

# Climate Change Skepticism in the Flood Zone? Risk and Risk Perception Among Virginia Coastal Residents, 2010–2013

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**ABSTRACT** How does life in a coastal flood zone influence sea level rise and global warming beliefs? This study explores the association between residence in a coastal flood zone and climate change attitudes. Surveys of Hampton Roads Virginia coastal residents with varying degrees flooding vulnerability conducted from 2010 through 2013 show that coastal flood zone residents were more likely to perceive global warming as a serious environmental problem (with the exception of conservatives and Republicans), and more likely to believe they were personally vulnerable to sea level rise.

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## INTRODUCTION

How does life in a coastal flood zone influence sea level rise and global warming beliefs? This study examines climate change attitudes among individuals who reside in the coastal flood plain – individuals who are arguably the most likely to observe or experience fluctuations in sea level, and the most vulnerable to rising seas. It extends existing work on how experience and vulnerability influence individual beliefs concerning climate change (Myers et. al. 2013, Akerlof et. al. 2013), and how abnormal weather or temperature influences information seeking and climate change beliefs (Herrnstadt & Muehleger, 2013; Lang, 2014; Joireman, Barnes-Truelove, & Duell, 2010; Li, Johnson, & Zaval 2011; Risen & Critcher 2011; Egan & Mullin 2012; Goebbert et al. 2012; Howe, et al., 2013; Scannell & Gifford, 2013; Zahran et al., 2006) to examine sea level rise and global warming beliefs among individuals who likely have had close personal experience with sea levels. In particular, this study analyzes several years of survey data from seven cities in coastal Virginia. Although there have been many prior studies investigating factors that condition climate attitudes, this study is arguably unique in its analysis of the link between coastal flood-zone vulnerability and climate attitudes.

The main focus is Virginia's Hampton Roads region. This region has experienced rising sea levels in recent decades. Indeed, there is evidence that sea level has increased more rapidly in the Chesapeake Bay and along the adjacent Atlantic coast than the global average (Ezer et. al. 2013, Nash 2014). In the region of Hampton Roads Virginia, flood zone residents were exposed to multiple coastal flooding events including Hurricanes Irene (2011), and Sandy (2012). Three of the four highest sea levels ever recorded on the Sewells Point, Virginia tide gauge occurred during the decade from 2002 to 2012 (NOAA 2014). In addition coastal Virginia has experienced substantial sea level anomalies:

*“An unusually high coastal sea level (sometimes around 30 to 50 cm above NOAA's storm surge and tidal prediction...) can persist for months; these anomalies often cause floods*

*during high tides in places such as Norfolk, VA, even during times when there are no apparent storm surges or other weather events to explain these anomalies.” (Ezer et. al. 2013, p. 12).*

During coastal sea level anomalies in particular, residents of the Hampton Roads region experience sea level increases of a magnitude not anticipated for decades in most climate models. Because of these anomalies and the above global average increases in sea level, coastal Virginia provides a useful, perhaps even unique, opportunity to study the relationship between personal sea level rise risk and attitudes toward sea level and climate change in the coastal flood zone.

The next section examines the literature on climate change attitudes, and develops expectations for the empirical analysis. The subsequent section discusses variable measurement and operationalization. This is followed by a data analysis section, and finally by a discussion of conclusions.

## EXPERIENCE AND CLIMATE CHANGE PERCEPTIONS

A growing number of studies indicate that personal experience can – to an extent – shape beliefs about climate change. Abnormal weather leads to information seeking about climate change and change in climate change beliefs (Herrnstadt & Muehleger, 2013; Lang, 2014; Joireman, Barnes-Truelove, & Duell, 2010; Li, Johnson, & Zaval 2011; Risen & Critcher 2011; Egan & Mullin 2012; Goebbert et al. 2012; Akerlof et al. 2012; Howe, et al., 2013; Scannell & Gifford, 2013; Zahran et al., 2006). Furthermore, perceived or real personal experience with climate change is associated with changes in beliefs (Akerlof et al., 2013; Myers et al., 2013). If individuals experience, or think they have experienced, climate change personally they are more likely to perceive climate change as a significant threat (Keller, Siegrist, and Gutscher, 2006; Whitmarsh, 2008; Borick and Rabe 2010).

