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To cite this article: Tyler Reny, Andrew Reeves & Dino Christenson (18 Feb 2025): Rising seas, rising concerns: how climate change vulnerability shapes opinions towards policy, Environmental Politics, DOI: [10.1080/09644016.2025.2463860](https://doi.org/10.1080/09644016.2025.2463860)

To link to this article: <https://doi.org/10.1080/09644016.2025.2463860>



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Rising seas, rising concerns: how climate change vulnerability shapes opinions towards policy

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ABSTRACT


Public opinion towards human-induced climate change is polarized along partisan lines. Indeed, scholars debate whether direct experiences with the consequences of climate change result in durable effects on opinions or behaviors. Our analysis of hundreds of thousands of survey respondents and nearly 30,000 precinct-level voting returns challenges this emerging consensus for one kind of climate change outcome: rising sea levels. We find that persistent vulnerability to rising sea levels is associated with opinions and behaviors about global warming. Coastal residents affected by sea-level rise are more likely to support climate mitigation policy. This association is strongest among those firmly attached to their communities, as opposed to those with the most to lose financially. We speculate that sea-level rise is exceptionally salient in the minds of those affected as an ever-present reminder of the inevitable toll of climate change.

ARTICLE HISTORY Received 5 March 2024; Accepted 24 January 2025

KEYWORDS Climate vulnerability; climate policy; climate mitigation; sea level rise; climate attitudes

Despite a scientific consensus around the human causes of climate change, research on US public opinion suggests that Americans are skeptical that it exists, have low levels of concern for its effects, and generally oppose costly policy interventions (Bowman *et al.* 2016). In the aggregate, these attitudes are stable and polarized along partisan lines (for an overview, see Egan and Mullin 2017). However, first-hand experiences with climate change may lead individuals to know the urgency of taking action and adjust their policy preferences accordingly. Weather phenomena brought on by climate change reclaiming or destroying lands once utilized by a community may be a more influential stimulus than government reports. We hypothesize that this is especially true for those individuals experiencing sea-level rise, a threat that varies

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 Supplemental data for this article can be accessed online at <https://doi.org/10.1080/09644016.2025.2463860>

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significantly among coastal residents in the US. The relationship between threatened coastal communities and sea level is constant and ever-present, and we suggest that this omnipresent force raises the salience of climate change in the minds of those most directly affected.

Across the US, communities face substantial variation in risk from sea-level rise (Krasting *et al.* 2016). We leverage a wide array of measures to capture and conceptualize this variation. We hypothesize that threats from sea-level rise influence individuals because of the nature of the exposure. We use several original and existing surveys, as well as precinct-level voting returns on climate-related ballot propositions, to assess the relationship between susceptibility to sea-level rise and support for climate mitigation policies. We argue that coastal residents' exposure to rising sea levels – which, even among coast-dwellers, varies by geography (Krasting *et al.* 2016) – facilitates support for governmental action on the climate. This relationship is robust across various datasets and methodological and substantive modeling choices. Further, this effect is predominantly concentrated among residents with strong connections to their communities and not those with the strongest economic interests.

Taken together, our findings reveal how residential vulnerability to climate disasters may shape support for climate mitigation policy and among whom this relationship is strongest. We theorize that increased salience from climate change at the community level may play an increasingly crucial role in the climate debate (see also Gaikwad *et al.* 2022, which looks at distributive preferences). From a policy-making perspective, our findings suggest that efforts to raise the visibility of the effects of climate change – such as educational campaigns and public messaging about the susceptibility of low-lying coastal areas to rising sea levels – could further increase public support and demand for climate mitigation policies among many coastal residents. Additionally, our findings suggest that as the effects of climate change become more severe and undeniable, public opinion may follow.

American beliefs about climate change

Though climate change is an urgent and existential issue, public opinion is characterized by disagreement over the severity of the problem, its origins, and its potential solutions. In early 2022, 46% of Americans said human activity contributed 'a great deal' to climate change, while 29% said human activity played 'some' role, and 24% said human activity has 'not too much' of a role.¹ Controversy over the veracity, origins, or seriousness of the issue further translates into disagreement on policy solutions. In 2021, thirty-three percent of the public opposed the Democrats' 'Green New Deal,' a series of policies aimed at restructuring the US economy around green energy jobs.² Individual policies show similar ambivalence. Thirty-

two percent oppose restricting CO₂ emissions from coal-powered plants³ and 43% oppose putting a price or tax on fossil fuels like coal, oil, and gas to reduce carbon emissions in the United States.⁴

The increase in extreme weather from climate change may allow individuals to update their opinions in response to their objective experiences with their environment and heighten the salience of environmental issues. The increasing frequency of extreme weather events might affect individual beliefs and mobilize the public to pressure governments to enact mitigation strategies (Konisky *et al.* 2016).

Many studies examine how experiences with extreme weather influence opinions toward climate change. The findings are decidedly mixed. Much of the research suggests, at most, a weak link between individual exposure to extreme weather and opinions. Howe *et al.* (2019, p. 1). Many studies find no relationship between personal experience with extreme weather and opinions toward climate change (Brulle *et al.* 2012, Marquart-Pyatt *et al.* 2014, Carmichael *et al.* 2017). Other studies conclude that the effect of experiencing extreme weather on opinions is small or highly conditional on other factors (Konisky *et al.* 2016, Hopkins and Pettingill 2018). Similarly, proximity to wildfires may increase self-reported support for adaptation policies among Republicans (Hui *et al.* 2020). Still, its effect on voting behavior only emerges in Democratic areas and is hyper-localized (Hazlett and Mildenerger 2020). Other studies find that natural disasters bear only temporary influences on citizens' retrospective and prospective policy and political beliefs (Healy and Malhotra 2009, Gasper and Reeves 2011, Bechtel and Hainmueller 2011).

