

Homeowner perceptions of North Carolina sea level rise policy

By

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Abstract:

The North Carolina coastline faces various threats such as erosion, increasing pressure from booming coastal populations, and increasing frequency of major storm events. In 2012, the state addressed the threat of sea-level rise (SLR) on development by enacting NC House Bill 819: “An Act to Study and Modify Certain Coastal Management Policies” (HB819). HB819 did not allow for any guidelines to define a rate of SLR for regulatory purposes and mandated that the Coastal Resource Commission Science Panel update the SLR report in the next 5 years, but could only use historical models to determine future rates of SLR for up to 30 years. NC provides a fascinating case study in SLR policy, because the state previously passed progressive policies for oceanfront erosion control, but halted any regulatory planning for sea level rise until July 1, 2016 with HB819. This thesis sought to address if NC waterfront homeowners and statewide residents were aware of HB819, their opinions of HB819, and what factors were most likely to predict awareness and acceptance of HB819. Surveys were sent out via Qualtrics to waterfront homeowners and statewide residents in NC in summer 2016. The results show that: 1) a greater awareness and stronger opinions of HB819 were reported by the waterfront group; 2) political party primarily impacted awareness of HB819; and, 3) those who believe they will be harmed by SLR are most opposed to HB819. These findings demonstrated that SLR is both a geographic and politicized issue with varying implications for legislators, state-wide residents, and waterfront residents. In the future, NC policy-makers should consider the concerns of NC residents when creating new SLR policy, with a particular focus on coastal residents who will be most harmed.

I. Introduction:

Climate change is a real and imminent threat to both human and natural ecosystems. Risks will be unevenly spread across the globe, with coastlines in particular subject to submergence, flooding, and erosion primarily due to sea-level rise (SLR; IPCC 2014; Cazenave and Cozannet 2013). Kopp *et al.* (2016) estimated that 20th century global SLR ranged from approximately 7- 11 cm and predicted a global SLR of 52-131 cm in the 21st century. Although impacts of SLR will vary by region (Tebaldi *et al.* 2012, Nicholls and Mimura 1998), SLR along the east coast of the United States is predicted to be higher than the global average by 2100 (Cazenave and Cozannet 2013). The wide ranges of predicted SLR values contribute to the uncertain future for shorelines and policy.

There are a variety of approaches that decision-makers may utilize to adapt to future climate change scenarios, with policies usually falling under the categories of adaptation or mitigation. Generally, adaptation is framed as a long-term solution and mitigation is framed as a short-term solution (IPCC 2014). The Intergovernmental Panel on Climate Change (IPCC; 2014) identified the following factors needed to create climate change adaptation or mitigation policies: effective institutions and governance; innovation and investments in environmentally sound technologies and infrastructure; sustainable livelihoods; and, behavioral and lifestyle choices. Furthermore, there are a variety of tools policy-makers may utilize to combat SLR, such as planning, regulatory, spending, and tax and market-based tools (Grannis 2011). Planning and regulatory tools may include: comprehensive plans, zoning ordinances, subdivision ordinances, or building codes. State and local governments may direct spending towards infrastructure built with SLR projections in mind or offer incentives for preserving property, relocating structures, and developing in areas that will be able to support infrastructure in the long-term (Grannis 2011).

SLR policy changes are likely to be slow, criticized, and difficult, whether it is an adaptation or mitigation strategy, because of lack of information, uncertainty, and conflicting ideas among stakeholders (Kousky 2014); however, a failure to respond to climate change will likely lead to detrimental, irreversible, and widespread impacts across the globe (IPCC 2014).

Historically, North Carolina was a progressive coastal state in terms of SLR policy after establishment of the Coastal Area Management Act of 1974 (CAMA; Moser 2005, Peterson *et al.* n.d., Yusuf *et al.* 2015). CAMA first mandated new set-back laws and oceanfront shoreline hardening rules (with few exceptions allowed) to plan for long-term erosion challenges (Moser 2005; Poulter *et al.* 2009). Since the passage of CAMA in the 1970s, the NC shorelines have faced various pressures from an increase in erosion, (CRC 2010), coastal populations (Small and Nicholls 2003), and major storm events (Knutson *et al.* 2010). Sea level in NC is predicted to rise 0.5-1.4 m by 2100, with higher rates in the north and lower rates in the south due to local geology and crustal subsidence and uplift (CRC 2010). For example, SLR along the NC coast varied consistently with the spatial pattern and magnitude variability of the Gulf Stream from 1940-2010 (CRC 2015, Kopp *et al.* 2015). Specifically, SLR near Cape Hatteras was greatly impacted by the Gulf Stream as opposed to regions north of Cape Hatteras that were less impacted over the past decade (Ezer *et al.* 2013). Thus, geographic location can determine vulnerability to sea level rise and should be accounted for in SLR policy.

The response to SLR may also vary with population density, whereby larger cities may be better equipped with resources to protect residents. Coastal residents in low-elevation, small, agricultural communities may be most at-risk due to a limited amount of resources as opposed to more densely populated near-coastal areas associated with cities (Small and Nicholls 2003). With only one major coastal city in NC (Wilmington), and a population of almost one million

spread throughout the 20 coastal counties in NC (NOAA Office for Coastal Management 2017), a massive displacement of coastal residents because of rising sea levels will pose a great challenge to NC in the future.