Individuals who live in coastal flood zones are uniquely vulnerable to sea level rise, as even modest increases in sea levels

would likely increase the frequency with which property is inundated by flood waters, potentially producing major economic losses. Nash (2014) provides detailed maps and discussion of these risks in the context of coastal Virginia. Prior work suggests that individuals who live in close proximity to the coast are more likely to express concern about climate change (Milfont et. al. 2014, Howe et. al. 2015), although no previous study has specifically investigated the role of residence in coastal flood zones, as opposed to more general coastal proximity.

The most basic and important expectation tested in this study is that *flood zone residents should be more concerned about global warming and sea level rise than other coastal residents*. This is a logical extension of previous work that suggests those residing nearer the coast are more likely to believe in climate change (e.g. Milfont et. al. 2014). The novel element here is the investigation of how coastal flood zone residence influences attitudes – does flood zone residence further increase climate change concern among coastal residents?

In addition to exploring the impact of coastal flood zone residence, this study investigates the way political attitudes – partisanship and ideology – mediate climate change beliefs in the flood zone. In Virginia politics there is substantial partisan polarization on the issue of climate change. For instance, a 2013 survey of Virginia likely voters (Richman 2013, p. 11) found that 66.4 percent of those who supported the Republican candidate for governor did not believe that “human activity is a major contributing factor in climate change” whereas 88.5 percent of those who supported the Democratic candidate did believe that that “human activity is a major contributor to climate change.” Across the United States, party identification and ideology are strongly associated with climate change beliefs (Borick and Rabe 2010; Dunlap 2008; Dunlap and McCright 2008; 2011; McCright and Dunlap 2015; Schuldt, Konrath, and Schwarz, 2011). Hence, the general expectation that *conservatives and Republicans are less likely to be concerned about climate change than liberals and Democrats*.

It is an open question whether Republicans and conservatives who live in the coastal flood zone will abandon the partisan / ideological resistance to belief in climate change found among their political compatriots who live at higher elevations. Some previous literature suggests that information seeking through partisan news sources (Akerlof et al. 2012; Feldman et. al. 2012; Williams 2011) might lead to motivated reasoning (Kunda, 1990; Hart & Nisbett, 2011) that produces a larger partisan / ideological gap rather than a diminished one. Ideological or partisan attention and motivated reasoning suggest that *residence near the coast and in a flood zone will lead to less of an increase in global warming and sea level rise risk perception among conservatives and Republicans than among other ideological or partisan groups*. But it is also possible that the effect goes the other way: one might hypothesize that a sufficiently intense personal experience could override normal partisan or ideological biases. When it comes to sea level rise, the Hampton Roads region of Virginia is the second most vulnerable urban region in the United States (Nash 2014) and arguably provides the potential for such experiences to occur.

Inclusion of control variables for gender and race in some of the analysis below reflect evidence that both are associated with perceptions of global warming and climate change. Previous studies have suggested males and whites are less likely than females and blacks to see global warming and climate change as a threat (e.g. Davidson & Haan, 2012; Hamilton, 2011; McCright, 2010; McCright & Dunlap, 2011). Some analyses also control for education level, although the previous literature does not provide an unambiguous expectation concerning its effect on attitudes.

A final set of variables involve length of residence. Given the extraordinary frequency of coastal flooding during the years studied, it is unlikely that even short-term coastal flood zone residents escaped exposure to substantial coastal flooding prior to responding to the survey. None-the-less, longer-term residence may be associated with more extended exposure to flooding and an ability to judge increasing levels of inundation. Hence, some analyses control for the number of years respondents reported having lived at their current residence. A related control is for recent arrival at a residence – recent arrivals (less than one year) are much less likely to have had time to assess their risk in detail.<sup>1</sup>

## METHODS

This study relies upon survey data to estimate attitudes. The primary survey data was collected over a span of four years (2010, 2011, 2012, and 2013) in the Life in Hampton Roads Survey (LIHR), a dataset collected by the Social Science Research Center at Old Dominion University through telephone calls to a random sample of Hampton Roads residents. The survey aims to gauge overall quality of life within the Hampton Roads region. Variables included the individual’s residential status in a flood zone or not, their individual risk perception concerning the effects of sea level rise and the likelihood that global warming is a real environmental problem or an environmental hoax. The survey also included questions concerning race, gender and education levels, and measures of partisanship and ideology.