Like many issues in American politics, partisan polarization dominates opinions toward climate change (see, *inter alia*, Shwom *et al.* 2015). Compared to Democrats, Republicans are typically more skeptical of the link between humans and climate change and more resistant to policy interventions. Political identities frequently swamp contextual experience in defining views around the environment. There is compelling evidence that elite-level cues and signals (Zaller 1992, Lenz 2012) shape mass opinions about the environment (Konisky *et al.* 2016, Tesler 2018, Hopkins 2018, Merkely and Stecula 2021).

Despite some glimmers of optimism, the extant literature *writ large* suggests a pessimistic outlook between experiencing extreme weather and becoming more supportive of policies to mitigate climate change, which jeopardizes the transformational change required to support environmental policies for mitigation and adaptation (Egan and Mullin 2017, p. 221). Yet other studies suggest that we may not have reached a tipping point where extreme weather is pervasive enough to alter opinions (Konisky *et al.* 2016, p. 546) and reshape political alignments (Colgan *et al.* 2021). In the next section, we build on previous work and hypothesize that the rising salience

and vulnerability to future climate disasters may overcome public resistance to change.

Salience and support for climate mitigation policy

We hypothesize that the underlying mechanism driving the attitudes of coastal residents is an increased salience of climate change due to the vulnerability to sea-level rise. This increased salience may come about directly as residents face danger to life and property. Rising sea levels exacerbate flooding, swallow small islands, sweep away beaches, erode sea-side bluffs, and compromise critical infrastructure. Local media may increase the salience by more regularly highlighting threats from climate change within local communities. Living near the ocean is not a sufficient condition to affect policy views, rather it is the threat and estimated future impact of sea-level rise – which varies substantially even across coastal communities – that is associated with attitudes.

One way that sea-level rise increases the salience of climate change is through the destructive forces that accompany it. For example, coastal flooding events have increased dramatically since the 1950s, and their severity is highly correlated with threats posed by the rise in sea levels. The number of coastal floods has increased from an average of one per year to nearly six per year between 1950–1969 and 2010–2020 in 33 of the largest coastal cities tracked by the US Environmental Protection Agency (EPA). Flood waters also threaten septic tanks, buried electric lines, water supplies like wells, and various rail and automobile tunnels. Additionally, these waters threaten many economic sectors, including tourism and agriculture. Frequent floods inundate coastal farmlands, washing away topsoil and increasing soil salinity, which reduces crop yields. Among the most salient of impacts is on housing stocks where floods from rising seas threaten to wash away and flood homes and apartment buildings, rendering the land uninhabitable.

This damage exerts high economic costs and generates a profound threat to neighborhoods of families and individuals whose ties may stretch back generations. Reports highlight economic costs at both the individual and community levels. Residents must decide whether to relocate after damaging floods. If they do rebuild, they face lower property values, more expensive property insurance, and an uncertain outlook for their community as it may face depopulation and loss of tax base. Communities must spend revenue on beach re-nourishment and construction of sea walls as they face a potential collapse of local economic sectors, including tourism, fishing, and agriculture.

These repeated and increasingly frequent threats can also take a psychological toll on coastal residents. Humans have strong evolutionary drives toward self-preservation (Catanzaro 1991). Exposure to threats that

are resistant to treatment tends to encourage sensitization, feelings of helplessness, and amplified emotional reactions, like acute stress and anxiety (Holman *et al.* 2014). Research shows that perceptions of both crime and terrorism can influence political beliefs and behaviors (e.g. Aksoy 2014, Noble *et al.* 2022). Crime and terrorism, like sea-level rise, may be constantly looming threats that are not easily ignored, generating anxiety among those potentially affected.

Experiences with a looming threat shape attitudes and behaviors by eliciting emotional responses. Anxiety causes individuals to avoid danger, seek information, find protection from threatening events (Roseman 1984, Marcus 2000, Brader 2006), and support political policies and candidates who advocate for policies that protect from threat (Albertson and Kushner Gadarian 2015, Noble *et al.* 2022). Anxiety also encourages residents to weigh new information more heavily rather than rely on predispositions like partisanship or ideology when making political decisions (Marcus and Mackuen 1993, Marcus 2000), and it increases sensitivity to risk (Huddy *et al.* 2007), which can be severely underestimated, particularly with rare events (Taleb 2007). Within climate science, there is a well-developed literature on climate anxiety, which reflects the psychological stress that comes from the changing climate.⁵ Climate anxiety is mitigated both by individual-level characteristics such as age and the country of residence (Hickman *et al.* 2021).

These strands of research are instructive for understanding attitudes toward the environment. Threat from sea-level rise may be analogous to the persistent and anxiety-inducing stimuli of terrorism or crime. While some research suggests that acute and severe climate events are easily forgotten or decoupled from climate change, sea-level rise may be different. With sea level rise, the destructive force remains even after its damage is done. With every crash of a wave along the shore, a coastal-dweller is reminded of the force of the sea.

