers.

Our data show that past experiences are important in determining future behavior, sometimes in ways we might not expect. Coastal Georgia residents appear to be becoming more comfortable with severe storms, and emergency managers may need to rethink their communication strategies, emphasizing the individuality of different storms. There is also an opportunity to explore new strategies for helping coastal residents enlarge their catalogues of experience through sharing stories and developing scenarios and tools through which they can "experience" not evacuating from a storm, "see" the sea level rise around them, or "feel" the emotional impact of severe property damage. Ensuring a future in which coastal residents are well-positioned to act in their best interests will require carefulness, creativity, and a strong commitment to equity.

Acknowledgments

References

Adamo, Susana B. 2010. "Environmental Migration and Cities in the Context of Global Environmental Change." *Current Opinion in Environmental Sustainability* 2(3):161-5.

Aerts, Jeroen C.J.H. 2017. "Climate-induced Migration: Impacts beyond the Coast." *Nature Climate Change* 7(5): 315-6.

Albert, Simon, Robin Bronen, Nixon Tooler, Javier Leon, Douglas Yee, Jillian Ash, David Boseto, and Alistair Grinham. 2018. "Heading for the Hills: Climate-Driven Community Relocations in the Solomon Islands and Alaska Provide Insight for a 1.5ºC Future." *Regional Environmental Change* 18(8): 2261-72.

Baker, Justin, W. Douglass Shaw, David Bell, Samuel D. Brody, Mary Riddel, Richard T. Woodward, and William Neilson. 2009. "Explaining Subjective Risks of Hurricanes and the Role of Risks in Intended Moving and Location Choice Models." *Natural Hazards Review* 10(3):102-12.

Binder, Sherri Brokopp and Alex Greer. 2016. "The Devil Is in the Details: Linking Home Buyout Policy, Practice, and Experience after Hurricane Sandy." *Politics and Governance* 4(4):97-106.

Black, Richard, W. Neil Adger, Nigel W. Arnell, Stefan Dercon, Andrew Geddes, and David Thomas. 2011a. "The Effect of Environmental Change on Human Migration." *Global Environmental Change* 21:S3-11.

Black, Richard, Stephen R.G. Bennett, Sandy M. Thomas, and John R. Beddington. 2011b. "Climate Change: Migration as Adaptation." *Nature* 478(7370):447-9.

Black, Richard, Dominic Kniveton, and Kerstin Schmidt-Verkerk. 2011c. "Migration and Climate Change: Towards an Integrated Assessment of Sensitivity." *Environment and Behavior* 43(2):431-50.

Boas, Taylor C., Dino P. Christenson, and David M. Glick. 2020. "Recruiting Large Online Samples in the United States and India: Facebook, Mechanical Turk, and Qualtrics." *Political Science Research and Methods* 8(2):232-50.

Bukvic, Anamaria and Graham Owen. 2017. "Attitudes towards Relocation following Hurricane Sandy: Should We Stay or Should We Go?" *Disasters* 41(1):101-23.

Bukvic, Anamaria, Andrew Smith, and Angang Zhang. 2015. "Evaluating Drivers of Coastal Relocation in Hurricane Sandy Affected Communities." *International Journal of Disaster Risk Reduction* 13:215-28.

Bukvic, Anamaria, Hongxiao Zhu, Rita Lavoie, and Austin Becker. 2018. "The Role of Proximity to Waterfront in Residents' Relocation Decision-Making Post-Hurricane Sandy." *Ocean and Coastal Management* 154:8-19.

Chandler, Jesse and Danielle Shapiro. 2016. "Conducting Clinical Research Using Crowdsourced Convenience Samples." *Annual review of clinical psychology* 12:53-81.

Davis, Kyle Frankle, Abinash Bhattachan, Paolo D'Odorico, and Samir Suweis. 2018. "A Universal Model for Predicting Human Migration Under Climate Change: Examining Future Sea Level Rise in Bangladesh." *Environmental Research Letters* 13(6): 064030. doi: 10.1088/1748-9326/aac4d4

DeVellis, Robert F. 2017. *Scale Development : Theory and Applications.* Applied Social Research Methods Series: 26. Los Angeles, CA: SAGE.

Dunteman, George H. 1989. *Principal Components Analysis*. Sage University Paper Series on Quantitative Applications in the Social Sciences, No. 69. Newbury Park, CA: Sage.

Elkin, Rosetta S. and Jesse M. Keenan. 2018. "Retreat or Rebuild: Exploring Geographic Retreat in Humanitarian Practices in Coastal Communities." Pp. 149-65 in *Climate Change Impacts and Adaptation Strategies for Coastal Communities*, edited by Walter Leal Filho. Cham, CHE: Springer International.

Fatorić, Sandra. 2014. "Migration as a Climate Adaptation Strategy in Developed Nations." *Briefer* Vol. 24. Washington DC: The Center for Climate and Security.

Findlay, Allan M. 2011. "Migrant Destinations in an Era of Environmental Change." *Global Environmental Change* 21(1):S50-8.

Fletcher, Cameron S., Alicia N. Rambaldi, Felix Lipkin, and Ryan R. J. McAllister. 2016. "Economic, Equitable, and Affordable Adaptations to protect Coastal Settlements against Storm Surge Inundation." *Regional Environmental Change* 16(4):1023-34.