Three measures of global warming and sea level rise risk were analyzed from the LIHR survey. The first variable assessed whether respondents believed that global warming was a serious environmental problem or an environmental hoax on a 5 point scale (available in the 2010 and 2011 surveys). The second and third were dichotomous measures (available in the 2011 through 2013 surveys) of whether respondents were concerned that rising sea levels in Hampton Roads would “affect you personally” and whether respondents were “concerned about rising sea levels in the rest of the world.”

To assess sea level rise risk, the locations of survey respondents with land-line telephone numbers were geocoded, and then used to identify residences in a high risk flood zone using <https://www.floodsmart.gov/floodsmart/> and national flood insurance program maps. Individuals were dichotomously

<sup>1</sup> A control variable for rental versus ownership did not have statistically significant effects and is omitted from the analyses presented in this study.

Table 1. Tabulation of Coastal Flood Zone Residence and Climate Change Attitude

QUESTION	YEAR	FLOOD ZONE (N)	NOT FLOOD ZONE (N)	STATISTICAL SIGNIFICANCE?
Are you concerned that rising sea levels here in Hampton Roads will affect you personally? (Percentage “Yes”)	2013	48.5% (134)	34.4% (349)	$\chi^2 = 8.17^*$
	2012	45.9% (122)	37.3% (351)	$\chi^2 = 2.79 +$
	2011	51.7% (143)	38.3% (350)	$\chi^2 = 7.54^*$
	All	48.9% (399)	36.7% (1050)	$\chi^2 = 17.94^*$
Are you concerned about rising sea levels in the rest of the world? (Percentage “Yes”)	2013	64.2% (137)	62.3% (350)	$\chi^2 = 0.16$
	2012	61.0% (123)	63.8% (359)	$\chi^2 = 0.36$
	2011	72.2% (144)	69.8% (354)	$\chi^2 = 0.71$
	All	66.9% (399)	65.9% (1053)	$\chi^2 = 0.13$
Global warming is a serious environmental problem (coded 1) or hoax (coded 5)? (Mean rating on five-point scale.)	2011	2.5 (142)	2.6 (349)	t=0.90
	2010	2.6 (136)	2.6 (414)	t=0.38
	All	2.5 (278)	2.6 (763)	t=0.94

Note: + p<0.10, \* p<0.05

classified as living in a flood zone (high risk area) or not. As a robustness check, the 2013 survey included the question, “Is recurrent flooding a problem in your neighborhood.” There was a statistically significant difference (p<.0005) between the portion of flood zone residents (35 percent) and non-flood zone residents (14 percent) who responded in the affirmative.<sup>2</sup>

### DATA ANALYSIS

The data analysis begins with simple by-year cross-tabulations, and then moves to multivariate regression and logistic regression analyses that permit control for several variables, and more detailed investigation of conditional or interaction relationships. At the forefront throughout is the question of how, in what ways, and in what contexts, residence in a coastal flood zone conditions climate change attitudes. Is residence in a coastal flood zone associated with distinctive sea level rise risk perceptions or global warming attitudes?

Table 1 is the most basic of the analyses provided. It examines no interaction relationships and contains no control variables. Hence, there are limits to what can be inferred from this analysis. The evidence concerning a link between coastal flood zone residence and sea level rise or global warming concern is mixed in this table.

The table provides evidence that coastal flood zone residence

<sup>2</sup> Self-reported neighborhood experience with recurrent flooding was strongly associated with concern about sea level rise in the 2013 survey (the only survey which included this question). Those who indicated that recurrent flooding was a problem in their neighborhood were almost twice as likely (65.8 percent versus 34.2 percent, Chi-Square 57.8, p<.0005) to indicate that they were “concerned that rising sea levels here in Hampton Roads will affect you personally.” This extended to concern about “rising sea levels in the rest of the world” with 76 percent of respondents who thought “recurrent flooding a problem” indicating concern, compared to 59.4 percent of other respondents (Chi-Square 17.3, p<.0005). However, analysis of the relationship between self-reported neighborhood flooding and climate change attitudes is not a focus of this paper because perception of neighborhood flooding might be caused in part by beliefs about sea level rise risk as appears to be the case with other self-reported climate related phenomena (e.g. Goebbert et. al. 2012, Howe and Leiserowitz 2013).

