

A World Under Water

Eastern Coastal States of the United States Diverse Approaches to Sea Level Rise Policy

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Sea Level Rise (SLR) is a phenomenon experienced internationally and increasingly poses a threat to communities everywhere. Sea level rises as ice sheets and glaciers melt in response to rising global temperatures.¹ These global temperatures are spurred on by the greenhouse gasses emitted from anthropogenic sources such as the burning of fossil fuels that become trapped in the Earth's atmosphere. The global mean sea level has risen about 8-9 inches since 1880 with its pace continuing to grow exponentially.² By 2100, global sea level rise is projected to be anywhere between 0.6 to 1.1 meters higher, and, under the most extreme circumstances, seas could rise as much as 5 meters by 2300.³ How will governments adjust their policies to adapt to the rising waters that threaten to put our communities underwater?

At the United States federal level, policy action regarding sea level rise only extends as far as the Coastal Zone Management Act of 1972 (CZMA). The CZMA implemented coastal zone management programs at the state level with the intention of setting coastal management goals. The act was amended in 1990 and 2005 to specifically address, anticipate, and plan for sea level rise.⁴ While this program at first glance appears to be very helpful in addressing sea level rise, one plot hole in its plan remains: it is within the state's jurisdiction to choose how, if at all,

¹ *Global Climate Change, Vital Signs of the Planet*. 2021.

² Lindsey, Rebecca, *Climate Change: Global Sea Level*, 2020.

³ Intergovernmental Panel on Climate Change, *Sea Level Rise and Implications for Low-Lying Islands, Coasts and Communities*, 2019.

⁴ Yusuf, Neill, St. John, Ash, and Mahar. *The sea is rising... but not onto the policy agenda: a multiple streams approach to understanding sea level rise policies*. 2016.

to act. This makes sense because states vary so radically in their geography, and their needs and capabilities in responding to sea level rise are just as localized as the issue itself. On the flip side, if sea level rise is not a priority for state legislators, states can choose not to act at all. In this paper I assess what influences the extent to which Eastern Coastal states in the U.S. have created sea-level rise policy.

Since the 1950's, flooding along the U.S. coastline has increased both in severity and frequency, with the Eastern coast of the United States experiencing the most frequent coastal flooding.⁵ Given that about 29.1% of the US population lives in one of the 255 coastline counties of the United States as of 2017⁶, a significant amount of the US's population continues to be at risk of severe flooding, worsened episodic climatic events, and general devastation to coastal habitats. Even still, local and state legislators find climate change adaptation to be a low priority issue when compared against other issues like jobs and transportation because of its intangibility in the short term.⁷ When the threat from sea level rise is exacerbated by proximity to the coast, the urgency with which states risk assess and respond to the threat from sea level rise is thus tremendously important in shaping the future of our communities, industries, and nation as we know it. The low-lying reality of most coastal lands, means that their low elevation in relation to sea-level places them at greater risk to chronic conditions much like SLR as well as episodic events such as storm surge inundation and king tide flooding.⁸ With their shared, and more dire threat from SLR as coastal communities, it is reasonable to expect that eastern coastal

⁵ United States Environmental Protection Agency, *Climate Change Indicators: Coastal Flooding*, 2021.

⁶ Cohen, Darryl, *94.7M Americans Live in Coastline Regions*, United States Census Bureau, 2017.

⁷ Brody S, Grover H, Lindquist E, Vedlitz A, *Examining climate change mitigation and adaptation behaviors among public sector organizations in the USA* Local Environment, 2010.

⁸ Gesch, Dean B., *Best Practices for Elevation-Based Assessment of Sea-Level Rise and Coastal Flooding Exposure*, 2018.

states of the U.S. have taken some policy action to address SLR. This paper illuminates the influences that explain how disparities in state-level SLR policy arose and tells us something about the circumstances necessary to create effective change at the policy level regarding legislation on sea level rise.

Dependent Variable:

Strategies for addressing sea-level rise at the policy level can take many forms. There is no explicit hierarchy of better or worse policy because localized conditions means there is no one-size-fits-all solution to sea level rise mitigation and adaptation. In preparation for this analysis, I sought out literature on best practices on sea level rise policy strategies. The three most heavily referenced SLR policy strategies: Protect, Accommodate, and Retreat act as a guide to the most stringent forms of SLR policy a state can implement. The literature suggests effective approaches to sea level rise policy fall broadly under four categories: Protect, Accommodate, Attack, and Retreat.⁹ The *protection* strategy aims to defend vulnerable areas by decreasing the possible impacts of some negative event. *Accommodation* requires the continued use of these vulnerable lands but intends to increase the capacity of the location to better cope with environmental impacts. *Retreat* can be interpreted as a more aggressive approach requiring the “abandonment of land and structures in vulnerable areas and resettlement of inhabitants”¹⁰ Meanwhile, *attack*, which is less acknowledged in the literature as a distinct policy approach, advances resilient infrastructure towards the sea, much like piers and ports. Attack is omitted

⁹ Howes, Michael, Dedekorkut-Howes, Aysin, and Torabi, Elnaz. *When the tide gets high: a review of adaptive responses to sea level rise and coastal flooding*, Journal for Environmental Planning and Management, 2019.

¹⁰ Dronkers and Mulder, *Strategies for Adaptation to Sea Level Rise. Report of the Coastal Zone Management Subgroup*. Geneva: Intergovernmental Panel on Climate Change, 1990.

from the stringency measure because much of the literature surrounding these different strategies suggests it is not significant enough to warrant its own category and can be easily absorbed by other categories with similar features.

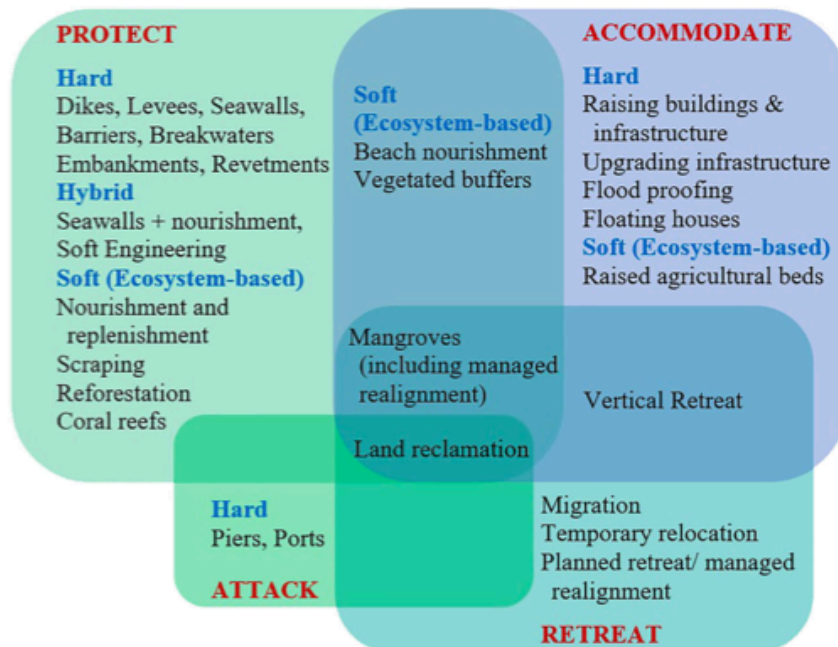


Figure 1. There is overlap between the different types of adaptation strategies.⁸

The three strategies, Protect, Accommodate, and Retreat, tackle the issue of sea-level rise by specifically addressing two central components: long term solubility and proactive action. Long-term solubility is an essential component to aggressive sea level rise adaptation because it ensures that states are not simply ‘buying themselves time’ through quick fixes but rather developing infrastructure that will be necessary in the future with inevitable sea level rise. Proactive action emphasizes the need to respond to potential issues before they occur or worsen rather than choosing to act after significant damage has already occurred. It is important to note that each of these strategies will have varying degrees of effectiveness depending on how and where they are implemented because localized conditions vary so drastically across the eastern

United States. Through the framework of prioritizing proactive policy changes that aim for longevity to avoid quick-fix solutions, I construct the rubric through which I assess the stringency of state-level SLR policy.