In 2010, the NC Coastal Resource Commission's Science Panel Report on Sea Level Rise "recommended that a rise of 1 meter (39 inches) be adopted as the amount of anticipated rise by 2100, for policy development and planning purposes" (CRC 2010). This scientific recommendation sparked a regressive and swift change within the NC policy realm. The North Carolina House Bill 819: An Act to Study and Modify Certain Coastal Management Policies (SL 2012-202; now referred to as HB819; Shipley 2014) was introduced in 2012 and was the first piece of major legislation in NC relating to shoreline development since CAMA. Section two of HB819 addressed SLR policy, and it mandated that any guidelines to define a rate of SLR for regulatory purposes were not to be accepted anymore. Further, it mandated that the Coastal Resource Commission (CRC) Science Panel must update the science panel report in five years and use only historical models to determine future rates of SLR for up to 30 years (NC General Assembly 2011). HB819 was not updated after the second CRC report and it expired on July 1, 2016. Nevertheless, the CRC Science Panel intends to update the report with a "Rolling 30-year time table" every five years (CRC 2015). Ultimately, HB819 signaled a major policy change in NC and it may have lasting effects on future SLR policies.

North Carolina has regressed in terms of SLR policy in an age of overwhelming literature linking SLR to human-induced climate change. Therefore, it is critical to understand how NC coastal homeowners perceive sea-level rise policy and whether or not their personal values and concerns about the effects of SLR on their properties affect their support for HB819. Although HB819 was only a short-term policy, an evaluation of the perceptions of North Carolina

residents of HB819 is needed because it could predict the future of SLR policy in NC and other states.

Opinions on HB819 could vary due to perceptions of risk. For example, women generally perceive SLR as a higher risk than men, older people are less concerned than younger, and the industrial sector is less likely to believe that climate change is caused by humans (Fatorić and Morén-Alegret 2013). Additionally, coastal homeowners are less likely to believe a small mean SLR will negatively impact their home due to the constant exposure to daily/yearly tide and sea level cycles (Gibbs 2016). Even more, coastal homeowners often find the most effective adaptation policies to be the least favored because they have a financial stake in SLR policy (Gibbs 2016). Finally, most Americans do not believe that local SLR will affect them personally and they have a negative perception of the term "global warming"; but, many Americans are concerned about SLR more generally (Leiserowitz 2006). This disconnect, along with analogous disconnects of environmental, monetary, and risk perceptions, can cause homeowners to make decisions that could ultimately harm their property as opposed to protect it (Smith 2017). Consequently, homeowners may not fully understand SLR and the potential impacts to their property.

This study specifically targeted waterfront homeowners because they will be most directly impacted by SLR and any future SLR legislation. Furthermore, their acceptance and compliance with new policy may indicate to some extent how successful new climate change adaptation initiatives will be. Ultimately, the goal of this study was to aid decision-makers in NC (and beyond) on future policies concerning SLR. Here, I pursue this goal by investigating coastal homeowners' perceptions of the North Carolina SLR bill HB819 and determining which factors are most likely to predict support for new SLR policy. Specifically, this study addresses the

following questions: 1) if NC waterfront homeowners were aware of HB819; 2) respondents' opinions of HB819; and, 3) what factors were most likely to predict awareness of and support for HB819.

II. Methods

a. Survey Design

The results presented in this thesis are derived from a follow-up survey that was emailed to waterfront property owners from 16 out of the 20 North Carolina coastal counties who previously responded to a print survey that was distributed in 2014 (*see Smith et al. 2017 and Gittman and Scyphers 2017 for detailed methods and results from the original survey*). Waterfront homeowner participants from the original 2014 survey were recruited using a modified Dillman method (Millar and Dillman 2011), which involved an initial mailing of postcard invitations (n = 6000) to complete an online survey and one follow-up reminder postcard. Of the 689 respondents to the original waterfront homeowner survey, 398 provided an email address and consented to being contacted for follow-up surveys. These email addresses served as our waterfront population. Additionally, another survey was sent out to a smaller population of 255 non-waterfront residents of North Carolina. These email addresses were collected from a 2014 statewide survey similar to the one above.

My 41-question survey was developed in May 2016 with input from an interdisciplinary team of scientists including Dr. Charles H. Peterson, Dr. Rachel Gittman, Dr. Steven Scyphers, and Carter Smith. The survey was divided into three sections: 1) Resources waterfront property owners use to gather information about various shoreline stabilizations methods (19 questions); 2) Perceived impact of various rates of SLR on waterfront properties (14 questions); and, 3) Opinions on North Carolina HB819 (8 questions). The waterfront survey was administered by

Qualtrics Survey Software. The first email invitation to participate in the survey was sent in June 2016, with two follow up reminder emails sent over the next month. The statewide residents were emailed a 27-question version of the survey (without the shoreline stabilization portion). This thesis focuses on sections 2 and 3 of the survey addressing awareness of HB819, opinion on HB819, and opinion on 30-year restrictions for modeling SLR based only on historical rates in HB819. A table of specific questions and answer choices analyzed in this study may be found in the appendix.

b. Statistical Analysis

Survey questions were dichotomous variables (e.g., yes or no), ordinal categorical variables (e.g., Likert Scale), and continuous variables (e.g., descriptive statistics such as respondent age). If questions were based on a 5-point Likert Scale, they were condensed to a 3-point scale; for example, “somewhat support” and “support” were combined, and “somewhat oppose” and “oppose” were combined. Predictive variables were determined using Chi-squared Automatic Interaction Detection (CHAID) tree-based classification models in SPSS software. Tree models were created for a combination of the waterfront and state groups, the waterfront group alone, and statewide group alone. When groups were run individually, responses of “neither” and “undecided” were removed from the dataset. Chi-Square tests were additionally used to determine statistically significant relationships between the waterfront and state groups. The “neither” and “undecided” responses were included for Chi-Square analysis. A p-value of 0.05 or less was used as the significance threshold. Chi-squared tests were conducted in R software (version 3.3.0).