is associated with concern that one will be personally affected by sea level rise. In 2011, 2012, and 2013 there is a statistically significant relationship between coastal flood zone residence and concern that “rising sea levels here in Hampton Roads will affect you personally.” Overall, 48.9 percent of flood zone residents expressed concern that they would be personally affected while 36.7 percent of residents who did not live in a flood zone expressed a similar concern. The magnitude of the difference is substantial. Analysis of all years of data indicates that flood zone residents were 12 percent more likely than non-residents to express concern. This difference is highly statistically significant (p<0.005). Perhaps it is unsurprising that the link between sea level rise concern and coastal flood zone residence is pronounced when the question asks about concern that rising seas will “affect you personally” since Virginia coastal flood zone residents arguably have good reason to worry that they will be personally harmed by rising seas (Nash 2014).

Flood zone residence is not as strongly associated with the other two measures of climate change attitudes, however. Thus, if an association exists at all, any relationship between flood zone residence and these variables is likely to be conditional, or obscured by the absence of appropriate control variables. Concern about sea level rise in the rest of the world and belief in global warming were not strongly associated with coastal flood zone residence. While in two of three years coastal flood zone residents expressed more concern about “rising sea levels in the rest of the world” than non-flood-zone residents, the difference in attitudes never achieved statistical significance. Similarly, although in both years coastal flood zone residents were slightly less likely than the rest of the sample to see global warming as “an environmental hoax” this difference did not achieve statistical significance.

Table 2 provides an analysis of the extent to which partisanship and ideology condition the association between climate change attitudes and residence in a coastal flood zone. In addition, the table provides strong, if perhaps unsurprising, evidence that ideology and partisanship are linked to climate change attitudes among Virginia coastal residents.

In every instance conservative and/or Republican respondents evidenced less concern about climate change than their liberal and/or Democratic counterparts, with moderate and non-partisan respondents somewhere in-between. For example, 82 percent of respondents who said that they were liberals and/or Democrats indicated that they were “concerned about rising sea levels in the rest of the world” while only 49.6 percent of conservative and/or Republican respondents indicated that they were concerned. These partisan differences are strongly statistically significant ( $p < 0.001$ ). Respondents who identified as Democrats and/or liberals were more than 30 percent more likely to express concern.

The analysis in Table 2 also yields evidence that global warming belief – the degree to which individuals rated global warming a “serious environmental problem” as opposed to an “environmental hoax” -- is associated with coastal flood zone residence for all but conservative or Republican respondents. Among all respondents who were neither conservatives nor Republicans flood zone residents were 0.25 points more likely ( $p < 0.05$ ) to see global warming as a “serious environmental problem.” By contrast, respondents who were conservatives and or Republicans and lived in a flood zone were 0.2 points less likely to see global warming as a serious environmental problem. Partisanship, it would seem, conditions the association between some climate change attitudes and coastal flood zone residence.

The association between responses to the global warming question and flood zone residence varies substantially across party / ideology groups. Among respondents who were neither self-identified conservatives nor self-identified Republicans, flood zone residence was associated with a significantly higher

probability of believing that global warming is a “serious environmental problem.” The mean rating was 2.17 among flood zone residents, an average significantly below the 2.42 average among non-flood-zone residents ( $t = 2.3, p < 0.05$ ). However, among Republican and/or conservative respondents there was no statistically significant difference between flood zone residents and other respondents. Indeed, if anything flood zone residents expressed less concern than other respondents, although that difference is not statistically significant. Conservatives and/or Republicans who resided in a flood zone more often rated global warming a hoax (average 3.25) than their non-flood zone political / ideological compatriots (average 3.05).

Does partisanship and ideology condition the association between flood zone residence and the sea level rise questions as well? And in particular are Republicans and/or Conservatives in flood zones particularly unconcerned about the risks posed by rising seas? There is some evidence that a similar pattern may be present on the personal sea level concern question, albeit to a more modest degree: conservative and/or Republican respondents who lived in a flood zone were only slightly more likely to express concern that sea level rise would affect them personally (8 percent more likely) compared to the two other groupings of respondents (16 percent and 14 percent more likely).