Given the nature of residential selection, the difficulty in isolating causal mechanisms, the nature of the phenomenon that we are studying, and the goals of our paper, we remain agnostic as to the exact mechanisms by which sea-level rise shapes climate change. Our broader hypothesis is that exposure to threats from sea-level change will raise the salience of the issue and, in doing so, magnify policy concerns and behavior related to climate change. Other work finds that attitudes toward climate change are not related to the mitigation behaviors of coastal homeowners (Javeline *et al.* 2019) or that environmental anxiety (Dodds 2021) or trauma generally (Marsh 2022) demobilizes involvement. We cannot say whether our results are driven by being on the leading edge of a de-or re-alignment around environmental issues by improved empirical specification.

Applied to the case of rising sea levels, our main theoretically-derived expectations and first hypothesis are clear and consistent with existing suggestive evidence:

- *Vulnerability and Policy Attitudes*: Living in an area that is more vulnerable to rising sea-levels will be associated with higher levels of support for climate mitigation policies.

We further consider factors that may influence how exposure to rising seas translates into political attitudes and behavior. We propose two potential moderators: economic self-interest and attachment to a community.

First, increased salience may be motivated by *economic self-interest*, which can be defined in several ways. Income serves as one measure given that the costs of inaction may be concentrated among those with more assets at risk like homeowners (Sears and Funk 1991). Homeowners may face higher insurance costs and a decline in their property value with mounting threats from sea-level rise. For example, even with federal assistance, the cost of elevating homes at risk from sea-level rise is typically between \$49,000 and \$89,000.⁶ Likewise, there is increasing risk of a total loss of property as a result of rising sea-levels. One report from 2017 estimated that nearly 2% of all US homes, \$882 billion of property, could be underwater by 2100.⁷ Though wealthy individuals may have the most exposure to damage from climate change, they may also be better able to bear the costs. Wealthy individuals are likely to mitigate risk through insurance, have savings to deal with temporary hardship, or be better positioned to relocate if needed. Aside from wealth, those whose economic livelihoods are tied to the ocean (fishing, tourism, etc.) may also be concerned about their economic future. Taken together, these factors motivate our second hypothesis:

- *Economic Moderators*: The relationship between vulnerability to rising ocean levels and support for climate mitigation policies will be stronger amongst those who face the greatest financial threat.

Second, subjective and symbolic factors like attachment to a community may motivate anxiety related to environmental change. Many Americans have deep ties to their communities, and this place-based identity can be politically consequential (Cramer 2016, Jacobs and Kal Munis 2019). Those with a strong attachment to their neighborhood, town, or city may be particularly concerned about the future of that community and thus supportive of policies that could protect from climate-related harm. Thus, we explore an alternative moderation hypothesis:

- *Place-Attachment Moderators*: The relationship between susceptibility to rising ocean levels and support for climate mitigation policies will be stronger amongst those with the strongest attachment to their communities.

Sea-level rise stands apart from other human-induced climate change disasters in that coastal residents are reminded daily of the inexorable force of the ocean. For some Americans, human-induced climate change is not recognized as a lived experience but rather something they occasionally hear about in the national news. Others experience drought, extreme heat, tornadoes, or other disasters associated with climate change. But residents may more readily dismiss these disasters as epiphenomenal or bad luck than systematic and human-caused (Healy and Malhotra 2009). Similarly, people may be more sensitive to economic stimuli they consistently observe in their daily lives – like rising gas prices or local unemployment – compared to global or national trends or less frequent events (Reeves and Gimpel 2012, Park and Reeves 2020), which they may more easily dismiss in forming their own attitudes.

We do not merely assert the uniqueness of sea-level rise compared to other disasters. We show that susceptibility to other forms of climate disaster, including extreme heat, wet bulb (heat and humidity), wildfire, and lower farm crop yields, are not associated with support for climate mitigation policy. Humans have learned to adapt to a variety of harsh environments and to rebuild following natural disasters. For example, air conditioning has made it possible for large populations to live in areas with extreme heat in ways that were not possible in the recent past (Culver 2012). Cities like Phoenix, Arizona, which experienced 144 days of temperatures exceeding 100 degrees Fahrenheit in 2020,⁸ are among the fastest growing cities in the United States.⁹ Similarly, communities that experience destruction from hurricanes, tornadoes, and wildfires often rebuild (e.g. Kates *et al.* 2006). By contrast, adaptation to rising sea levels is both constant and also costly or infeasible in many parts of the United States. In the last analytic section, we discuss the implications for the distinction of sea-level rise vis-à-vis other types of severe weather events.

Data and methods

We first analyze the relationship between susceptibility to rising ocean levels and individual-level support for climate mitigation policy using a variety of original and existing datasets listed in Table 1. These include two original surveys collected via Lucid Theorem between January 2021 and March 2022, the UCLA + Democracy Nationscape survey, a large-N multi-wave survey

Table 1. Details of survey data.

Name	Vendor	Field Dates	Sample	N Waves	Sample Size
Original Survey 1	Lucid	21 January 2021 to 3 February 2021	National	1	$N=2,984$
Original Survey 2	Lucid	5 September 2021 to 12 March 2022	National	3	$N=3,267$
Nationscape	Lucid	18 July 2019 to 3 February 2021	National	71	$N=465,521$
CES	YouGov	6 November 2019 to 5 December 2019	National	1	$N=18,000$

Note: Full details of each survey can be found in Appendix A.

fielded between July 2019 and February 2021 (Tausanovitch and Vavreck 2021), and the Cooperative Election Study (CES) fielded in 2019. Lucid surveys are sampled to match key demographic quotas of the adult US population, and the CES relies on YouGov's proprietary sample matching procedures to approximate random sampling.¹⁰

