JCRFR

TU Delft OPEN

JOURNAL OF COASTAL AND RIVERINE FLOOD RISK

Vol. 3, 2024, 14

Adaptation to Flooding in St. Augustine, USA

Ezekiel I. Grant[1], Miguel Esteban [2], Onuki Motoharu [3], Gerasimos Voulgaris[4]

[1]zeke.grant@gmail.com, The University of Tokyo, Kashiwa, Japan
[2]esteban.fagan@gmail.com, Waseda University, Tokyo, Japan
[3]onuki@edu.k.u-tokyo.ac.jp, The University of Tokyo, Kashiwa, Japan
[4]voulgaris.gerasim.gp@u.tsukuba.ac.jp, The University of Tsukuba, Tsukuba, Japan

Research Article. **Submitted:** 1 December 2023, **Revised:** 31 July 2024. **Accepted** after double-anonymous review: 01 December 2024, **Published:** 16 December 2024.

DOI: https://doi.org/10.59490/jcrfr.2024.0014

Cite as: "Grant, E., Esteban, M., Motoharu, O., & Voulgaris, G. (2024). Adaptation to Flooding in St. Augustine, USA. Journal of Coastal and Riverine Flood Risk , 3. https://doi.org/10.59490/jcrfr.2024.0014"

Abstract

Sea level rise, often perceived as a future challenge, has already begun to impact low-lying communities globally due to the cumulative effect of gradually increasing water levels. This phenomenon is evident in numerous regions, including the United States, and is exemplified by the situation of St. Augustine, Florida. The city has not only contended with rising sea levels but has also suffered severe hurricane damage in the early 21st century. Understanding how communities navigate the complex process of adaptation or relocation is crucial. This study proposes a new framework to elucidate the individual experiences of those affected by climate change stressors. Notably, the emotional aspects of adaptation have been underexplored, prompting the authors to conduct a qualitative analysis. The investigation involved interviews with 20 individuals from two neighborhoods in St. Augustine, with a focus on understanding the influence of "eco-anxiety." The findings reveal that the city has implemented some adaptation measures at both individual and municipal levels. However, community-level strategies have been slow to materialize. While short-term adaptive measures may suffice, even if individuals remain unaware or deny long-term climate change, the sustainability of retroactive approaches for long-term adaptation remains uncertain.

Keywords

Flooding; sea level rise; USA, eco-anxiety

1 Introduction

Across the world, sea levels are rising due to compounded effects of climate change, so far mostly due to the thermal expansion of the oceans, although the melting of glaciers and poles is likely to become a bigger issue in the future, as highlighted in the 6th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC 6AR, 2021). Global sea level has risen by about 21-24 cm since 1880, with the rate of change increasing drastically over the last few decades (NCA 4 2018). This trend of increase is expected to continue, yet there is great uncertainty as to by how much. According

to the National Oceanic and Atmospheric Administration (NOAA) the global rate of rise between 2006 and 2015 was 3.6 mm/year (NOAA 2021, Lindsay 2021). However, not all areas around the globe are experiencing the same pace of sea level rise (SLR) and this difference can greatly affect the range of future projections. While the average predicted SLR for the United States up to 2050 is 25-30 cm, for the West Coast it is predicted to be just 0.1-0.2 m, increasing to 0.35-0.45 m for the Gulf Coast (Sweet et al. 2022). There are many reasons for this, including shifts in gravity from the relocation of large bodies of water, deformations in the crust of the Earth due to isostatic rebound, land subsidence from groundwater pumping and compaction of delta soils shifts in large ocean currents, and others (USGCRP, 2018, IPCC 6AR, 2021).

Regardless of the reasons, there has been a significant increase in the level of regular tidal flooding (i.e. that which occurs without being associated with a weather system), something referred to as "sunshine," "nuisance," or tidal flooding, particularly during spring tides (sometimes referred to as "king tides"), which are the highest high tides of a year. The number of such events has been increasing rapidly, as many communities get closer to their flooding threshold due to the rising seas. In the United States, 127 million people live in coastal communities, which make up only 10% of the total landmass of the country, although they represent a significant portion of the nation's economy. In just one of these communities, Charleston, South Carolina, with a population of just under 140,000, each flooding event costs the city an average of about $12 million (Johnson, 2018). In 2015 the city experienced 38 "sunshine flooding" events, which increased to 50 in 2016, with each year breaking the previous record (Sweet et al., 2016).