However respondent’s politics does not appear to condition the extent to which coastal flood zone residents express concern about rising sea level in “the rest of the world.” Coastal flood zone residence is not associated with concern about sea level rise in the “rest of the world” for any partisan or ideological group.

*Table 2. Political Orientation and Coastal Flood Zone Residence Interaction*

QUESTION	POLITICAL ORIENTATION	FLOOD ZONE (N)	NOT FLOOD ZONE (N)	STATISTICAL SIGNIFICANCE?
Are you concerned that rising sea levels here in Hampton Roads will affect you personally? (Percentage “Yes”)	Conservative or Republican	32.6% (141)	24.3% (346)	$t = 1.82+$
	Liberal or Democrat	66.4% (122)	50.7% (367)	$t = 3.13^*$
	All Others	49.3% (140)	35.3% (363)	$t = 2.85^*$
Are you concerned about rising sea levels in the rest of the world? (Percentage “Yes”)	Conservative or Republican	51.0% (143)	46.5% (342)	$t = 0.91$
	Liberal or Democrat	82.0% (122)	81.8% (369)	$t = 0.31$
	All Others	69.8% (139)	68.5% (368)	$t = 0.28$
Global warming is a serious environmental problem (coded 1) or hoax (coded 5)? (Mean rating on five-point scale.)	Conservative or Republican	3.25 (97)	3.05 (256)	$t = 1.22$
	Liberal or Democrat	1.89 (72)	2.19 (195)	$t = -1.72+$
	All Others	2.35 (109)	2.57 (312)	$t = -1.52$
	Non-Conservatives or Republicans	2.17 (181)	2.42 (507)	$t = -2.28^*$

Note: +  $p < 0.10$ , \*  $p < 0.05$ . Respondents who indicated that they were Republicans, conservatives, or both were coded into one category, respondents who indicated they were liberals, Democrats, or both were coded in a second category and respondents who were in neither of the above categories were coded in the third category.

Table 3. *Multivariate Analysis of Flood Zone Residence and Risk Perceptions*

	<b>EQUATION 1</b> SEA LEVEL RISE PERSONAL CONCERN (LOGIT)	<b>EQUATION 2</b> SEA LEVEL RISE GLOBAL CONCERN (LOGIT)	<b>EQUATION 3</b> GLOBAL WARMING A SERIOUS CONCERN (OLS)
Flood zone resident	0.64 (0.21)*	0.36 (0.23)	0.38 (0.15)*
Conservative or Republican	-0.49 (0.16)*	-0.97 (0.16)*	-0.45 (0.11)*
Liberal or Democrat	0.51 (0.13)*	0.57 (0.16)*	0.38 (0.10)*
Flood zone * Conservative or Republican	-0.18 (0.28)	0.32 (0.28)	-0.49 (0.19)*
Residence < year	0.80 (0.28)*	0.004 (0.3)	0.10 (0.19)
Length of Residence	0.010 (0.005)*	0.017 (0.006)*	-0.001 (0.004)
Flood zone * Length of Residence	0.004 (0.01)	-0.021 (0.006)*	-0.007 (0.007)
Education	0.02 (0.03)	-0.01 (0.03)	0.06 (0.02)*
Female	0.52 (0.12)*	0.88 (0.12)*	0.44 (0.09)*
White	-0.60 (0.13)*	-0.58 (0.14)*	0.05 (0.09)
Constant	-1.46 (0.32)*	-0.43 (0.32)	2.33 (0.21)*
N	1420	1423	1010

Note: \* p<0.05 two-tailed.

Table 3 reports the results of multivariate analyses that control for gender, education, race and length of residence. As in Table 2, each analysis pools responses across survey years. The three dependent variables are (Equation 1) response to the dichotomous question: “Are you concerned that rising sea levels here in Hampton Roads will affect you personally?” (Equation 2) “Are you concerned about rising sea levels in the rest of the world?” And finally (Equation 3) a five point scale bounded at one end by the view that “global warming is a serious environmental problem” and on the other by the position that “global warming is an environmental hoax.” Each of the three dependent variables is coded so that higher (positive) values indicate more climate change concern.