Our primary dependent variable is support for climate mitigation policies. We measure support for climate mitigation policy using an additive scale of support for a host of proposed federal-level climate mitigation policies, including support for a carbon tax on heavily polluting industries, increasing fuel efficiency standards for motor vehicles, a ban on single-use plastics, increasing research on meat alternatives, increasing gas taxes, investments in the transition to 100% electricity generation from renewable energy sources, building an energy-efficient smart grid, upgrading industrial buildings for

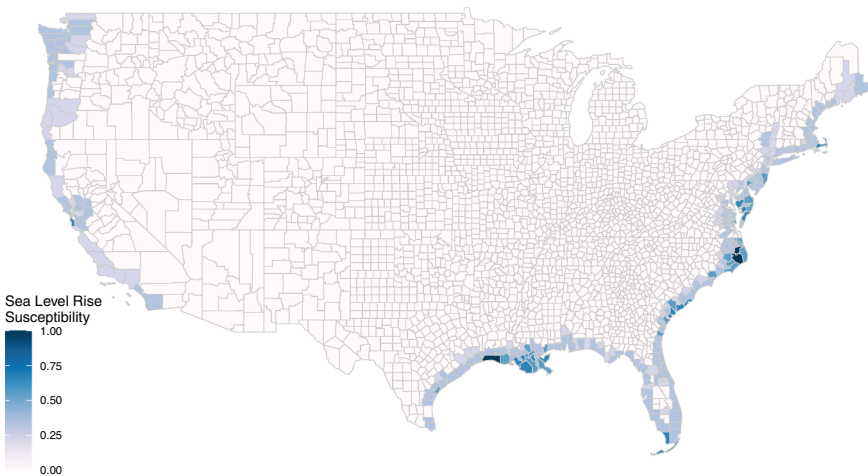


Figure 1. County-Level Susceptibility to a Rising Sea. Data from ProPublica based on projections of sea-level rise by 2100 by the Rhodium Group.

state-of-the-art energy efficient, and investments in projects to capture climate-damaging gases.¹¹

Our primary independent variable is a continuous measure of susceptibility to rising sea-levels compiled for ProPublica by the Rhodium Group at the county level. We present these data in [Figure 1](#). This continuous measure is based on an estimate of the percentage of properties below sea level based on their proximity to the ocean, average ground-level altitude above high-tide, and projections of sea-level rise. We re-scale this measure to range between zero and one. Inland counties have a score of zero, meaning no risk from rising sea levels. Coastal counties vary in their susceptibility based on geographic features and building patterns. For example, nearly all (97%) homes in Hyde County, NC, which includes parts of the Outer Banks, are at extremely high risk of flooding in the near future due to rising seas.¹² Hyde County has the highest risk score (score = 1) in our data. Counties like Monroe County, FL, which contains the Florida Keys (score = 0.67) and Lafourche Parish, LA (score = 0.55) had moderately high levels of risk due to rising sea levels. Other coastal communities that face less severe flood risk, like Douglas County, OR, had among the lowest non-zero risk scores in our data (score = 0.22). The mean county-level risk score in our data is 0.11. We assess the robustness of this measure in our main model using alternate measures of exposure to sea-level rise from Moody's Rating Agency, the NOAA, and a finer-grained measure of susceptibility at the 5-digit ZIP code tabulation area, which is generated from Zillow data (Dahl *et al.* 2017). We geo-located respondents within their respective counties based on their ZIP code using a ZIP code to county crosswalk. For more details on these measures see Appendix B.

A major concern is that any differences in attitudes toward environmental issues are a function of compositional differences in the populations that live on the coasts. Suppose only Democrats live in places threatened by sea-level rise and only Republicans live elsewhere. In that case, differences in attitudes may be a function of the distinct characteristics of the two populations. To address this concern, we control for standard individual-level demographic factors, including race and ethnicity, age, sex, family income, education, ideology, and partisanship. We include demographic data from the US census 2015–2019 American Community Survey (ACS) for robustness checks. We merge additional data for various robustness checks that are described in greater detail below and in Appendix B.

Results

We begin by testing whether living in low-lying coastal areas that are susceptible to rising sea levels is associated with greater levels of support for climate mitigation policies. [Table 2](#) presents the results of our model.

Table 2. Susceptibility and support for climate mitigation policy.

	Support Policy	Support Policy
Susceptibility	0.19*** (0.05)	0.10*** (0.03)
Control Variables		✓
Num. obs.	2846	2584
N Clusters	932	932

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Note: Dependent variable is a scale of support for climate mitigation policies (columns 1 and 2). Independent variable is an objective measure of county-level susceptibility to sea-level rise. OLS coefficients with heteroskedastic-robust standard errors clustered at the county level. Model 2 includes political and demographic controls. Full models can be found in Appendix Table C1.

Column 1 displays the bivariate association, and column 2 shows the association controlling for standard demographic and political factors. Consistent with our expectations, living in an area susceptible to rising ocean levels is positively associated with greater support for climate mitigation policy. These results are substantively meaningful. Holding all else equal, moving from an area least (inland county) to most susceptible (Hyde County, NC) to rising ocean levels is associated with a 0.44 standard deviation increase in support for climate mitigation policy, roughly equivalent to the change in support for climate mitigation between a weak Republican (2) to weak Democrat (6) on a seven-point party ID scale, or a self-identified conservative (2) to liberal (4) on a 5-pt ideology scale, all else equal. Similarly, moving from the lowest risk area to a moderate risk area (e.g. Lafourche Parish, LA) or a lower risk area (e.g. Douglas County, OR) is associated with a still meaningful 0.25 and 0.1 standard deviation shift in support for climate mitigation policy, respectively.