Fussell, Elizabeth, Narayan Sastry, and Mark Vanlandingham. 2010. "Race, Socioeconomic Status, and Return Migration to New Orleans after Hurricane Katrina." *Population and Environment* 31(1-3):20-42.

Garner, Andra J., Michael E. Mann, Kerry A. Emanuel, Robert E. Kopp, Ning Lin, Richard B. Alley, Benjamin P. Horton, Robert M. DeConto, Jeffrey P. Donnelly, and David Pollard. 2017. "Impact of Climate Change on New York City's Coastal Flood Hazard: Increasing Flood Heights from the Preindustrial to 2300 CE." *Proceedings of the National Academy of Sciences of the United States of America* 114(45):11861-6.

Gibbs, Mark T. 2016. "Why Is Coastal Retreat so Hard to Implement? Understanding the Political Risk of Coastal Adaptation Pathways." *Ocean and Coastal Management* 130:107-14.

Greer, Alex and Sherri Brokopp Binder. 2017. "A Historical Assessment of Home Buyout Policy: Are We Learning or Just Failing?" *Housing Policy Debate* 27(3):372-92.

Groen, Jeffrey A. and Anne E. Polivka. 2010. "Going Home after Hurricane Katrina: Determinants of Return Migration and Changes in Affected Areas." *Demography* 47(4): 821-44.

Gutmann, Ethan, Roy M. Rasmussen, Changhai Liu, and Kyoko Ikeda. 2018. "Changes in Hurricanes from a 13-Yr Convection-Permitting Pseudo-Global Warming Simulation." *Journal of Climate* 31(9):3643-57.

Hauer, Mathew E. 2017. "Migration Induced by Sea-Level Rise Could Reshape the US Population Landscape." *Nature Climate Change* 7(5):321-5.

Hauer, Mathew E., Jason Evans, and Deepak Mishra. 2016. "Millions Projected to be at Risk from Sea-Level Rise in the Continental United States." *Nature Climate Chang.* 6(7): 691-5.

Hauer, Mathew E., Elizabeth Fussell, Valerie Mueller, Maxine Burkett, Maia Call, Kali Abel, Robert McLeman, and David Wrathall. 2020. "Sea-Level Rise and Human Migration." *Nature Reviews Earth & Environment* 1(1):28-39.

Hays, Ron D., Honghu Liu, and Arie Kapteyn. 2015. "Use of Internet Panels to Conduct Surveys." *Behavior Research Methods* 47(3): 685-90.

KC, Binita, J. Marshall Shepherd, and Cassandra Johnson Gaither. 2015. "Climate Change Vulnerability Assessment in Georgia." *Applied Geography* 62: 62-74.

King, David, Deanne Bird, Katharine Haynes, Helen Boon, Alison Cottrell, Joanne Millar, Tetsuya Okada, Pamela Box, Diane Keogh, and Melanie Thomas. 2014. "Voluntary Relocation as an Adaptation Strategy to Extreme Weather Events." *International Journal of Disaster Risk Reduction* 8:83-90.

Lu, Max. 1999. "Do People Move When They Say They Will? Inconsistencies in Individual Migration Behavior." *Population and Environment* 20(5): 467-88.

Marino, Elizabeth. 2018. "Adaptation Privilege and Voluntary Buyouts: Perspectives on Ethnocentrism in Sea Level Rise Relocation and Retreat Policies in the US." *Global Environmental Change* 49:10-3.

National Weather Service. 2020. *Tropical Cyclone History for Southeast South Carolina and Northern Portions of Southeast Georgia (1851-2018).* Retrieved May 1, 2020 (https://www.weather.gov/chs/TChistory).

Neumann, Kathleen, Diana Sietz, Henk Hilderink, Peter Janssen, Marcel Kok, Han van Dijk. 2015. "Environmental Drivers of Human Migration in Drylands – a Spatial Picture." *Applied Geography* 56:116-26.

Piguet, Etienne. 2012. "The Drivers of Human Migration." *Nature Climate Change* 2(6):400-1.

Rossi, Marcello. 2019. "Surrendering to the Sea by Choice." *Nature Climate Change* 9(12):904-5.

Song, Jie and Binbin Peng. 2017 "Should We Leave? Attitudes towards Relocation in Response to Sea Level Rise." *Water* 9(12): 941. doi:10.3390/w9120941.

Thomas, Merryn, Nick Pidgeon, Lorraine Whitmarsh, and Rhoda Ballinger. 2015. "Mental Models of Sea-Level Change: A Mixed Methods Analysis on the Severn Estuary, UK." *Global Environmental Change* 33:71-82.

Weller, Susan, Roberta Baer, and John Prochaska. 2016. "Should I Stay or Should I Go? Response to the Hurricane Ike Evacuation Order on the Texas Gulf Coast." *Natural Hazards Review*. 17(3): 04016003. doi:10.1061/(ASCE)NH.1527-6996.0000217.

Wenk, Amy. 2016. "Hurricane Matthew Damages Reach $90 Million in Georgia." *Atlanta Business Chronicle,* October 21st.

Wilmot, Susan Reid. 2009. "Attitudes, Behavioral Intentions, and Migration: Resident Response to Amenity Growth-Related Change in the Rural Rocky Mountain West." PhD Dissertation, Utah State University, Logan, UT.