Realistically, the time table for which states have become aware of their need to act in response to sea level rise varies greatly. While sea level rise has consistently been identified as a threat to coastal communities, it was not until the past decade or so that states have truly begun to take that risk seriously. Because of this, it is worth considering the time between the moment a state has decided to take action and the time by which policy will be implemented. Delays in the policy making process means that while states might have actively made the decision to address sea level rise through one of the proposed strategies (accommodate, retreat, or protect), the work happening under the hood remains unreflected in their policies until the date of implementation. In order to pull back the curtain and make the distinction between states who have chosen to do nothing, and states whose policies are under construction, the rubric I construct is made up of three categories:

Category 1: Do Nothing.

Category 2: In the Process.

Category 3: Policy Implemented.

Using this framework, it is much easier to assign a reasonable points system that credits states for having begun the process of taking action while not inflating their progress so far to be on equal standing with states who are much further along in the process and have already implemented policy. All state policies, or lack thereof, that fall into category one, will receive zero points. State strategies that document some form of action being taken that do not qualify as

policy implemented but show motion in the policy making process fall under category two and earn one point. States laws that indicate strong policy action through either the accommodation, retreat, or protection strategy fall under category three and are given two points. To be able to better assign a numerical value to the aggressiveness of action on sea level rise mitigation strategies, I have created a rubric to rank eastern coastal states of the US policy approaches to addressing sea level rise by specific action items consistent with the policymaking process and recommended sea level rise policy strategies from the scholarly literature.

Category 1: Do Nothing (0 points). Effectively represents a “do nothing” approach. Sea level rise may make it to the problem recognition stream of John Kingdon’s 1995 multiple stream framework for agenda-setting, but will not extend past this into the political or policy proposal stream.³ This approach neither mitigates the issue of sea level rise, nor proposes any adaptation to it by way of long-term management. It is entirely possible states may recognize the issue of sea level rise but forgo any responsibility by passing it on to smaller entities or simply choosing not to act at all.

Category 2: In the Process - Create a Council (1 point).¹¹ State has acknowledged the threat of sea level rise to their communities and is putting effort into resolving the problem by delegating responsibilities to a group of people whose purpose is to produce best practices, recommendations, commission risk assessments, or propose policy responses. Upon solely the establishment of the council, the state earns one point. This point is not contingent on seeing

¹¹ Miller, Leduc and McCarthy. *Sea Level Rise Adaptation Policy in Various States*. Old Research Report, 2012.

follow through on the council's responsibilities because of the possibility that the window of time between the council's establishment and the state's assessment is not large enough to expect significant action be taken yet.

Category 2: In the Process - Conduct a Vulnerability Assessment (1 point).¹¹ A state has commissioned a risk assessment to aid in eliminating uncertainty surrounding the most severely impacted communities. The state is awaiting the results of this plan before taking official policy action and as such are maintaining the momentum of the policy making process.

Category 2: In the Process - Set Guidelines/Recommendations (1 point).¹¹ A state has put significant thought into the best practices that would aid their communities' resilience to sea level rise. The best practices/guidelines are not mandatory and as such have the capacity to be very ineffective, simultaneously they serve as a stepping stone for larger policy considerations. Guidelines likely follow some sort of vulnerability assessment and are created as a response to the identified risk. The non-mandatory status of guidelines and recommendations places them at a level below policy in their likelihood to be far less effective.

Category 3: Policy Implemented - Retreat (2 points). Largely considered to be a variation of a do nothing approach, it does not actively address sea level rise through mitigation but is a very drastic approach to combating SLR by relocating inhabitants away from vulnerable areas. Retreat allows more flexibility in the future in responding to uncertainty¹² and ensures that states

¹² Kirshen P., Ruth, M. and Anderson W., *Interdependencies of Urban Climate Change Impacts and Adaptation Strategies*, Climactic Change, 2008.

are given a little more time to develop proper infrastructure that can accommodate sea level rise when it inevitably reaches inland. It is worth noting that when sea level rises, populations will need to continue moving further inland and uprooting their ways of life, so without another form of .it is costly, time consuming, unsuitable for highly developed urban areas¹³, and can be the cause of inequality and increased vulnerability of some groups given relocation without compensation and offering little choice over settlement destination.¹⁴

Category 3: Policy Implemented - Accommodation (2 points). The accommodation approach, by contrast, has a strong adaptation focused framework that prioritizes the longevity of our communities in a world with rising seas. Accommodation shares many of the disadvantages of the retreat strategy with its high costs and long term impracticality. The most popular structural choices seawalls, dikes, and elevating buildings/infrastructure, often have a negative effects on coastal environments¹⁵ when not paired with some form of protection/mitigation strategy..

Category 3: Policy Implemented - Protection (2 points). Protection strategies can vary from hard structural approaches to soft ecosystem-based approaches. The advantages and disadvantages of each structural or ecosystem-based decision will vary depending on localized conditions. However, hybrid strategies involving both structural and ecosystem-based approaches have been seen to be both cost effective and efficient,¹² create high amenity

¹³ Harman et al, *Global Lessons for Adapting Coastal Communities to Protect Against Storm Surge Inundation*, Journal of Coastal Research, 2013.

¹⁴ Lonsdale, K. G., et al, *Plausible Responses to the Threat of Rapid Sea-Level Rise in the Thames Estuary*, Climactic Change, 2008.

¹⁵ Cisneros, L. *Sea Level Rise Impacts in Coastal Zones: Soft Measures to Cope with It*, Dalhousie Journal of Interdisciplinary Management, 2013.

environments,¹² and have a no-regrets strategy to handling uncertainty in that the environment benefits regardless of whether sea level rise persists as an urgent concern.¹⁶ However, it is noted that this approach is limited in that it requires alternative strategies to address longer term SLR concerns.¹⁷

The process behind each state's sea level rise stringency assessment requires searching through all 14 states online laws, regulations, or statutes for all policies that mention, acknowledge, or take into account sea level rise in any capacity. The rubric is then used to assess the strategy implemented in each state law. After all the resulting regulations have been scored, the sum of all of a given state's policy's scores is their final stringency assessment. Given that a state's score is cumulative, and each law has the capacity to gain points for implementing several of the rubric's strategies within a single policy, the rubric accommodates the possibility that states have gone about addressing SLR through multiple avenues. For example, a given state may choose to raise its seawalls and elevate much of its infrastructure, earning them 2 points for an accommodation-style strategy. Should this state also choose to implement an ecosystem-based approach by reforesting depleted areas of their land, the state will earn an additional 2 points, totalling 4 points, for their hybrid accommodation-protection SLR policy response. Hybrid strategies involving some degree of adaptation and mitigation are ranked highest given that climate mitigation may only 'buy us time' to adapt as it will reduce the rate of sea level rise but will not stop the absolute rise in sea level.¹⁸ A combination of responses is necessary to slow the

¹⁶ Tobey, J. et al, *Practicing Coastal Adaptation to Climate Change: Lessons from Integrated Coastal Management*, Coastal Management, 2010.