One key take away from Table 3 is that flood zone residence tends to be associated with heightened concern about climate change. In both Equation 1 and Equation 3, flood zone residence has a statistically significant (p<0.05 two tailed) positive association with climate change concern. Coastal flood zone residents were more likely to indicate that they thought global warming was a serious environmental problem, and more likely express concern that rising sea levels would affect them personally. The association between the third climate change variable – concern about rising sea levels in “the rest of the world” and coastal flood zone residence also approaches but does not reach standard levels of statistical significance (p=0.124).<sup>3</sup>

A second take away is that the magnitude of the relationship between coastal flood zone residence and climate change attitudes is often conditional. In Equation 2, length of residence had a strong positive association with concern about sea level rise in the rest of the world except among coastal flood zone residents. And in Equation 3, there is evidence that flood zone

residence is not associated with belief that global warming is a serious environmental problem among conservative and/or Republican respondents.

Several other variables have intriguing associations with climate change concern. Equation 1 shows that there is a substantively large and statistically significant relationship between having recently moved to a new house and concern that sea level rise will affect the respondent personally. A plausible interpretation of this association is that individuals who have recently changed residence in a region in which almost no properties are far above sea level and real estate agents have limited obligations to disclose hazards (Nash 2014) are for a time particularly concerned about the risk of flooding and sea level rise – they do not yet have a sense of how vulnerable their new residence is, and this prompts concern. If this interpretation and these results can be replicated in other studies involving similar contexts, it suggests that a key time to educate individuals about actions aimed at increasing resilience and preparedness for sea level rise and flooding might well be in the period shortly after they have moved to a new residence.

Both personal concern about sea level rise (Equation 1) and concern about sea level rise in the “rest of the world” (Equation 2) also provide evidence that length of residence is associated (significantly) with increased climate change concern. This may reflect the ability of those with a longer-term perspective to see worrying trends, and an increased likelihood of having experienced flooding in the coastal cities of Hampton Roads. There was no statistically significant relationship between belief that global warming is a serious environmental problem and the length of residence variables in Equation 3, however. This null result is puzzling in light of the significant relationships identified between length of residence and climate change concern in Equations 1 and 2. Perhaps this reflects the particular opportunities long residence in Hampton Roads provides to observe changes in sea levels (the focus of the dependent variables in Equations 1 and 2).

3 Perhaps the phrasing of the question encouraged respondents to ignore personal vulnerability: “Are you concerned about rising sea levels in the rest of the world?” frames the question in a way that arguably limits the influence of personal vulnerability.

Given the results from Table 2, and the long history of similar findings in the literature, it should come as no surprise that political partisanship and ideology have a strong association with climate change attitudes in all three equations. In all three equations the coefficients show that respondents who indicated they were liberals and or Democrats expressed a significantly higher level of concern ( $p < 0.05$ ) than the omitted category (ideological moderates without a Democratic or Republican Party affiliation). And it is also unsurprising that conservative and/or Republican respondents expressed the least concern about climate change.

Perhaps more intriguing is the evidence for an interaction between flood zone residence and the conservative/Republican variable. In Equation 3 the statistically significant interaction coefficient for the variable “Flood zone \* Conservative or Republican” arguably provides some evidence that flood zone residence does not lead conservatives and/or Republicans to adopt heightened levels of concern about climate change, unlike other flood zone residents. In Equations 1 and 2 this interaction coefficient is not statistically significant, however, so evidence for an interaction is clearly muted and ambiguous.

Race is strongly associated with climate change attitudes in two of the three equations of Table 3. Respondents who identified as white were significantly ( $p < 0.05$ ) less likely to express concern about sea level rise in the “rest of the world” or to indicate a concern that sea level rise would “affect you personally.” However, whites were not more likely to believe that global warming is “an environmental hoax,” marking one exception to the pattern of lower levels of climate change concern among whites.

A similar pattern pertains for gender: women were more likely than men to give survey responses indicating concern about sea level rise in the “rest of the world,” and concern that sea level rise would “affect you personally.” Women were also more likely to give responses indicating that sea level rise is a “serious environmental problem.” In all three equations the gender coefficients achieved standard levels of statistical significance ( $p < 0.05$ ). In Hampton Roads, Virginia women are more concerned about climate change than men.