Robustness tests

Before testing moderators, we conduct a series of robustness checks on the main result. First, we show that the results are robust and substantively identical if we control for additional potential contextual confounders, including county-level racial demographics (pct white), college education (pct over 25 with college), unemployment (pct unemployed), median income (median household income), total population, and population density (Appendix Table C3). A sensitivity analysis suggests that for an unobserved confounder to explain away the observed estimated association, it would need to be more than twice as jointly predictive of the independent variable and dependent variable as partisanship (Cinelli and Hazlett 2020). Given the influence of partisanship in shaping both where individuals live and climate policy attitudes, we cannot think of what such a confounder might be

(Appendix Table C4). The results are also fairly robust when substituting alternate estimates of sea-level rise (Appendix Table C5 and Table C6) or ZIP code-level risk (Appendix Table C7). We further show that the result is not unique to our primary Lucid dataset. The result replicates, and the magnitude of the association is consistent with our other multi-wave Lucid survey, the Democracy Fund + UCLA Nationscape survey ($N = 465,521$) fielded between 2019 and 2021, and the Cooperative Election Study ($N = 18,000$) fielded in 2019. We present these statistical models in Appendix Tables C8, C9 and C10. The results are also robust to a different modeling strategy that regresses county-level climate opinion data from the Yale Program on Climate Change Communication (YPCCC) surveys on our county-level measure of SLR risk and controls (see Appendix Figure C1).

As we have previously noted, one concern is that those who live in low-lying coastal areas are different from other Americans, and those compositional differences explain our findings. While our models adjust for confounding factors like partisanship and ideology, it may be the case that these respondents are more culturally liberal, more altruistic, less anthropocentric, or spend more time enjoying nature than other Americans. In a series of falsification tests, we find that living in an area susceptible to rising sea levels is not predictive of other cultural or political attitudes like support for the police, racial resentment, or affect toward Republicans, Prius drivers, or pickup truck drivers (Appendix Table C11). Further, susceptibility to sea-level rise is not predictive of future orientation or anthropocentric views and is, on average, *negatively* correlated with altruism, enjoyment of nature, and outdoor recreation (Appendix Table C12).

We might also be concerned with the construction of our independent variable, the composition of our ‘control’ units, or that our findings are driven by counties in one or more liberal states that have large numbers of susceptible residents (e.g. Cape Cod in Massachusetts). It could also be that our measure of susceptibility is proxying for living in a coastal county or on another body of water like the Great Lakes. In Appendix Table C13, we show that neither is predictive of greater levels of support for climate mitigation policy. Similarly, we might be concerned that by including all Americans, including those who live in the Midwest and Mountain States as ‘control’ units introduces an enormous amount of heterogeneity, making it more difficult to approximate all-else-equal inferences. To address this, we calculate the distance between the centroid of each county in the US and its nearest coastal county and then subset and re-run our analyses at various bandwidths, each time including more ‘control’ units further from the coast. In other words, we restrict our sample to just ‘treated’ and ‘control’ residents that live in counties that are within 50, 100, 150 miles, and so on, from the coast before re-estimating our main model with each restricted sample. As we show in Appendix Figure C2, the main coefficient of interest is

substantively identical and statistically significant no matter how we restrict our sample. Finally, we run a series of tests to assess whether our results are driven by any outlier states or regions. In Appendix Tables C14 and C15 and Appendix Figure C3, we show that our results are not sensitive to the inclusion of state or region fixed effects, that results are not driven by residents living on one coast or the other, and our results do not change if we drop any each state from the sample and re-run the analysis. Finally, we show in Appendix Tables C16 and C17 that our measure of SLR is not proxying for or driven by other natural disasters like hurricanes that might exacerbate the effect of SLR.

Our results thus far suggest that all else being equal, living in areas that are susceptible to rising sea levels is associated with greater support for federal climate mitigation policies. These results are robust to a variety of model specifications, different operationalizations of key variables, and a variety of falsification tests, and they replicate with other datasets collected at different time periods with different samples. We move next to consider among whom these effects are most concentrated.

Economic self-interest & place-based identity moderators

We now turn to examine the two hypothesized moderators of sea-level threat and environmental attitudes. We are interested in the extent to which economic self-interest and place-based attachment condition the effect of environmental threat on policy beliefs. To test the main hypothesized moderators – economic self-interest and place-based attachment – we turn to our multi-wave Lucid survey. We begin by assessing the role of economic self-interest using multiple items. First, we interact susceptibility with home ownership, one of the most important individual-level measures of economic risk. We also interact susceptibility with a logged measure of county-level average home values gathered from Zillow to see if effects vary as a function of the price of homes.¹³ Similarly, we subset our survey dataset to homeowners and interact susceptibility with a logged measure self-reported cost of home insurance to see if those already paying the highest home insurance bills are most likely to connect their susceptibility with support for climate mitigation policy. Lastly, we interact susceptibility with annual household income. All continuous moderators use tercile splits estimated by the interflex package (Hainmueller et al 2025) to account for non-linearities in the interaction term.¹⁴

We also test two additional logged measures of community-based economic self-interest – county-level measures of the number of hotels and amount of tourism-related payrolls – to assess whether residents who live in communities with economies based more heavily on tourism are particularly likely to support climate mitigation policies. Similar to the measures above,