So far, many of the cities that have already begun work on this problem are either those with big budgets, such as New York City, or have had to apply for special projects through the United States Army Corp of Engineers (USACE) or the Federal Emergency Management Agency (FEMA) (USGCRP, 2018). However, as the problem grows, the latter may not be an option. Currently, according to Dahl et al. (2017) there are 91 communities among the 23 Atlantic and Gulf Coast states that are listed as Effectively Inundated Communities, categorized as any community where 10% or more of the land is inundated 26 times per year or more. Most of these (59) are in Louisiana. This number is expected to rise to 183-272 by 2060 under the intermediate scenario, as defined by the 4th United States National Climate Assessment of 2018, and 360 under their highest scenario. By 2100, these numbers are predicted to be 290-489 under the intermediate and 668 under the highest scenario (Dahl, 2017), assuming that no further adaptation measures such as sea walls, polders, or bulkheads are constructed. This represents a huge amount of land lost, people displaced, and economy interrupted. Just for Florida, one estimate puts the losses at $130 billion in property and displacement of 1.5 million people (Weiss et al. 2011). There are already many problems that these individual cities are experiencing in the form of friction with state and federal governments, causing a great deal of anxiety amongst residents.

Despite all of these pressures, cities are adapting. New York City is spending over $1 billion in its flood mitigation program (DuPuis and Greenberg 2019). New Orleans has long spent money creating, maintaining, and updating its dyke and levee system to protect against storm surges (Carter 2005). Miami Beach has raised whole sections of the city as well as building sea walls and pumps (Esteban et al., 2019). Retreat en masse seems like something that communities are loath to do, with very few examples in the United States outside of a few very small indigenous communities in Louisiana and Alaska (Ristroph 2019, USGCRP 2018). One reason why places are so willing to spend these enormous amounts of money and put in much time and effort is the attachment people have to their places and the political opposition to moving people out. Place attachment creates an emotional connection which, when broken by events such as being forced to move, can cause deep emotional distress and foster opposition (Fullilove 1996; Scannell and Gifford 2010).

Thus, as increasing numbers of communities experience the obvious impacts of climate change and its negative effects and are forced to adapt, eco-anxiety is increasing. Although there are various definitions in use and a number of similar and related terms, for the purpose of this paper, eco-anxiety will be defined as a significant negative feeling caused by the knowledge of, or direct experience with, the effects of climate change, including, but not limited to, anxiety, frustration, anger, fear, and hopelessness. A number of qualities can mark individuals as being vulnerable to eco-anxiety, including being forced to move or experiencing damage due to the effects of SLR and flooding (Coffey et al. 2021). This anxiety is also increasingly being recognized as not just coming from direct experience, but also being related to increased knowledge about climate change and its potential effects on the future (Clayton and Karazsia, 2020). As the effects of climate change and the need for adaptation increase, the study of eco-anxiety becomes more important, not only for understanding the health effects involved in it, but also to help explain how it influences the abilities and willingness of individuals and their communities to adapt.

There are various questionnaire methods linked to measuring climate anxiety in psychology. (Clayton and Karazsia, 2020; Agoston et al. 2022; Innocenti et al. 2021). Stress from the perception of ecological problems has been shown to have a strong association with depression or the symptoms of depression (Helm et al. 2018). Other work has attempted to use questionnaires to determine how worry about climate change affects relationships or the ability to complete work using a climate change distress scale with two subscales, anxiety and hopelessness, finding a link with these and symptoms of depression, anxiety, and stress (Boluda-verdu et al. 2022). Many works before this did not seem to differentiate between the negative emotions associated with climate anxiety. However, a newly developed scale has been used to examine three eco-emotions: eco-anxiety, eco-depression and eco-anger, finding that eco-anxiety was associated with symptoms of anxiety and stress, and less engagement in collective action (Coffey et al. 2021). Some studies have suggested that climate anxiety can be either adaptive or maladaptive, depending on the surrounding factors (Taylor 2020). Maladaptation in physical responses has been noted in literature on climate change adaptation. For instance, Jamero et al. (2018) report how as a consequence to higher water levels residents of small islands in the Philippines initially responded by elevating the level of the floor in their houses using coral stones, a maladaptive approach that could hurt their livelihoods as fishermen, and which subsequently changed to a better adaptation response when the municipal authorities started supplying them from stones from the mountains nearby. This has important implications for how cities, communities, and individuals adapt now and in the future to climate change. Extending this idea to eco-emotion and the responses it might cause we can imagine eco-anger at the perception that the local government is not helping enough or is engaged in corruption exacerbating the problem as experienced by residence either leading to more personal and community based activities if they have enough personal resources or if their community has enough infrastructure which could be viewed as adaptive or manifesting as a distrust in government causing them to ignore storm warning and evacuation orders which could be perceived as maladaptive.