c. Qualitative Analysis

The survey also included sections with qualitative answers where participants could respond in their own words. This fill-in portion allowed for deeper analysis of participants' responses and overcame certain limitations of quantitative survey analysis (Dey 1993, Weiss 1994). The analysis of fill-in explanations was guided by Grounded Theory, which identifies common themes that emerge from the data (Strauss and Corbin 1990). The Grounded Theory approach is unique because it allows the data to speak for themselves, rather than relying on assumptions (Glaser and Strauss 1967). In order to identify themes, Grounded Theory relies on a "coding" technique where responses are assigned to different categories based on reoccurring themes. For this study, all fill-in questions were read, placed in a representative category, and then analyzed.

III. Results

a. Sample Population

The waterfront survey received 215 responses for a 54% response rate. The mean age of the population was 64 ± 10 (mean \pm SD) and ranged from 30-84 years old. The sample was well educated, as 70% reported completing a bachelor's degree or higher. Furthermore, the population was wealthy with 49% earning over \$100,000 per year. The majority of respondents were men (83%). Finally, the participants were from 13 out of the 20 coastal North Carolina counties (Beaufort: 5%, Brunswick: 8%, Carteret: 15%, Craven: 12%, Currituck: 4%, Dare: 13%, New Hanover: 11%, Onslow: 17%, Pamlico: 4%, Pasquotank: 2%, Pender: 2%, Perquimans: 4%, Washington: 2%). The statewide survey received 79 responses for a 31% response rate. The mean age was 51 ± 12 and ranged from 21 to 73 years old. In contrast to the waterfront group,

only 35% reported earning a bachelor’s degree or higher and 12% earned over \$100,000 per year. Lastly, the gender ratio in the statewide survey was disproportionately female (60%).

b. Awareness of HB819

Waterfront residents were more aware of HB819 than statewide residents (32% versus 17%; chi-squared, $p = 0.046$; Figure 1). In the CHAID regression tree analysis, political party was found to be the most statistically significant predictor of the combined responses from both groups (other factors included were: survey group; impact of 1.9-10.2 in SLR; impact of 55 in SLR; political party; primary news source; generations in NC; likelihood descendants could live in home in 2020, 2030, 2050, and 2100; belief in global warming; years lived in NC; gender; age; education; income; Figure 2; see appendix for a table with full list of questions and answer choices). After the regression tree analysis of combined state and waterfront respondents, each group was separately examined, but no statistically significant relationships were found.

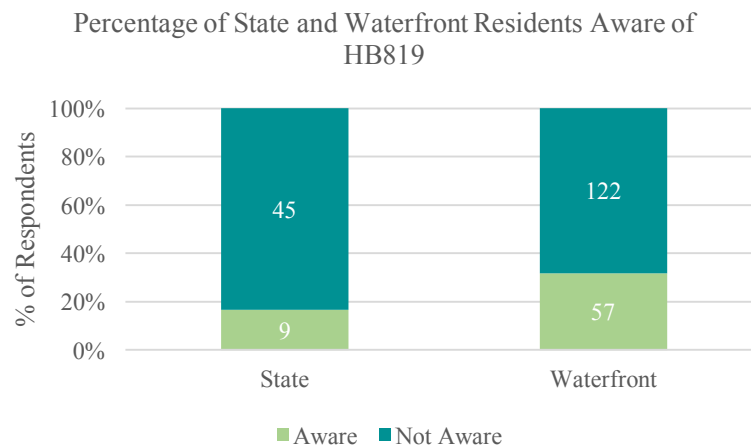


Figure 1. Awareness of HB819: Percentage of waterfront and statewide respondents who are aware of HB819 (chi-squared, $p= 0.046$). The numbers within the bars refer to the total number of respondents.

Are you aware of North Carolina House Bill 819 (SL 2012-202)
 Section 2: An act to study and modify sea-level policy?

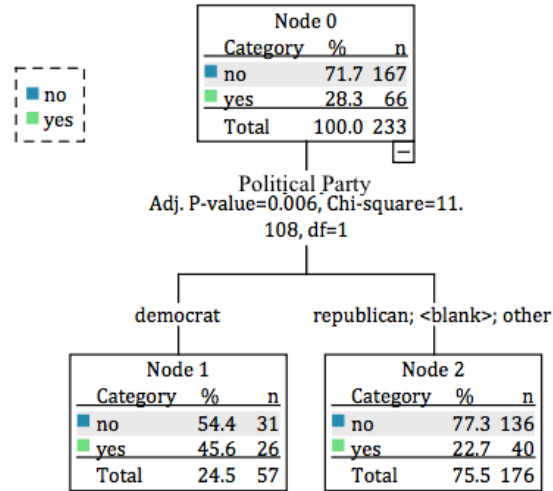


Figure 2. CHAID Regression Tree of the best predictor for whether or not a homeowner was aware of HB819.

c. Opinion on HB819

There was a significant difference in opinion of HB819 between the state and waterfront groups (chi-square, p-value= 0.000; Figure 3), with the statewide group less opinionated on the bill overall. Awareness of HB819 was the first statistically significant predictor of opinion of HB819 in the CHAID regression tree when the statewide and waterfront groups were combined (other factors included were: survey group; impact of 1.9-10.2 in SLR; impact of 55 in SLR; develop land in 100 years; political party; primary news source; generations in NC; likelihood descendants could live in home in 2020, 2030, 2050, and 2100; belief in global warming; years lived in NC; gender; age; education; income; Figure 4). Belief in global warming was the second predictor in the tree among respondents that were not aware of HB819 (Figure 4). Respondents that were more aware of the bill were more likely to oppose it, and among those that had not heard of the bill, those who believed in global warming were more likely to oppose it.