¹⁷ Jallow, B. P., M. K. A. Barrow, S. P. Leatherman. *Vulnerability of the Coastal Zone of the Gambia to Sea Level Rise and Development of Response Strategies and Adaptation Options*, Climate Research, 1996.

¹⁸ Nicholls, Robert J., *OECD Workshop on the Benefits of Climate Policy: Improving Information for Policy Makers, Case-Study on sea level rise impacts*, Organization for Economic Cooperation and Development, 2003.

rate of sea-level rise and its impact on local communities and allow time to build the infrastructure necessary to adapt to long term inevitable sea level rise. While in most cases this operationalization of policy stringency is likely to be an effective measure particularly in its capacity to accommodate to flexible hybrid policies, under the circumstances that a state is taking action through an innovative avenue that does not fall under any of the aforementioned categories in the rubric, this measure of policy stringency may fail. It is my intention that these categories are broad enough to encompass all possible actions but it is worth noting that not operationalization will be entirely foolproof.

Explanatory Variables:

Wealth

Wealth of state plays an important role in the policies made feasible to it. Many of the proposed policy tactics to sea-level rise have the shared disadvantage of being extremely costly.⁸ Any amount of action whether it requires building entirely new infrastructure or simply modifying pre-existing structures will involve some amount of significant investment by the state. Studies conducted globally have seen that sea-level rise can lead to the definitive loss of infrastructure and productive capital.¹⁹ Given this information, this permanent loss of physical capital might incentivize states with greater wealth to invest greater amounts into solutions to resolve the issue of sea-level rise and minimize the long term costs to their community. Many studies reiterate the idea that there is a positive relationship between infrastructure and wealth, such that, increasing infrastructure investment significantly increases growth of wealth and minimizes wealth

¹⁹ Hallegatte, *A framework to investigate the economic growth impact of sea level rise*, Environmental Research Letters, January 2012.

inequality.²⁰ This positive relationship would suggest that states with greater financial capacities would be keen to invest in more aggressive policy strategies given their significant pay off. The wealth explanatory variable tests the hypothesis that states with higher Gross Domestic Product (as measured in the most recent quarter assessment) by State are more likely to invest in much more stringent policy responses to sea-level rise. GDP per capita is not an exact measure of a state's budget for investing in policy solutions - but it may suggest, on a broader scale, greater wealth of state and implicate greater capability for investment into SLR policy solutions.

Vulnerability to Climate Disaster

Proximity to sea level is one way to logically risk assess the threat of sea level rise. The low-lying nature of many coastal lands and their elevation in relation to sea level, largely controls coastal areas exposure to the many consequences of SLR including extreme climatic events and chronic flooding.²¹ Locations with very low elevation must anticipate significant flooding in the case of extreme climatic events and can expect that these symptoms will grow even stronger given projected sea level rise trends. Long-term perspectives of elevation data serve as reminders that, globally, over 190 million people currently occupy land below the projected high tide lines for 2100.²² In just the United States, the estimated population at risk due to land inundation by 2100 is between 1.8 and 7.4 million solely along the U.S. coast.²³

²⁰ Gibson, John, Rioja, Felix. *A Bridge to Equality: How Investing in Infrastructure Affects the Distribution of Wealth*. The American Economic Review, 1996.

²¹ Gesch, Dean B., *Best Practices for Elevation-Based Assessment of Sea-Level Rise and Coastal Flooding Exposure*, 2018.

²² Kulp, S., Strauss, B. *New elevation data triples estimates of global vulnerability to sea level rise and coastal flooding*, Nature Communications, 2019.

²³ Haer, T., Kalnay, E., Kearney, M., Henk, M., *Relative sea-level rise and the conterminous United States: Consequences of potential land inundation in terms of population risk and GDP loss*, Global Environmental Change, December 2013.

Considering the coastal nature of the states in this case study, low point elevation is not a useful measure to use because it does not communicate anything significant about the elevation and topographical variation amongst the eastern coastal states of the U.S.. Mean elevation poses an interesting option but ultimately does not reflect the significant topographical variation between states as usefully as high point elevation. Meanwhile high point elevation allows for greater understanding of the elevation range across the state, following the logic that states with greater high point elevations may experience lower vulnerability to climate disaster. Using this framing of vulnerability as a lens through which state policy adaptation strategies may experience greater pressure to implement more aggressive sea level rise policy, it can be hypothesized that eastern coastal states of the U.S. at lower elevations experience greater urgency to address sea level rise because of increased vulnerabilities to climate disaster.

Political Alignment

Belief in climate science is often low in conservative and even moderate republican households.²⁴ The highly politicized issue of climate change broadly means that while climate scientists have largely come to a consensus on the existence and persistence of climate change, legislators and average citizens remain doubtful. Data collected by the Pew Research Center suggests that trust in climate scientists is low among Republicans and significantly higher among liberal Democrats.²⁰ Following this logic, it is likely that if a large percentage of the state population aligns with republican beliefs, their belief in and support for any sea level rise policies will be minimal. However, it is possible that people's level of concern about the issue of

²⁴ Pew Research Center, *The Politics of Climate*, 2016.

sea level rise is higher regardless of political alignment if they have personal ties to it, i.e. if they live in a coastal area where the consequences of SLR can be tangibly seen as a localized issue.²⁰ While research suggests that the relationship between republican party affiliation and support for environmental protections is negative, it is possible (though unlikely) that the relationship between sea level rise strategy implementation is not connected to party affiliation simply based on the lived experience of the complications of sea level rise. The highly politicized nature of climate change and its current framing as a partisan belief despite the objectivity of the research behind it, suggest that the most likely trend the data will reveal is a positive trend between democratic party affiliation and SLR policy stringency. Party affiliation by state measured in percent democratic party affiliation can thus be a useful measure to gather how influential political alignments are in the implementation of aggressive SLR policy.

Shoreline Vulnerability

Similar to vulnerability to climate disaster, the shoreline vulnerability variable operates off of the idea that sea level rise will cause shoreline retreat of sandy coasts in response to the absence of sand supply mechanisms.²⁵ Operationalizing shoreline vulnerability by shoreline size might pose an interesting relationship with stringency of SLR strategies because states may risk assess the threat from sea level rise to be greater if they have a significant coastline size. Sandy beaches often operate as the first defense against storm surges.²⁶ When minimized by the harsh realities of shoreline retreat, the possibility for sea level rise to increase vulnerability to inland flooding means that, in the long run, the threat of sea level rise extends beyond that of coastal

²⁵ Athanasiou, Dongeren, Giardino, Voudoukas, Ranasinghe, and Kwadijk. *Uncertainties in projections of sandy beach erosion due to sea level rise: an analysis at the European scale*. 2020.

communities. Whereas, states with very small coastlines, by contrast may not prioritize the issue of sea level rise because it affects so little of their population. If states recognize the threat of sea level rise to be greater then they will feel inclined to take more immediate action resulting in more stringent policy measures. If several states take on a 'do nothing' approach, it might be reasonable to assume that one reason for this might be that their stake in the issue is minimal because their shoreline is small enough that sea level rise mitigation strategies are pushed to the bottom of their list of priorities. By operationalizing shoreline vulnerability by shoreline size in miles, I am prioritizing the value of the ecosystem itself rather than the service it provides to human communities and simplifying the measurement down to a known number. If instead, shoreline vulnerability were to be measured by coastal population size, the exact population may be blurred depending on individual migrations and also is inconsistent in the population accounted for by the depth inland, especially when it is uncertain to what degree slightly more inland communities will be threatened by sea level rise.