## DISCUSSION AND CONCLUSIONS

This study finds that coastal residents who reside in the areas most vulnerable to risk of coastal inundation often have higher levels of concern about climate change. This result is arguably important – it suggests that experience with and vulnerability to coastal flooding may well influence individuals to change their minds about the risks posed by climate change, a precondition for political or other action.

One might argue, however, that most Hampton Roads residents are to a degree exposed to coastal flooding whether or not their home is physically located in a high risk flood zone. Indeed, the effects identified here likely reflect only one aspect of a broader pattern of increased climate change concern among those closer to the coasts, as has been reported in previous research (Milfont et. al. 2014). But this likelihood highlights what is new

in this study – the result that even among coastal residents residence in a high risk flood zone is often associated with increased climate change concern. Appendix 1 briefly explores the association between residence in a coastal county or city and climate change attitudes.

This study replicates and extends existing work on the relationship between personal experience with climate change and environmental attitudes. By utilizing geographic data on flood zone residence, the research design bypasses the risk of biased self-perceptions of vulnerability or experience with climate change – doubtless many of the individuals in coastal flood zones who responded to the survey had personally experienced coastal flooding events. And indeed there is evidence that longer-term residents tend to perceive greater sea level rise risk. Personal vulnerability did influence attitudes, with a larger portion of respondents from coastal flood zones expressing concern about their personal vulnerability to sea level rise, and a tendency for those residents (especially those who were neither conservatives nor Republicans) to be more likely to see global warming as a serious environmental problem. These results appear to affirm in a new context the important role that personal experience can play in shaping environmental attitudes.

## APPENDIX A: CLIMATE ATTITUDES AMONG NON-COASTAL RESIDENTS

This study focuses on climate change attitudes in Hampton Roads Virginia, the second most vulnerable region when it comes to sea level rise in the entire United States (Nash 2014). A potential limitation of this study is therefore the fact that all residents in Hampton Roads arguably face substantial risk from sea level rise, and in the region there are opportunities to observe nuisance coastal flooding on a regular basis while traveling frequently inundated roads, opportunities readily available even for those who live on relatively high ground. All seven cities surveyed are categorized by NOAA as coastal counties (Wiley undated). Hence, the evidence for effects of coastal flood zone residence observed in Hampton Roads likely stack on top of similar effects that play out to a greater or lesser degree for many residents of Virginia coastal counties and cities. Table A.1. examines responses to the one climate change question asked in a statewide survey of likely voters taken in 2013 (Richman 2013). The question was “Do you believe human activity is a major contributing factor in climate change?” and the response categories were dichotomous – yes or no. To focus on the question of whether the climate change attitudes of non-flood-zone residents of coastal cities or counties differ from than those who live far inland and hence face little sea level rise risk. Residents of coastal flood zones were relatively rare in this state-wide sample (47 cases) are excluded from Table A.1. in order to focus on the way climate change attitudes are influenced by residence in a coastal county. Coastal cities and counties were identified using the categorization provided by Wiley (undated).

Table A.1. provides some evidence that coastal residents are more likely to see human activity as “a major contributing

Table A.1. Climate Attitudes in Virginia Coastal and Non-Coastal Residents (Coastal Flood Zone Residents Excluded)

QUESTION		COASTAL	NON-COASTAL	TOTAL
Do you believe human activity is a major contributing factor in climate change?	Yes	165 (64.7%)	93 (55.7%)	258 (61%)
	No	90 (35.3%)	74 (44.3%)	164 (38.9%)

factor in climate change.” The difference between coastal and non-coastal residents is 9 percentage points, and this difference is on the margins of standard levels of statistical significance ( $p=0.04$  Fisher’s exact test, one-sided, Chi-square = 3.45,  $p = 0.6$ ). Thus, there is reason to think that coastal residents, even those who do not live in high risk flood zones tend to be at least somewhat more likely to see a human causal role in climate change than non-coastal residents.

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A relationship between climate change attitudes and coastal residence such as that suggested by Table A.1. has been demonstrated in the literature already. The novel aspect of this study involves further subdividing Hampton Roads Virginia coastal residents by flood zone to investigate the degree to which even among coastal residents, different degrees of proximity to sea level rise risk condition climate change attitudes.

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