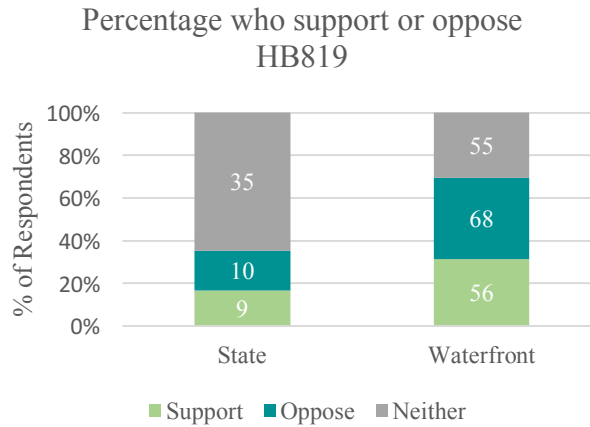


Figure 3. Percentage of state and waterfront respondents who support or oppose HB819 (chi square, p-value= 0.000). The numbers within the bars refer to the total number of respondents.

The North Carolina legislature passed House Bill 819 in 2012. The section on sea level rise policy does not allow any “rule, policy, or planning guideline to define a rate of sea level change for regulatory purposes...prior to July 1, 2016.” The bill also mandates that the Coastal Resource Commission (CRC) Science Panel must update the report every five years to but can only “compare the determination of sea level based on historical calculations.”

Based on this information, do you support or oppose this section of House Bill 819?

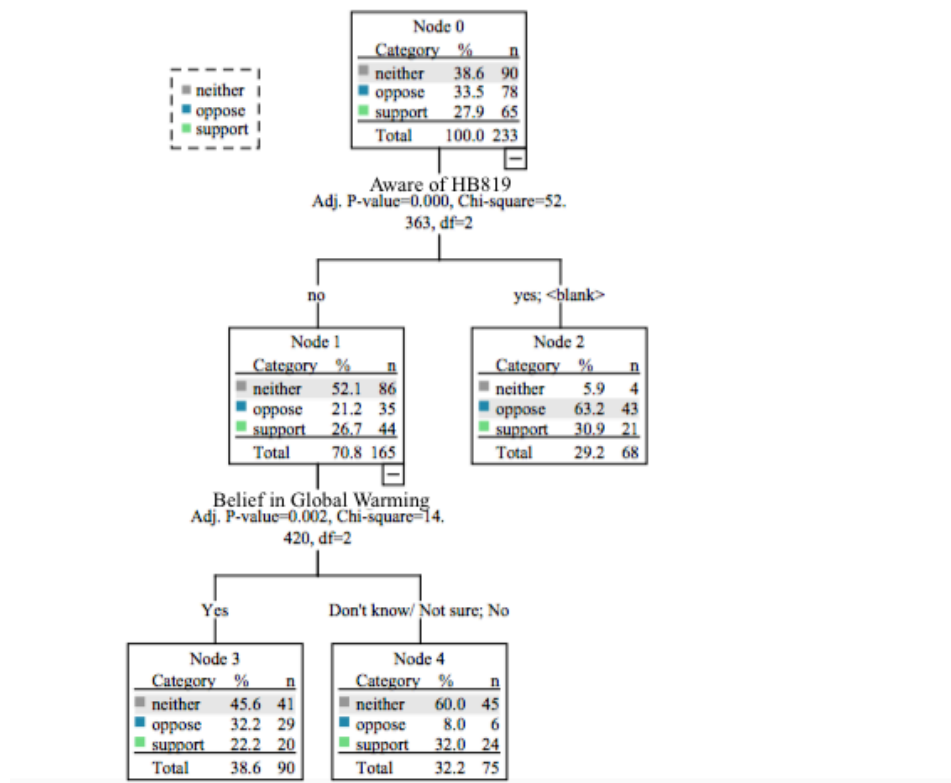


Figure 4. Opinion of HB819: CHAID Regression Tree.

The state and waterfront groups were then separately analyzed. No statistically significant relationships were found within the state group in the CHAID regression tree. In the waterfront CHAID regression tree, the likelihood of family or descendants' ability to live in the same location as your property in the year 2100 was the most statistically significant predictor of the opinion of HB819 for waterfront residents (Figure 5). If it was likely that a respondent's family or descendants would be able to live in the same location as their property in the year 2100, then respondents were more likely to support the bill.