Case Studies:

In order to maintain constancy in case studies and avoid bias, all states along the Eastern coast of the United States will be used in this study. To avoid selection bias, rather than selecting states with notably lackluster, or alternatively, aggressive SLR policies, all 14 states on the Eastern coast are being used in this study. The 14 states are as follows: Maine, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Delaware, Maryland, Virginia, North Carolina, South Carolina, Georgia and Florida.

Florida - 3 points

Florida's 3 point score can be broken down into its score on two policies: the Florida Statutes 161.551²⁶ and 380.093²⁷. Statute 161.551 enforces the idea that new projects being undertaken by the state must be able to withstand the next 50 years of SLR, potential disaster, and flood risk and be actively addressing them through adaptation, mitigation, or some reduction of risk. This is a strong accommodation style law, relying on the updating of any new infrastructure requirements such that resistance to the next 50 years of sea level rise are central to understanding which buildings receive approval. Meanwhile, statute 380.093 mandates that the state conduct a vulnerability assessment to set up the framework for future action to be taken. A preliminary plan for addressing sea level rise was released on December 1st 2021 but will not be solidified until uncertainty of vulnerability of given coastal lands has been reduced and the vulnerability assessment is complete.

Georgia - 0 points

Georgia does not have a single policy that mentions sea level rise in any capacity. Given 0 points for its do-nothing approach, Georgia is one of few states that employs the do-nothing strategy in the most obvious sense: none of their laws mention or take into account sea level rise.

²⁶ Florida Statute 161.661, *Public financing of construction projects within the coastal building zone*. The 2021 Florida Statutes.

²⁷ Florida Statute 380.093, *Resilient Florida Grant Program; comprehensive statewide flood vulnerability and sea level rise data set and assessment; Statewide Flooding and Sea Level Rise Resilience Plan; regional resilience entities*. The 2021 Florida Statutes.

South Carolina - 0 points

South Carolina's 0 point total might mislead one to think much like Georgia, they too have chosen to stick their neck in the sand. In reality, South Carolina has one policy²⁸: the Green County Space Sales Tax Act. This act essentially collects funds for the purpose of preservation procurements of green spaces. Because it is so broadly phrased, the funds collected fell just outside the range of items given valuation in the rubric. So while South Carolina does have a 0 point final score, it is worth noting that they do not remain unaware of the need to address sea level rise in some capacity.

North Carolina - 0 points

Similarly, North Carolina received 0 points for its less than impressive attempts at sea level rise policy mitigation. The law 113A-115.1²⁹ “Limitation on Erosion and Soil Control Structures” offers many specifications for how a given structure must be built, designed, and approved of but the law's pitfall lies in its explicit mention that structures need not take into account the potential for SLR in its design. This active omission brought what could have been an accommodation style infrastructure-based strategy down to a do nothing approach.

Virginia - 4 points

²⁸ South Carolina General Assembly, *Count Green Space Sales Tax Act*, 2021.

²⁹ North Carolina General Statutes Chapter 113A Article 7, *Limitation on Erosion and Soil Control Structures*. 2012.

Virginia's status as the highest values states as measured by the rubric rests on two executive orders: Executive Order 45³⁰ and Executive Order 24³¹. Executive Order 45 implements an accommodation style strategy (earning it two points) by taking significant strides to ensure that any new buildings being developed are deterred from building in a Special Flood Hazard Area or Shaded X Zone and if they still qualify, have to take significant measures to adapt to sea level rise. Meanwhile, Executive Order 24 conducts a vulnerability assessment (+ 1 point) and creates a plan/set of guidelines for the state (+1 point) requiring a review of the vulnerability of state-owned buildings, and the development of a standardized approach to SLR projections. The state plan/guidelines formed are to be updated every five years and intended to employ natural and nature-based solutions to the maximum extent possible. It will consider potential areas and options for managed coastal retreat. The plan has all the key elements involved: a little bit of retreat, protection, and accommodation in a way that exists unparalleled in other states' plans. But still, the Executive Order 24 falls under the category of guidelines rather than policy action because the plan has not yet mandated anything be done. Each of these elements totalling four points makeup Virginia's SLR stringency assessment.

Maryland - 3 points

Maryland's 3 point assessment can be divided into two defining laws: 3-1001³² "Sea Level Rise Inundation and Coastal Flooding" and 3-1009³³ "The Coast Smart Council". 3-1001

³⁰ Commonwealth of Virginia Office of the Governor, Execute Order Number Twenty Five. *Floodplain management requirements and planning standards for state agencies, institutions, and property*. 2019.

³¹ Commonwealth of Virginia Office of the Governor. Executive Order Number Twenty Four. *Increasing Virginia's Resilience to Sea Level Rise and Natural Hazards*. 2018.

³² House Bill 1427. *Sea Level Rise Inundation and Coastal Flooding - Construction, Adaptation, and Mitigation*. 2019.

³³ House Bill 415. *Coast Smart Council*. 2014.

establishes the Coast Smart Council earning itself one point for the creation of a council to address sea level rise inundation and coastal flood impacts on state and local projects. 3-1009 takes on a strong accommodation-strategy framework as the council is essentially given the responsibility to create new standards for construction and new procedures for which construction, disaster response, and assessments must be conducted. It is then followed by several detailed passages on how structures should be constructed or reconstructed to be at a certain elevation and built to withstand storm surges. This infrastructure-based adaptation earns the state another 2 points for its accommodation style SLR strategy solution.

Delaware - 0 points

Delaware is another example of a state who has policy that takes sea level rise into account and intends for the preservation of its coast, but has not taken significant enough action, or specific enough action to receive any valuation from the rubric designed in this paper. Delaware's "Coastal Zone Act" found in Title 7 Chapter 70³⁴ of the Delaware online code limits the potential pollution at coastal sites by way of setting barriers to potential industries polluting on coastal lands. Still the coastal zone act does not actively respond to any concerns of sea level rise beyond general coastal preservation. For this reason, its action in protecting its coastal lands is given 0 points.

New Jersey - 2 points

³⁴ The Delaware Online Code. Title 7 Chapter 70, *Natural Resources: Coastal Zone Act*.

New Jersey's 2 points rely on the Executive Order 89³⁵ that establishes a council, in this case an interagency council on climate change, demands a coastal resilience plan be developed, and delegates responsibilities to the new State of New Jersey Chief Resilience Officer. The executive order earns itself one point for the establishment of the council and one other for the later development of the State of New Jersey Climate Change Resilience Strategy Executive Summary³⁶ which sets guidelines and recommendations for the state of New Jersey. This Resilience Strategy was released in October of 2021 and outlines recommendations for how to proceed to address the threat of SLR. What is made explicitly clear is the plan's intention to not prescribe legislative, regulatory, or policy changes, but rather act as a baseline for continuous progress. The Strategy contains six priorities: Building Resilient and Healthy Communities, Strengthening Resilience of New Jersey's Ecosystems, Promote Coordinated Governance, Invest in Information and Increase Public Understanding, Promote Climate-Informed Investing and Financing, and develop a Coastal Resilience Plan. The coastal resilience plan places emphasis on ecosystem-based solutions prioritizing strengthening of tidal marshes and shoreline stabilization with nature-based features.