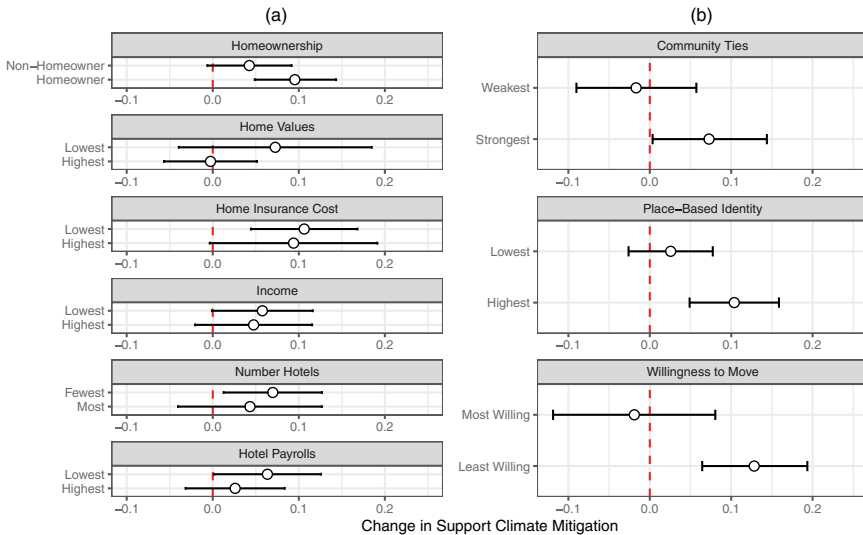


Figure 2. Economic and Place-Based Attachment Moderators. Note: Points indicate change in predicted support for climate mitigation policies moving susceptibility from its lowest to highest levels across various economic (A) and place-attachment (B) moderators with 90% confidence intervals. For ease of interpretation we only display the point estimates for the upper and lower quartiles of our binned moderators. For more information on model estimation see Appendix Tables C21 and C19 and Appendix Figure C4.

these continuous variables were broken into terciles to allow for non-linear interactions. In Figure 2 Panel A (Appendix Tables C18 and C19), we plot the change in support for climate mitigation policy, moving susceptibility from its lowest to highest values for those at the lowest and highest terciles of each moderator, except for homeownership which has two possible values. Our findings are nuanced. While it is true that the relationship between susceptibility and support for climate mitigation policy is statistically different from zero for homeowners, those with lower insurance costs, and those living in areas with fewer hotels, the differences between the points in each plot, that is, whether we can say with statistical confidence that the marginal effect of susceptibility is different for the two levels of the moderator, are not statistically significant at conventional levels (e.g. $p < 0.10$) for any of the moderators. This suggests that economic vulnerabilities at the individual or county level, at least in the ways we operationalize it, are not meaningful moderators of climate susceptibility on support for climate mitigation policy.

What about the role of place-based attachment? We interact three different measures of attachment to the community with susceptibility to sea-level rise. The first measures the strength of ties to their current communities, the second is an additive scale of seven items tapping into the extent to which

respondents' communities are integral to their identity which was binned into terciles to account for non-linearities, and the third measures a respondent's willingness to move from their current community.¹⁵ As we show in Figure 2 Panel B and Appendix Tables C20 and C21, moving susceptibility from its minimum to maximum values is associated with a statistically significant increase in support for climate mitigation policy *only* for those with the highest levels of place-based attachment. These differences are statistically significant at $p < 0.10$ for the willingness to move measure ($p = 0.04$) and the place-based identity scale ($p = 0.08$), though the p-value of the difference is slightly larger for the community ties measure ($p = 0.14$). Though imperfect, the evidence here suggests that susceptibility translates to increased support for climate mitigation policy predominantly amongst those with stronger ties to their communities and, thus, a strong incentive to want to stay, fight for, and protect their homes and neighborhoods.

Precinct-level voting on climate ballot propositions

Next, we test our theory by studying voting for state-level climate-related ballot propositions and initiatives. Precinct-level voting data overcomes several of the limitations of a survey-based approach. First, it maximizes external validity, given that voting is actual political behavior, not a survey response delivered in an artificial online setting. Second, it overcomes some of the concerns that our findings from our survey-based analysis may include bias due to unrepresentative samples in coastal areas. Electoral precinct vote return data represents the views of the population of voters in a given election at relatively low levels of geographic aggregation.

Using Ballotpedia and the National Conference of State Legislatures (NCSL) websites, we identify ballot propositions and initiatives from 2010 to 2021 that deal with climate-related matters, such as clean energy initiatives, state-level carbon taxing schemes, and investments in other greenhouse gas-reducing policies. We include only those states with variation across precincts in their exposure to sea-level rise, which eliminates non-coastal states and coastal states with uniform risks of exposure (e.g. Rhode Island). We further focus on those states where precinct-level election results are publicly available. This yielded three ballot propositions from states with different political cultures and located in different geographic regions of the country:

- California's Proposition 23, which aimed to suspend an air pollution control and failed at the ballot box in 2010,
- Washington State's Initiative 732 that aimed to levy a carbon tax in Washington State and failed at the ballot box in 2016, and

- Florida's Amendment 1, a measure that aimed to change the state constitution to allow consumers to lease or own solar equipment to generate electricity for their own use, that also failed in 2016.

We combined precinct-level returns for each ballot proposition with our ZIP code sea-level rise susceptibility measures, other electoral data, and census block demographics data from the 5-year American Community Survey in 2007–2011 or 2012–2016.¹⁶ For each model, we regress precinct-level percent support for the climate-related measure on the ZIP code sea-level rise susceptibility measure and control for median household income, college education, and partisanship as proxied by Democratic vote in a previous presidential election. Heteroskedastic-robust standard errors are clustered at the zip code level.