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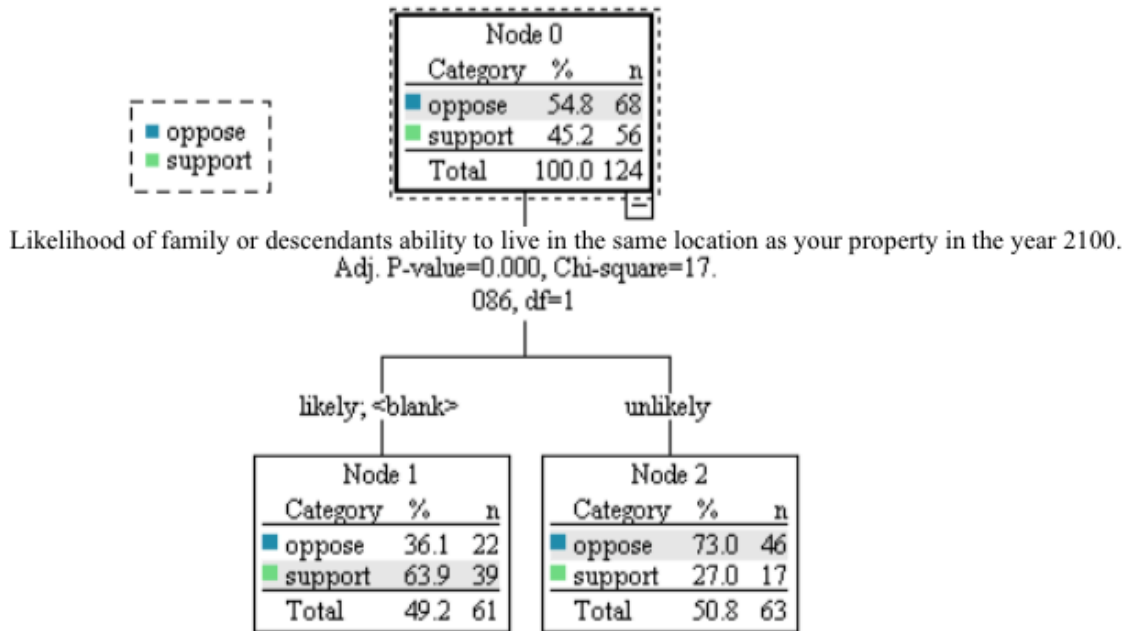


Figure 5. Waterfront opinion of HB819: CHAID Regression Tree where the likelihood of family or descendants' ability to live in the same location as your property in the year 2100 had the most significant impact on opinion of the bill.

The write-in answers provided added context for respondents' opinions. The primary reason for supporting the bill reported by the state group was that they thought it protected the coast and supported the use of scientific research for decision-making (n=5), but the waterfront group questioned the ability of scientists to make accurate enough predictions for regulation policy (n=19; Table 1). Both the state and waterfront groups primarily opposed the bill because they thought it ignored some forms of scientific research and that the historical rates would not provide accurate predictions (state n=4, waterfront n=27; Table 1). The waterfront group also stated they opposed the bill because they thought politicians were corrupt or created too many regulations already (n=26; Table 1).

Table 1. Opinion of HB819 write-in responses from state and waterfront respondents.

	# Times Mentioned		Reason	Example
	State	Waterfront		
Support	5	8	Supports research; protects the coast/ocean	<i>"I support the monitoring and upkeep of water-zones which help to preserve our environment."</i>
	0	19	question accuracy of predictions	<i>"'Rates of change' are open to interpretation and bias. Historical data is likely to be more definitive and objective."</i>
	0	7	corrupt/bad politicians; too many regulations	<i>"Because we simply do not know what the rate of sea level rise will be, and the whole climate change argument has been so politicized that I do not trust giving that regulatory authority to the politicians."</i>
	2	4	Supports use of historical rates; common-sense approach; good policy	<i>"This sounds like a common-sense approach to the problem, if it becomes a problem. And I think it will prevent hysteria over the problem if it is such."</i>
	1	4	Does not believe in global warming	<i>"Global warming is a myth, so why not wait on the scientific community to admit it before spending a bunch of money on nothing?"</i>

Oppose	4	27	ignores science; historical rate not accurate; more research	<i>"It is stifling science in the interest of development, though some of the prior predictions may have been a bit dire."</i>
	0	26	corrupt/bad politicians	<i>"Obviously pandering to real estate and developers' interests."</i>
	3	4	government should not/cannot regulate sea level	<i>"Property purchased does not belong to government and there should be no reason for government to stick their nose in private property problems."</i>
	1	4	increased protection of coast and long-term planning	<i>"We should be doing more to protect our resources & coastline from erosion." "Sea level rise projections should be a factor taken into account in policy development."</i>
	0	2	only historical rate	<i>"I believe historical record over the past 30 years should be used to determine future erosion rates as used in the past by the coastal resource commission."</i>
	0	2	CC/SLR skeptic	<i>"I don't believe there are sea level changes that amount to anything."</i>

d. Developing Land Predicted to be below Sea Level

There was a trend towards a higher percentage of statewide respondents versus waterfront respondents believing that land predicted to be below sea level in 100 years should not be developed (state= 60%, waterfront= 53%; Figure 6); however, this difference was not statistically significant (chi-square, p-value= 0.158).