New York - 2 points

New York's two point score can be split and attributed one point each to the New York Assembly Bill A8413³⁷ which establishes a commission to be known as the "New York State Temporary Commission on the Threat of Rising Oceans" and New York Regulation - Part 490³⁸

³⁵ State of New Jersey. *Executive Order 89*. 2019.

³⁶ *State of New Jersey Climate Change Resilience Strategy Executive Summary*. 2021.

³⁷ The New York State Senate, Assembly Bill A8413 *Establishes a commission to be known as the "New York State Temporary Commission on the Threat of Rising Oceans"*. 2021.

³⁸ The New York State Adopted part 490. *Projected Sea-Level Rise*. 2014.

which mandate that a vulnerability assessment be commissioned in response to the threat of rising oceans.

Connecticut - 3 points

Connecticut's final score reflects relatively significant action by way of a Vulnerability Assessment Final Report³⁹ titled "The Impacts of Climate Change on Connecticut Agriculture, Infrastructure, Natural Resources, and Public Health". The final report conducts an assessment and sets forth recommendations by identifying the need for adaptation, and assessing the impacts of climate change on the state earning the state two points for having conducted a vulnerability assessment and releasing recommendations/guidelines. Executive Order No. 3⁴⁰ goes on to establish the Governor's Council on Climate Change as well as council subcommittees and working groups earning the state of Connecticut an additional point for having established a council. They are created with the intention that their responsibilities in this new council are to identify new and emerging mitigation strategies to maximize climate change adaptation and resiliency opportunities.

Rhode Island - 3 points

Despite its relatively small state size, Rhode Island had taken fairly significant action to better prepare themselves for the threat of sea level rise. Executive Order 14-01⁴¹ creates the Rhode Island Executive Climate Change Council, delegating responsibilities to them for the continued

³⁹ A report by the Governor's Steering Committee on Climate Change. *The Impact of Climate Change on Connecticut Agriculture, Infrastructure, Natural Resources and Public Health*. 2010.

⁴⁰ State of Connecticut, *Executive Order No. 3*. 2019.

⁴¹ Rhode Island Executive Order 14-01: *Creates an Executive Climate Change Council*. 2014.

progress towards mitigating sea level rise. The establishment of this council earned the state one point closely followed by another for conducting a vulnerability assessment in Technical Paper 167: “Rhode Island: Vulnerability of Municipal Transportation Assets to Sea Level Rise and Storm Surge”⁴² which analyzed the estimated geographic extent of sea-level rise in relation to transportation infrastructure in the state of Rhode Island over the next century. The final point is earned in executive Order 17-10⁴³ which calls on the Chief Resilience Officer to work collaboratively with partners to develop a statewide “Action Plan to Stand Up to Climate Change” by July 1, 2018. This action plan sets up guidelines and best practices earning the state one extra point for their progress toward policy action.

Massachusetts - 2 points

Massachusetts earns two points for its commission of a vulnerability assessment and establishment of a council: the Ocean Advisory Committee in Section 4C of General Laws⁴⁴. It is also worth mentioning that though Massachusetts does not have an official plan addressing sea level rise they do have a policy mandating that one be made in Section 10 of the General Laws. Because of its recent implementation this plan has not yet been made and therefore they have not yet received credit for creating a set of guidelines/recommendations.

⁴² Technical Paper 167. Rhode Island: *Vulnerability of Municipal Transportation Assets to Sea Level Rise and Storm Surge*. 2016.

⁴³ State of Rhode Island and Providence Plantations. *Executive Order 17-20, Action Plan to Stand Up to Climate Change*. 2017.

⁴⁴ Section 4C: *Ocean Management Plan; ocean advisory commission; ocean science advisory council, duties of secretary*.

New Hampshire - 3 points

New Hampshire's Senate Bill 285⁴⁵ establishes the Coastal resilience and cultural and historic reserve district commission earning them one point for the creation of a council. It is made clear that municipalities may join into the Climate Resistance Cooperative if they so choose and establish a coastal resilience fund. New Hampshire's final report "Preparing New Hampshire for Projected Storm Surge, Sea-Level Rise, and Extreme Precipitation," acts as a vulnerability assessment of the threat of sea level rise and provides possible responses to serve as guidelines for future policy implementation. The final report does a significant amount of heavy lifting in that it both conducts a vulnerability assessment and puts forth recommendations and guidelines, earning the state an additional two points, totalling three.

Maine - 2 points

The last of the New England states follows a very similar path as its predecessors: Maine too, has established a council and conducted a vulnerability assessment. In LD 1679⁴⁶ "An act establishing a coastal resilience and economic development program", the law establishes the Maine Climate Council. Which was then closely followed by 1169–L.D. 1572⁴⁷, which directs state-level departments and agencies to conduct a review of their laws and regulations to incorporate considerations of a relative sea-level rise of 1.5 feet by 2050 and 4 feet by 2100. Additionally, this law directs state-level departments and agencies to identify ways to implement strategies from the Maine Climate Action Plan. This vulnerability assessment earn the state of

⁴⁵ Senate Bill 285-FN, Chapter 318. *An act establishing a coastal resilience and economic development program*. 2019.

⁴⁶ Public Law Chapter 476. *An Act to Promote Clean Energy Jobs and to Establish the Maine Climate Council*. 2019.

⁴⁷ State of Maine H.P. 1169-L.D. 1572. *Resolve to Analyze the Impact of Sea Level Rise*. 2021.

New Hampshire an additional point and makes room for future development of regulation (though this is not currently being considered in its valuation as it has not taken effect yet).

Analysis:

Wealth:

State	State GDP (Second Quarter of 2021)	Stringency of SLR Policy
Rhode Island	\$ 64,170.00	3
Maine	\$ 74,604.00	2
Delaware	\$ 79,282.00	0
New Hampshire	\$ 93,891.00	3
South Carolina	\$ 266,079.00	0
Connecticut	\$ 294,649.00	3
Maryland	\$ 443,729.00	3
Virginia	\$ 586,250.00	4
Massachusetts	\$ 625,113.00	2
North Carolina	\$ 646,207.00	0
New Jersey	\$ 671,483.00	2
Georgia	\$ 673,072.00	0
Florida	\$ 1,198,913.00	3
New York	\$ 1,868,224.00	2

Figure 1. Chart values of State GDP by cumulative policy stringency. Sorted in order of least to greatest GDP.