In Table 3 we show that susceptibility to rising sea-levels is positively correlated with pro-climate voting behavior in all three cases. These associations, again, are substantively meaningful. Our models suggest that moving from lowest to highest risk areas is associated with an increase in support for the ballot initiative of 7% points ($p < 0.01$) in California, a less precisely estimated 14% points ($p < 0.05$) in Washington, and 5% points in Florida ($p < 0.01$). This additional set of results, which is consistent with our attitudinal findings, offers further evidence that living in an area that is susceptible to rising ocean levels is associated not just with support for federal climate mitigation policy but also with actual voting for climate mitigation policies.

To assuage our concerns that susceptibility to SLR in these models is again just proxying for general policy liberalism or environmental attitudes, we run additional tests with three more ballot proposition outcomes from California in 2018: Proposition 3, a water infrastructure bond measure, Proposition 12,

Table 3. Zip-level vulnerability and precinct-level voting for climate-related ballot propositions and initiatives.

	No on Prop 23 (CA)	Yes on 723 (WA)	Yes Prop 1 (FL)
Intercept	0.23*** (0.01)	0.08*** (0.00)	0.52*** (0.01)
Susceptibility	0.07*** (0.02)	0.14** (0.06)	0.05*** (0.01)
Median Income	0.35*** (0.01)	0.06*** (0.01)	-0.25*** (0.02)
Pct College	-0.17*** (0.01)	-0.15*** (0.01)	-0.00 (0.03)
Pct Dem Vote	0.72*** (0.01)	0.60*** (0.01)	0.12*** (0.01)
Num. obs.	18372	6721	5326
N Clusters	1392	519	880

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Note: Dependent variable is precinct-level support for climate-related ballot proposition/referendum. Independent variable is a measure of zipcode-level susceptibility to sea-level rise. OLS coefficients with standard errors clustered at zip code level in parentheses.

an animal welfare measure, and Proposition 2 which would allow CA to use mental health funds from a tax on millionaires to fund housing for homeless individuals with mental illness.¹⁷ As tests, each proposition serves a unique purpose. A water infrastructure measure (Prop 3) could serve as a replication test, as it may be viewed as a climate adaptation measure, though it might alternately be interpreted by voters as a general environmental or infrastructure vote. The animal welfare bill is environmental but not related to climate. Finally, the millionaire's tax to fund homelessness can be interpreted as an ideologically liberal measure, again with little relation to climate change. Proposition 3, then, serves as a potential replication while the latter two propositions serve as useful falsification tests.

In Appendix Table C22, we show that SLR susceptibility in CA is positively associated with voting for the water infrastructure measure, is negatively associated with voting for the animal welfare measure, and is not at all associated with voting for the mental health measure. These additional tests are consistent with our survey-based evidence that susceptibility to SLR is uniquely associated with support for climate-related policy and doesn't appear to result from residents in susceptible areas having more environmental or liberal attitudes, more generally.

Susceptibility to other climate disasters

Finally, we assess whether susceptibility to other climate disasters is associated with greater support for climate mitigation policy. As we argued earlier, coastal residents are reminded daily of the force of the ocean. Tidal flooding, storms, and erosion are constant reminders of an increasingly dire

Table 4. Susceptibility and policy support.

	Support Policy	Support Policy	Support Policy	Support Policy
Intercept	0.81*** (0.01)	0.81*** (0.01)	0.81*** (0.01)	0.81*** (0.01)
Susceptibility Fires	-0.00 (0.02)			
Susceptibility Heat		-0.01 (0.02)		
Susceptibility Wet Bulb			0.01 (0.02)	
Susceptibility Crop Yields				-0.00 (0.01)
Controls?	Yes	Yes	Yes	Yes
R ²	0.26	0.26	0.26	0.26
Adj. R ²	0.25	0.25	0.25	0.25
Num. obs.	2845	2845	2845	2845
RMSE	0.19	0.19	0.19	0.19
N Clusters	932	932	932	932

*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Note: OLS coefficients with heteroskedastic robust standard errors clustered at county level. Full regression results available in Appendix Table C2.

future with rising seas. Other climate-induced phenomena like wildfire, extreme heat, wet bulb (heat and humidity), and plummeting crop yields may be more easily dismissed as rare or epiphenomenal. Using data on susceptibility from the same ProPublica report,¹⁸ we re-estimate our models using these other measures of susceptibility and support for climate mitigation policy. In Table 4, we show that there is no association between any of these other measures of susceptibility and climate policy support. These results, together with our findings that the association between SLR and climate policy attitudes holds when controlling for hurricanes, lend additional support to our contention that sea level rise is uniquely impactful among climate-induced disasters.

Conclusion and discussion

Large-scale political action on climate change in the US will require substantial backing from the public. Existing research on public support for such policies suggests that rapid opinion change is unlikely to happen. Like mass opinions in other political domains, belief in human-induced climate change and support for climate policies are both relatively stable in the aggregate and deeply polarized along partisan lines. Research suggests that exposure to extreme events like long periods of excessive heat, hurricanes, and wildfires can shape public opinion, but the effects are small and quickly decay.

We propose that climate change vulnerability offers a different route by which context can shape support for climate policy. More specifically, we hypothesize that individuals living in coastal areas susceptible to rising ocean levels face reminders of the pending effects of climate change daily, increasing the salience of the problem and anxiety over the gradual effects of such changes, which in turn helps boost support for federal climate mitigation policies. Joining other recent work on climate vulnerability and preferences (e.g. Gaikwad *et al.* 2022), we find evidence for our core hypotheses, which is remarkably robust across datasets and methodological approaches.