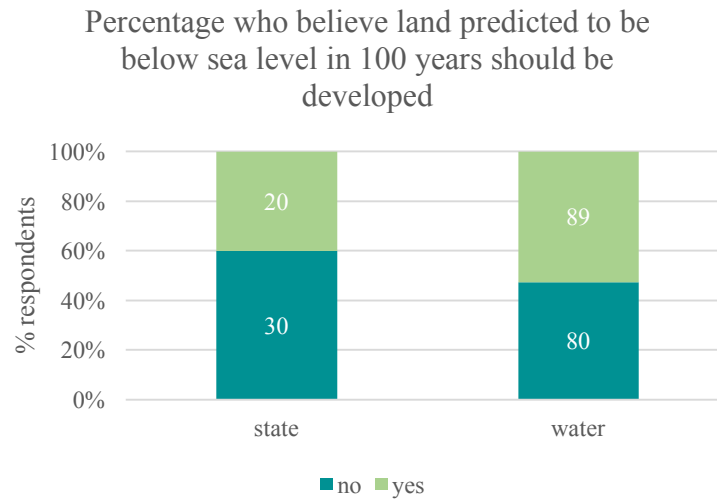


Figure 6. Percentage of state and waterfront residents that believe land predicted below SLR in 100 years should be developed (chi-square, p-value= 0.158). The numbers within the bars refer to the total number of respondents.

The qualitative responses (Table 2) provided an explanation for respondents’ opinions on whether or not land should be developed now if predicted to be below sea level in 100 years. The primary reason for supporting development, reported by both the state and waterfront groups, was that they thought it was the right of the homeowner to decide and not the government (state n=11, waterfront n=33; Table 2). Both groups also stated they supported development because of inability of scientists to make accurate enough predictions for regulatory policies (state n=2, waterfront n=18; Table 2). For those that opposed development, safety and risk of the residents and to the property was a concern for both groups (state n=13, waterfront n=10; Table 2). The waterfront group primarily opposed development because they believe that it will be financially costly in the form of taxes or insurance and property owners will request financial assistance (state n=6, waterfront n=25; Table 2).

Table 2. Write-in responses from state and waterfront respondents explaining beliefs on why or why not land predicted to be under sea level in 100 years should be developed.

	# Times Mentioned		Reason	Example
	State	Waterfront		
Yes	11	33	right of property owner	<i>“I don't feel that someone or government agency should tell me or anyone else that they cannot develop property I already own due to someone's opinion and speculation. As long as people are educated, they should be able to make their own decisions on what to do with their land.”</i>
	2	18	inaccurate predictions	<i>“Predictions do not always come true, or don't come true in the predicted time frame. Let them enjoy what time they have.”</i>
	5	12	no financial assistance	<i>“They can develop such property but it should be at their own risk with only private insurance and not public funds available to cover losses.”</i>
	4	4	not alive in 100yrs	<i>“In 100 years they will be gone anyway if this happens.”</i>
	0	7	building design/structure	<i>“Given the typical life cycle of structures and with proper design and elevations, structure can currently be placed in these settings.”</i>
	0	2	Sea level rise skeptic	<i>“I do not believe in this theory!”</i>
	0	3	let market/economics decide	<i>“I prefer the free market to make the decision and not arrogant predictions.”</i>
	1	0	impact environment	<i>“... they should be responsible for demolishing and properly disposing of materials which are subsequently below sea level.”</i>
No	6	25	no financial assistance	<i>“Irresponsible and costs of protecting or salvaging later down the road unfair to everyone in insurance pool.”</i>

	13	10	safety/risk	<i>“It could be a risk to their lives as well as their property.”</i>
	1	6	impact environment	<i>“Even if they were to accept the financial risk, the environmental risk to others from the waste and debris sourced from flooded property will be large and unavoidable.”</i>
	2	2	right of property owner	<i>“It will eventually be destroyed and should only be allowed if this is understood and the owner is aware and does not mind.”</i>
	0	3	learn from past	<i>“Katrina /New Orleans - enough said.”</i>
	0	3	inaccurate predictions	<i>“We can't predict the weather for tomorrow or for the next week accurately. How can we day what is going to happen in the next century...”</i>
	1	0	not alive in 100yrs	<i>“Common sense! I won't be there later.”</i>

IV. Discussion

Three major findings emerged from this study: 1) the waterfront group reported a greater awareness and stronger opinions of HB819 when compared to the statewide group; 2) the most significant predictor for awareness of HB819 was political party; and 3) those who believe they will be harmed by SLR are most opposed to HB819. Ultimately, this study served as an indicator for which populations in the state are concerned about SLR policy and illustrated the need for greater awareness about coastal issues throughout the state.

A greater awareness and stronger opinions of HB819 were observed in the waterfront group. This may suggest that waterfront residents recognize the impact of SLR on the coast more than the statewide residents because those who directly experience an environmental problem are more likely to exhibit environmental behavior as opposed to those who will be indirectly affected (Kollmus and Ageyman, 2002, Weber 2016). However, this behavior can either be positive or negative, where “positive” environmental behavior is interpreted as opposition of the bill and

“negative” environmental behavior is interpreted as support for the bill because it places limitations on how science may be utilized to prepare for environmental problems (i.e. predicted sea-level rise in the next century).

The range in environmental behavior may be caused by a variety of factors. For instance, people could be concerned about SLR, yet feel as if it is distant in space or time (Weber 2016) or some may have a negative perception of the term "global warming" and global warming rhetoric (Leiserowitz 2006). Notably, waterfront homeowners may be less likely to believe a small mean SLR will negatively impact their home due to the constant exposure to daily/yearly tide and sea level cycles (Gibbs 2016). As sea levels continue to rise in North Carolina over the next century (CRC 2010), it is critical to assess why waterfront and statewide residents may or may not be aware of policy decisions regarding the future of state coastlines and SLR and what factors may influence their environmental behavior.