Stringency of SLR Policy by State GDP (Second Quarter of 2021)

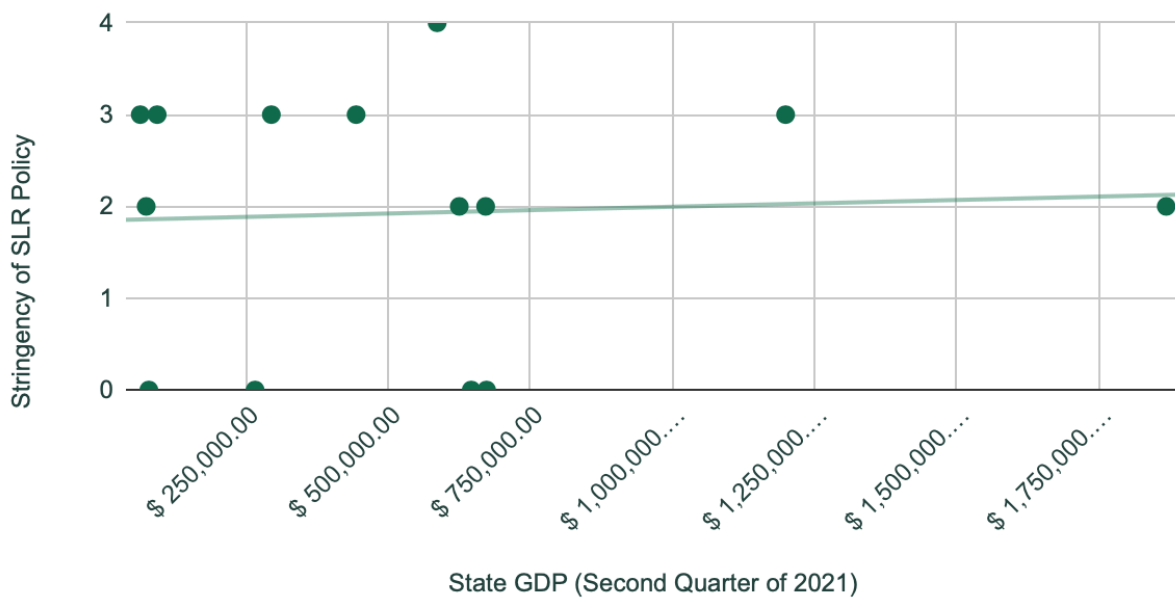


Figure 2. A comparison of stringency of sea level rise policy to state GDP.

The anticipated relationship between state GDP and Stringency of sea level rise policy is positive. In theory, greater amounts of wealth can afford states the opportunity to take on more aggressive stances in combating sea level rise. What this graph indicates is the absence of this relationship in its entirety. The relatively flat trendline reaffirms the apparent relationship or lack thereof between SLR policy stringency and state GDP. Even by looking at the chart in figure 1, the relationship between GDP and stringency appears to follow no significant pattern, which has very positive implications for less wealthy states. If wealth had been a determinant of creating stringent sea level rise policy action, then this would've posed somewhat of a hopeless circumstance. Drastically changing a state's level of wealth is an unrealistic challenge to take on particularly when given a short time frame. Alternatively, as we see in this case, the absence of a

relationship means that a state does not need to acquire significant wealth in order to take strong policy action in mitigating sea level rise. The accessibility to states regardless of wealth is a rather hopeful attribute of this explanatory variable and leaves open the possibility that significant action can be taken by states with the only barrier to action being the need for interest and political pressure in prioritizing action be taken to address sea level rise.

Vulnerability to Climate Disaster:

State	High Point Elevation	Stringency of SLR Policy
Florida	345.000	3
Delaware	450.00	0
Rhode Island	812.000	3
New Jersey	1803.000	2
Connecticut	2380.000	3
Maryland	3360.000	3
Massachusetts	3487.000	2
South Carolina	3560.000	0
Georgia	4784.000	0
Maine	5276.000	2
New York	5344.000	2
Virginia	5729.000	4
New Hampshire	6288.000	3
North Carolina	6684.000	0

Figure 3. Chart values of state high point elevations by cumulative policy stringency. Sorted in order of least to greatest elevation at the highest point in the state.

Stringency of SLR Policy vs. High Point Elevation

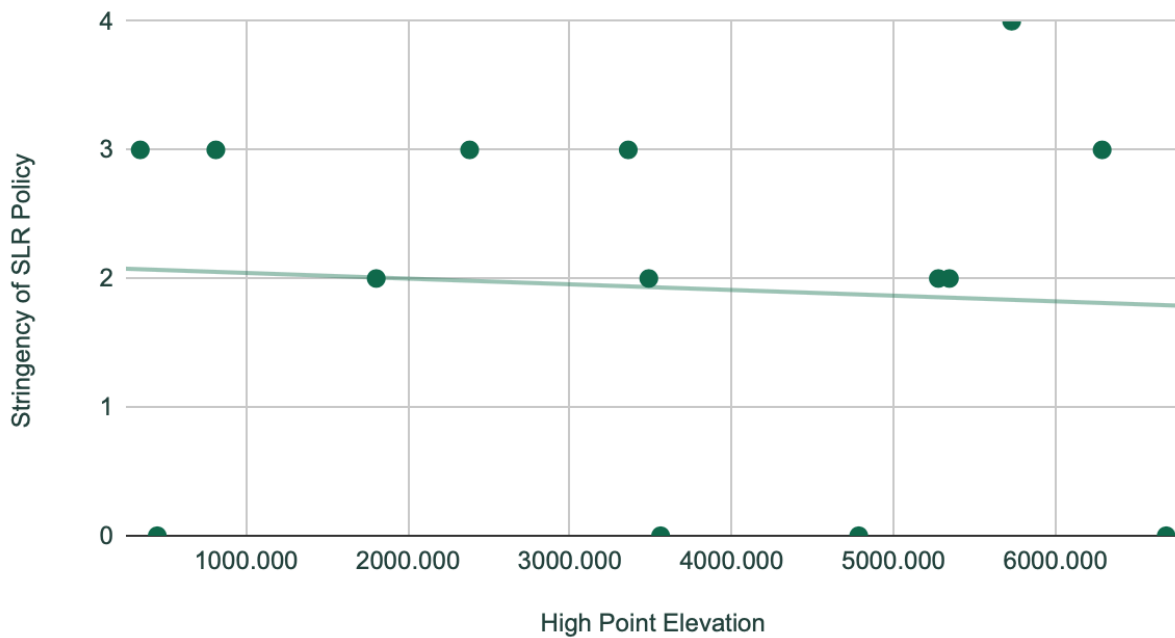


Figure 4. A comparison of stringency of sea level rise policy to a state's highest point elevation.

The intention behind measuring a given state's high point elevation is the possibility that it might bring to light some pattern in the way states risk assess their own standing in the face of sea level rise. If states at lower elevations sought out more immediate and stringent policy measures by comparison to states at much higher elevations, it might stand to reason that states at lower elevation see a much shorter time frame by which they need to take action before their communities are underwater. What this graph clearly indicates is a very insignificant relationship between elevation and policy stringency. This can mean two things: first, states are generally inconsistent in taking action to address climate change. Four out of fourteen states assessed were assigned 0 points for their lax, do nothing approach to sea level rise policy action. This could mean that certain states across the coast will be generally unprepared for sea level rise in the

future despite their potential to be at greater risk because of their proximity to sea level. But, on somewhat of a more hopeful note, it is possible that the disconnect between elevation and sea level rise is not due to inconsistency but rather consistency in the baseline understanding that all states along the coast have some risk from sea level rise posed to them. While some states might risk assess differently and conclude they need to take on urgent action to mitigate sea level rise, the shared experience of being on the eastern coast of the United States means that by default states are already aware of the moderate to high threat of sea level rise. The lack of relationship between elevation and stringency allows for the possibility that states at slightly lower risks from SLR can take on just as stringent policy action without necessitating a state of emergency.