We also find strong evidence that the link between climate change vulnerability and support for climate mitigation policy predominates amongst those with strong attachments to their communities, not those who potentially have the greatest economic exposure. Adopting the logic in Hirschman (1970), we view vulnerability to the climate crisis as a sort of long-term ultimatum facing residents of certain communities in the United States and around the world. These residents can either exit via out-migration or they stay and attempt to mitigate the worst effects of climate change by adopting and supporting policies aimed at attenuating climate change. Those with financial means can move (exit), but those who have strong ties to their communities or fewer financial means instead choose to stay and fight until they have no other choice. Indeed, scientists propose that policymakers plan

for strategic and managed retreat that integrate relocation plans into larger political, social, and economic goals (Hino *et al.* 2017, Mach *et al.* 2019, Siders *et al.* 2019).

Our findings suggest several avenues for future research. First, we hypothesize and present evidence that rising ocean levels are unique relative to other vulnerabilities in their omnipresence and persistence for coastal residents, as well as in the permanence of the damage inflicted by a rising sea. However, further research should explore these differences. As the effects of climate change grow more severe, these other climatic phenomena may result in similar changes. Second, while our empirical approaches address concerns associated with selection-on-observables designs, we remain limited in our ability to claim a causal connection between vulnerability and climate policy opinions. One potential path forward is assessing whether exogenous events like large coastal storms and associated flooding prime vulnerability for those in communities susceptible to rising ocean levels and cause subsequent spikes in support for climate mitigation policies.

Ultimately, our work differs from previous literature that suggests that contextual exposure to climate disasters has small to no effects. Consistent with Konisky *et al.* (2016), our findings suggest that tens of millions of residents who are susceptible to rising ocean levels are drawing strong connections between their lived experiences and their climate beliefs, concerns, policy opinions, and behaviors. Our findings suggest that educational campaigns and public messaging should highlight climate vulnerabilities and link them directly to communities and specific policies. In doing so, they may be able to generate greater public pressure across a broader range of constituencies for politicians to act (Grossman *et al.* 2021).

Notes

1. <https://www.pewresearch.org/fact-tank/2022/04/22/for-earth-day-key-facts-about-americans-views-of-climate-change-and-renewable-energy/> Alec Tyson, Cary Funk, and Brian Kennedy, 'What the data says about Americans'™ views of climate change,' *Pew Research Center* August 9, 2023.
2. <https://ropercenter.cornell.edu/ipoll/study/31118181/questions#b114a006-f479-4701-a822-8d39fe8eb1d0> George Mason University Center for Climate Change Communication/Yale University Project on Climate Change Communication, Yale University/George Mason University Climate Change in the American Mind Survey, Ipsos, (Cornell University, Ithaca, NY: Roper Center for Public Opinion Research, 2021), Dataset, DOI: 10.25940/ROPER-31118373.
3. <https://ropercenter.cornell.edu/ipoll/study/31118373/questions#43bffeea-23a3-4673-b9db-d26fbb9bdf07> George Mason University Center for Climate Change Communication/Yale University Project on Climate Change Communication, Yale University/George Mason University Politics Global

- Warming Survey, Ipsos, (Cornell University, Ithaca, NY: Roper Center for Public Opinion Research, 2020), Dataset, DOI: 10.25940/ROPER-31118181.
4. <https://ropercenter.cornell.edu/ipoll/study/31118362/questions#f46917f5-e15e-48d0-8b9b-49b2c8fc1eb8> University of Michigan Center for Local, State, and Urban Policy, National Surveys on Energy & Environment, Muhlenberg Institute of Public Opinion, (Cornell University, Ithaca, NY: Roper Center for Public Opinion Research, 2021), Dataset, DOI: 10.25940/ROPER-31118362.
 5. See Dodds (2021) for an overview.
 6. <https://www.wpri.com/target-12/few-in-charlestown-choose-to-elevate-homes-despite-storm-surge-risk/>.
 7. <https://www.zillow.com/research/climate-change-underwater-homes-12890/>.
 8. <https://ktar.com/story/4365520/phoenix-expected-to-hit-100-degrees-for-first-time-in-2021-this-weekend/>
 9. <https://www.rocketmortgage.com/learn/fastest-growing-cities-in-the-us>
 10. Our Lucid surveys were approved by the Institutional Review Board at Washington University in St. Louis. For details see Appendix A and for replication data files, see <https://doi.org/10.7910/DVN/MLFXXFhttps://doi.org/10.7910/DVN/MLFXXF>
 11. We combined the items into an additive scale (mean = 0.65; sd=0.22) and rescaled it to range between 0 and 1. The items are internally consistent (Cronbach's $\alpha=0.86$) and load consistently on a single factor. We include the factor loadings and correlation matrix for the scale items and justification of individual item choices in Appendix B.
 12. https://riskfactor.com/county/hyde-county-northcarolina/37095_fsid
 13. We display interflex binned estimates for all continuous moderators in Appendix Figure C4.
 14. Moderator tercile splits to allow for non-linearity in the interaction was extracted from the interflex package in R. See notes on Appendix Tables C21 and C19 for more information.
 15. Details for questions are in Appendix B. We used the highest and lowest Likert values for community ties and willingness to move since the scales took on 4 values.
 16. For details, see Appendix B.
 17. See the Appendix for more information on these additional propositions.
 18. <https://projects.propublica.org/climate-migration/>

Disclosure statement

No potential conflict of interest was reported by the author(s).

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