The second major finding of this study was the significant impact of political party on awareness of the bill, with democrats more aware of the bill's existence than republicans. Climate change has become a partisan issue (Weber 2016), and HB819 serves as a perfect example of partisan voting. HB819 was sponsored by Pat McElraft, a republican from District 13 representing Carteret and Jones County, and only two republicans voted “no” in contrast to 44 democrats who voted “no” (N.C. General Assembly n. d.). The passage of HB819 by republicans may have angered democrats, which could have motivated democrats to blame republicans (Lyons and Jaeger, 2014) and created greater political organization against republicans to mobilize voters in future elections (Huckfeldt and Sprague 1992). Additionally, this divide may be attributed to solution aversion, where conflicting ideological values of more environmentally skeptical republicans and environmentally friendly democrats are motivated to vote on a partisan

basis for environmental solutions (Campbell and Kay 2014). Consequently, the politicization of SLR can result in a range of outcomes if one party is primarily represented within the legislature, as demonstrated by HB819.

Local officials' perceptions of SLR may have also contributed to the passage of HB819. Bulla *et al.* (2017) found that NC Coastal official's perceived threat of climate change was a stronger indicator of whether or not officials will push SLR policy than knowledge or political ideology. Furthermore, representatives may seek to avoid passing any "fear-inducing" policies that can be ineffective, create a negative perception of policy-makers, and potentially increase climate change denial (Weber 2016). Therefore, if elected officials wish to remain in office, it may be imperative for them to maintain the status quo on SLR policy (i.e. no policy) rather than pass legislation based on predictions for regulatory policies.

The third major finding from this study was that those who believe they will be harmed by sea level rise are most opposed to HB819. Differences in location can greatly impact a person's reasoning for either supporting or opposing HB819. Within the waterfront group, those who were concerned about the long-term impacts of SLR on their property in 2100 were more likely to oppose the bill. As the NC coast will experience a range of SLR rates in the future, those who are in higher risk areas should be more concerned about increased SLR rates. Furthermore, in the write-in answers, state and waterfront respondents supported and opposed the bill for many of the same reasons; however, waterfront respondents primarily questioned the scientific accuracy of SLR predictions and noted the corruptness of politicians or abundance of regulations. Clearly, waterfront respondents have a distinct idea of what they believe to be primary problems behind this policy and their concerns for future policies.

The question of whether or not land should be developed demonstrated the contrast in state

and waterfront perspectives due to degree of SLR impact on private property and the regional economy. For example, both state and waterfront respondents explained that it was right of the property owner to develop or not, but those who choose to develop should not receive financial assistance. Interestingly, coastal residents are willing to trade the advantages of a coastal lifestyle for environmental risks (Zaharan *et al.* 2006). This becomes problematic if the coastal population continues to grow (Small and Nicholls 2003) and is drawn to the coastal lifestyle despite major risks. If coastal residents continue to make this trade-off, policy-makers will have to decide how far liberty and property rights should extend and if SLR is different from other coastal hazards, such as hurricanes and flooding.

In addition to the costs of protecting homes, coastal residents will have to forfeit developing land that could be economically profitable in the short-term if development is restricted based on SLR rates. This is unlikely to happen because officials prioritize economic development and see environmental protection as a ‘luxury’ as opposed to the demands of economic development (Norton 2005). In order to protect homeowners, the coast must be protected from threats and hazards, such as SLR, while also striking a balance with development regulations.

This study adds to the growing literature on SLR policies, though there are some notable limitations. First, the study is a result of non-random convenience sampling, where surveys were emailed to those who previously responded to a survey from Smith *et al.* (2017) and Gittman and Scyphers (2017). As a result, the surveys may suffer from volunteer bias. Furthermore, the sample population demographics from the groups vary in gender, education, and income. For example, the waterfront population was disproportionately older, male, wealthier, and more highly educated than the state population. Thus, our waterfront and statewide populations may not serve as representative samples of the population. Additionally, the formal question format of

the survey where the official title of the bill was used, “An Act to Study and Modify Sea-Level Policy,” and official language of the bill may have attributed to the high numbers of respondents unaware of the bill or who did not have an opinion on it.

Now that HB819 has expired, NC can look to other states in the southeastern region of the United States to determine if it will create a new SLR policy. Florida, Louisiana, and Virginia are the only states within the southeast to create statewide SLR policy. Virginia created the Climate Change Action Plan, which the state released in 2008, discontinued from 2010-2014 (while there was a Republican governor), and re-established in 2014 (Georgetown Climate Center 2016). As a result, Virginia appointed a state Chief Resilience Officer to design a state-wide protocol for sea-level rise projections (Georgetown Climate Center 2016). Florida created the Statewide Community Resiliency Initiative: Planning for Sea-level rise that took place between 2011 and 2016 (Georgetown Climate Center, 2016). This plan created pilot programs for Adaptation Action Areas to illustrate various types of local adaptation for local governments (Reiss 2016). Further, the Florida Peril of the Flood Act (enacted July 1, 2015) included SLR as a cause of flood risk and must be considered by local governments for plans regarding coastal flooding (Lenczewski n.d). Lastly, in Louisiana Governor Edwards declared a state of emergency due to the rapid rates of erosion on the coastline in 2017 (Kennedy 2017). The state legislature then unanimously voted to update its Coastal Master Plan to include over 100 restoration projects that will cost approximately \$50 billion over the next 50 years (Kennedy 2017). The worst-case projections for SLR in the 2012 plan are now the best-case scenarios for the 2017 plan (Georgetown Climate Center 2016). Consequently, each state has a different plan or policy, but is making progress towards addressing SLR and the unique challenges it presents.