Shoreline Vulnerability:

State	Shoreline Mileage	Stringency of SLR Policy
New Hampshire	131	3
Delaware	381	0
Rhode Island	384	3
Connecticut	618	3
Massachusetts	1,519	2
New Jersey	1,792	2
Georgia	2,344	0
New York	2,625	2
South Carolina	2,876	0
Maryland	3,190	3
Virginia	3,315	4
North Carolina	3,375	0
Maine	3,478	2
Florida	8,436	3

Figure 5. Chart values of shoreline mileage by state and cumulative policy stringency. Sorted in order of least to greatest shoreline size.

Stringency of SLR Policy vs. Shoreline Mileage

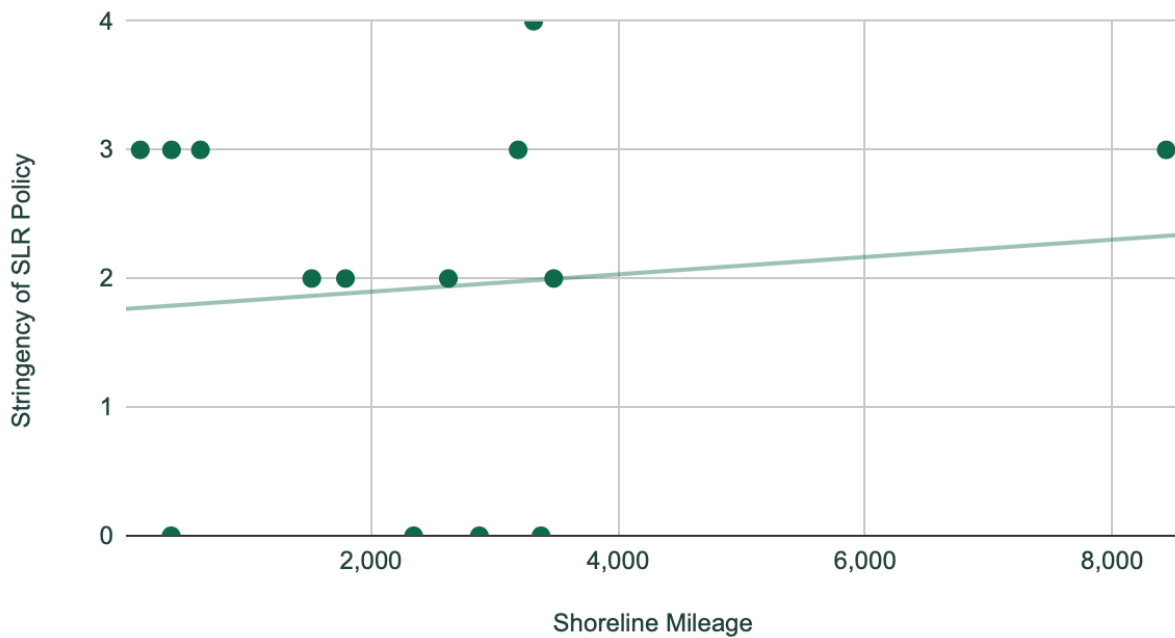


Figure 6. A comparison of stringency of sea level rise policy to a state's shoreline mileage.

Similar to Vulnerability to Climate Disaster, Shoreline Mileage is a measure of community vulnerability. The logic follows that states with very large shorelines have a greater stake in sea level rise mitigation because they stand to lose much of their lands. Whereas, states with very small coastlines may place sea level rise policy action on the back burner because its small portion of their total state size is not significant enough to warrant such urgent action. Plotting stringency of policy and shoreline mileage on the same graph reveal a slight relationship between shoreline size and stringency of policy that is weak at best. It is possible that given a larger sample size by using all coastal states in the United States that more variation amongst stringency might lead to a more clear relationship between shoreline mileage and SLR policy stringency. Given the data we have now, it is reasonable to assume that this confirms our

conclusions about the vulnerability to climate disaster variable. The weakness of the relationship between shoreline mileage and policy stringency could mean that states are willing to take action regardless of how much they stand to lose. As a baseline, all states across the coastal United States will or already have begun to experience shoreline retreat. If a large percentage of each state's population live along the coast then they may see their loss to climate change to be greater. This graph showcases hopeful results through this framing because it suggests the possibility that most states are taking action in some capacity regardless of the size of their shorelines.

Political Alignment:

State	Democratic Party Affiliation Percentage	Stringency of SLR Policy
South Carolina	39%	0
Rhode Island	48%	3
North Carolina	43%	0
New York	53%	2
New Jersey	51%	2
New Hampshire	44%	3
Massachusetts	56%	2
Maryland	55%	3
Virginia	39%	4
Maine	47%	2
Georgia	41%	0
Florida	44%	3
Delaware	55%	0
Connecticut	50%	3

Figure 7. Chart values of percent democratic affiliation by state and cumulative policy stringency. Sorted in order of least to greatest percent of democratic party affiliation.

Stringency of SLR Policy vs. Democratic Party Affiliation Percentage

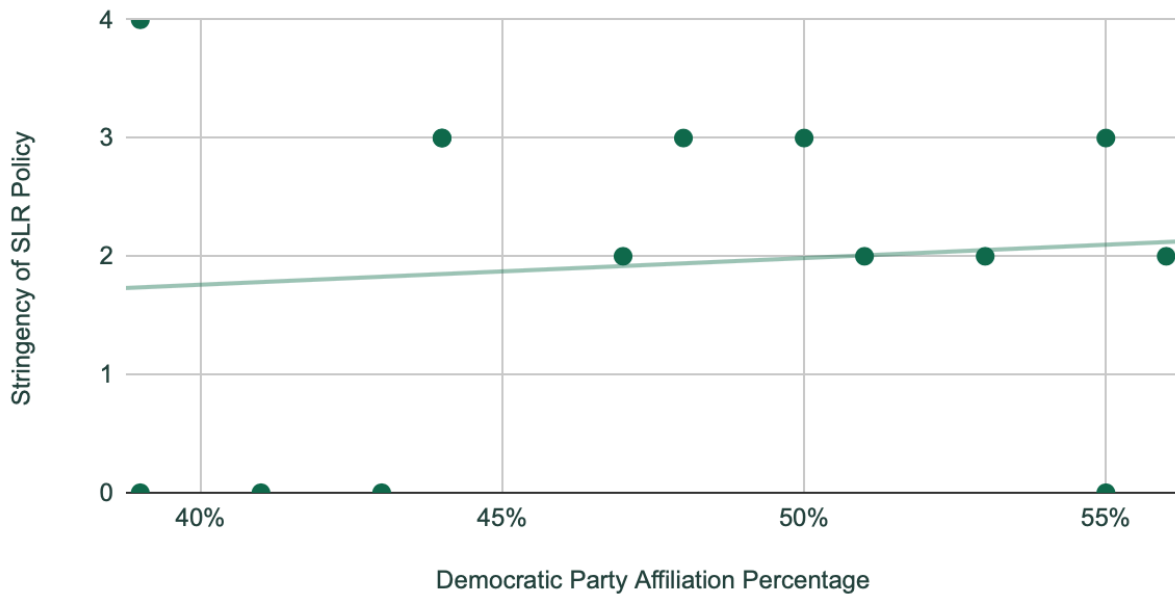


Figure 8. A comparison of stringency of sea level rise policy to a state's percent democratic party affiliation.

The highly politicized nature of climate change suggests that states with greater levels of democratic party affiliation will see much higher levels of investment into environmental protection by their government. Following this logic, in the relationship between policy stringency and democratic party affiliation we anticipate seeing a positive relationship, such that a higher percent of democratic party affiliation is tied to higher levels of party stringency. In Figure 8 we can see that this hypothesis does not seem to hold. The very slight positive slant does little to convince us that the relationship between democratic party affiliation and stringency is substantial. However, in the upper left hand corner of the graph, we see that the state of Virginia with the highest score of 4 is also one of the states with the lowest level of democratic

party affiliation. If we assume that virginia is an outlier and remove it from the graph, then the the graphs relationship is altered significantly:

Stringency of SLR Policy vs. Democratic Party Affiliation Percentage (* Virginia Omitted)

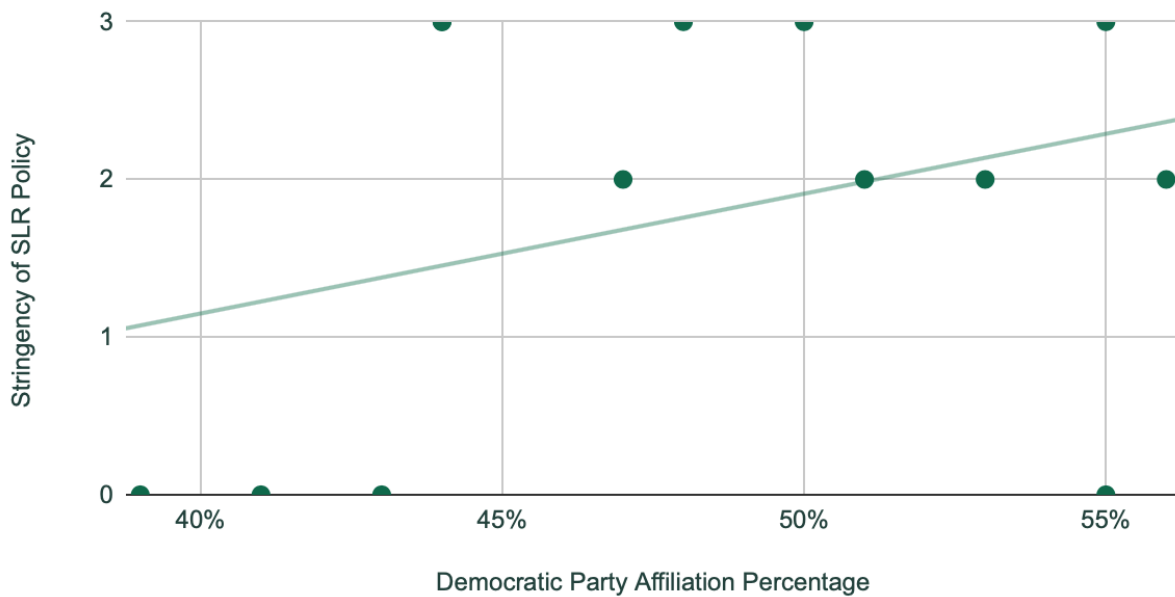


Figure 9. A comparison of stringency of sea level rise policy to a state's percent democratic party affiliation with the outlier Virginia omitted.

This new trend with the omission of Virginia confirms our anticipated results. The highly politicized nature of climate change and all of its resulting consequences mean that our initial graph was flawed in its reflection of the phenomenon made into a partisan battleground. The graph made with the omission of Virginia is a much more believable representation of the relationship between democratic party affiliation and stringency but highlights an important gap in that data: What's going on with Virginia? It is possible that the source used for data analysis is

partially responsible for the variation that we see. The data was taken from a survey taken in 2014. Since then, the nature of American politics has changed drastically. The last two presidential elections have been pivotal moments in the history of United States politics, and though my data on policy stringency measures are up to date, the measure of democratic party affiliation is not quite. It is also quite possible that this gap in Virginia's democratic party affiliation and current standing as the state with the greatest policy stringency can be accounted for by the state of Virginia's recent trends towards more democratic as data from the recent 2020 election reflects.⁴⁸

Still, the probability that Virginia will have swung to the far left enough to maintain the significance of this trend if its data point were to be added back in is unlikely. This suggests that there may be some other element responsible for Virginia's high levels of policy stringency. Research suggests that Virginia is facing the fastest rates of sea-level rise on the East Coast because of both rising seas and sinking lands.⁴⁹ Over-pumping groundwater has caused the aquifer to compact and much of the land above to weaken, effectively sinking the land while sea levels threaten to rise higher. Its generally flat topography and the global trends towards increased rainfall in the wake of climate change have exacerbated Virginia's circumstance and forced them to take action because the effects of sea level rise are already present and constant. This explains the variation in Virginia's policy responses in comparison to other eastern coastal states.

What democratic party affiliation highlights is that states with greater levels of democratic party affiliation are much more likely to have some form of stringent policy action or

⁴⁸ Mejia, Skelley. *How the 2020 Election Changed the Electoral Map*. Five Thirty Eight 2020.

⁴⁹ Lohan, Tara. *The Revelator. Why Virginia Could Be a Leader on Sea-level Rise Solutions*. 2018.

progress being made. The unfortunate flip side of this is states with lesser populations with democratic party affiliations are unlikely to implement stringent policy action and mediating this gap will prove to be nearly impossible.

Conclusions:

Looking at these explanatory variables through what they suggest about how states are conducting risk assessments, we know that the default assessment is that each state along the Eastern coast is experiencing and will continue to experience severe threats to sea level rise. While in the case of Virginia they have outstanding circumstances that have motivated them to take on even more urgent policy action, most states (with the exception of Georgia) have begun to think about sea level rise and take it into consideration in their policymaking process. So regardless of the unchangeable size of the shoreline or high point elevation, most states by default have acknowledged the presence of sea level rise and are putting thought into the implications of this threat. If we consider the wealth explanatory variable we can see that the lack of relationship between wealth and sea level rise policy stringency is the ideal result. If achieving stringent sea level rise policy hinged on wealth, it would be unlikely that most coastal states of the U.S. would be able to implement an adequate sea level rise policy response. The relationship between wealth and stringency gives us hope that states will continue to invest in stringent sea level rise policy because the threat to coastal communities outweighs the monetary cost of aggressive policy response. Lastly, democratic party affiliation confirms the harsh reality that sea level rise is a highly politically charged subject. While states with high levels of democratic affiliation may not experience the pitfalls of this relationship, states who lean more

republican are likely to be left exposed to the consequences of sea level rise. Ultimately what this tells us is that we need to put more effort into depoliticizing climate change and all its associated complications. Increasing environmental education programs and outreach to teach communities about climate change from a purely scientific standpoint might help to bring about change in states with less democratic party affiliation. Using Virginia as an example, there is another possible avenue through which climate change may be depoliticized - through learned experience. Though Virginia is on the lower end of the spectrum of democratic party affiliation, they maintain the highest policy stringency because the risk posed to them from sea level rise becomes much more tangible when flooding from rains becomes more regular. The reality of climate change is that if it is not depoliticized now, those who are in opposition to acting or cannot afford to advocate for themselves and their communities, will become those most impacted by sea level rise, and by then the window for proactive action will have passed.

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