Addressing SLR may come in the form of a statewide adopted plan or policy, and NC can

learn from these other states. Major erosion is predicted for NC (Kopp *et al.* 2015), and collective action is needed to prepare shorelines and coastal communities for the long-term impacts of SLR. NC can help lead the charge for SLR policy in the southeast in hopes that other states such as Georgia and South Carolina who lack SLR policies altogether will join this movement as well.

V. Conclusion

This study assessed awareness of HB819, opinion of HB819, and factors that predicted awareness and acceptance of HB819 among different stakeholders (i.e. waterfront versus statewide). The results showed that a greater awareness and stronger opinions of HB819 were reported by the waterfront group, political party primarily impacted awareness of HB819, and those who believe they will be harmed by SLR are most opposed to HB819. These findings demonstrate that SLR is both a geographic and politicized issue with varying implications for legislators, state-wide residents, and waterfront residents. Further, future SLR policies should be flexible to accommodate for a range of SLR. Lastly, NC can learn from other states in the southeastern region of the US to develop a new policy to address the unique needs of the state. NC has the potential to regain its progressive status and be a SLR leader in a region where SLR is a growing threat. Ultimately, HB819 was an experiment in non-action, which was not well accepted by waterfront homeowners and illustrates the need for a new SLR policy to protect homeowners and property from the threat of SLR.

Appendix

Full questions and answer choices from survey that were analyzed in study.

Name of Question	Question	Answer Choices
Awareness of HB819	Are you aware of North Carolina House Bill 819 (SL 2012-202) Section 2: an act to study and modify sea-level policy?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Opinion of HB819	<p>The North Carolina legislature passed House Bill 819 in 2012. The section on sea level rise policy does not allow any “rule, policy, or planning guideline to define a rate of sea level change for regulatory purposes...prior to July 1, 2016.” The bill also mandates that the Coastal Resource Commission (CRC) Science Panel must update the report every five years to but can only “compare the determination of sea level based on historical calculations.”</p> <p>Based on this information, do you support or oppose this section of House Bill 819?</p>	<input type="checkbox"/> Somewhat support <input type="checkbox"/> Support <input type="checkbox"/> Somewhat Oppose <input type="checkbox"/> Oppose <input type="checkbox"/> Undecided
Restrict modeling to 30 years	<p>In the latest 2015 report, the NC Coastal Resource Commission specified that its Science Panel only predict sea level rise rates for the next 30 years. The predicted rate of sea level rise by 2045 is approximately 1.9-10.6 inches along coastal NC. The predicted rate of sea level rise by 2100 in NC could be as high as 55 inches.</p> <p>In your opinion, should NC continue to restrict predicted models of sea level rise to a 30-year timeframe for regulatory planning and policies? Please explain why or why not.</p>	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Undecided
Develop land in 100 years	Should people be able to develop land that is predicted to be below sea level in the next 100 years?	<input type="checkbox"/> Yes <input type="checkbox"/> No
Impact of 55 in SLR	How do you think a sea level rise of 55 inches will affect the value of your waterfront property? Please explain your answer.	<input type="checkbox"/> Benefit <input type="checkbox"/> Harm <input type="checkbox"/> No effect
Impact of 1.9-10.2 in SLR	How do you think a sea level rise of 1.9-10.6 inches will affect the value of your waterfront property? Please explain your answer.	<input type="checkbox"/> Benefit <input type="checkbox"/> Harm <input type="checkbox"/> No effect
Likelihood descendants could live in home in 2020, 2030, 2050, and 2100	Please rate how likely you think your family or descendants will be able to live in the same location as your property in the year 2020, 2030, 2050, 2100.	<input type="checkbox"/> Not likely <input type="checkbox"/> Unlikely <input type="checkbox"/> Undecided/No Opinion <input type="checkbox"/> Likely <input type="checkbox"/> Very likely
Generations in home	How many generations of your and/or your spouse’s family have lived along the coast of NC? (NC Coastal Counties: Beaufort,	<input type="checkbox"/> I am (we are) the first generation to live

	Bertie, Brunswick, Camden, Carteret, Chowan, Craven, Currituck, Dare, Gates Hertford, Hyde, New Hanover, Onslow, Pamlico, Pasquotank, Pender, Perquimans, Tyrrell, Washington)	<p>in coastal NC</p> <input type="checkbox"/> 2 (Your and/or your spouse's parents live(d) in coastal NC)
		<input type="checkbox"/> 3 (Your and/or your spouse's grandparents live(d) in coastal NC)
		<input type="checkbox"/> 4 (Your and/or your spouse's great-grandparents live(d) in coastal NC)
		<input type="checkbox"/> 5 (Your and/or your spouse's great, great grandparents or more lived in coastal NC)
Political party	If you identify with a political party, which do you identify with?	<input type="checkbox"/> Democrat <input type="checkbox"/> Republican <input type="checkbox"/> Independent <input type="checkbox"/> Other: _____ <input type="checkbox"/> None
Primary News Source	What is your primary source of news?	<input type="checkbox"/> Newspaper (print or online) <input type="checkbox"/> Television <input type="checkbox"/> Radio <input type="checkbox"/> Internet search engine (e.g. Bing, Google, or Yahoo) <input type="checkbox"/> Online Social Media (e.g. Facebook, Twitter, Instagram) <input type="checkbox"/> Other: _____
Belief in global warming	Do you think that the global climate is warming?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Don't know/ Not sure

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