A review study on eco-anxiety found that studies so far have examined it only using quantitative methods, with a call for future research to employ qualitative methods to add more nuance to the understanding of the complexities at work (Coffey et al. 2021). Essentially, past research in psychology has focused on whether emotions about climate change were positive or negative, but there is limited literature available on the nuances of specific emotions (anger vs sadness, obliviousness vs hopefulness, see Stanley et al. 2021). Similar results have been found in the field of environmental education, with studies looking at whether increases in awareness were associated with positive or negative emotional responses (Pihkala 2020). It is important to distinguish between adaptive and maladaptive levels of anxiety. There has been some work examining the effect that migration has on climate anxiety, but not what effect climate anxiety has on migration. There is also a growing body of work on the indirect climate anxiety caused by media (Crandon et al. 2022, Maran and Bagotti 2021, Ojala et al. 2021, Whitmarsh et al. 2022). While media coverage likely has an effect, the area that will be the target of this study (namely the city of St. Augustine in the ISA) is in fact directly affected by climate change through increased tidal flooding caused by SLR, and storms, and has already taken some measures to adapt (as will be explained later).

The work described above emphasizes the need to mitigate anxiety by scientifically-based climate activism rather than by denying, dismissing, or discounting the threat posed by climate change. Adaptive anxiety could motivate climate activism, if correctly channeled. However, one of the challenges resides in how to find ways of countering anxious passivity and defeatism, meaning that people distressed about the possible consequences of climate change may feel helpless about their ability to do anything about it. This could lead them to deny, dismiss, or trivialize the climate problem, as a means of coping with climate anxiety. A study in Samoa indicates that when faced with too much of a perceived future threat, communities appear less able to foresee a path when compared to more "manageable" scenarios of SLR (Crichton et al. 2020).

Higginbotham et al. (2014) described a model in which the responses to climate change start with experiences, which could be both direct and indirect. The experiences individuals may have had then lead to threat and coping appraisals, together with an emotional response, which may in turn lead to problem-solving, self-protection, and an emotional expression. The connection from a perceived threat to taking climate action would be based partly on assessments of their own ability to cope with the threat, which could be described as "(climate) self-efficacy". This self-efficacy has been shown to be an important predictor of behavior (Clayton 2020). The factors which increase, decrease, or alter the impact of experience, and the context in which different emotions arise is still not understood well enough for quantification. Additionally, work dealing with emotions and qualitative work is well suited to describing the nuance and socio-cultural circumstances. For many of the residents, their experiences are best captured through stories which allows them to express

their emotions rather than a survey or other more quantitative tool which may put their ideas and responses in a more clinical mindset.

This study focuses on the lived experiences of disaster and adaptation of residents in two neighborhoods of St. Augustine, Florida, a small city at the forefront of the problem of sea level rise and work to adapt to it on the Atlantic coast of the United States. Essentially, the authors postulate that the feelings (including eco-anxiety) of those affected by climate change may be more important than having a very detailed knowledge about it, and that these feelings can help people to take appropriate adaptation action. Essentially, the feelings of people are often ignored in research, although these are key in explaining their actions on how they are adapting, which further emphasizes the need for a qualitative approach. Thus, in order to address this problem, the authors conducted qualitative research through detailed interviews, which shed some light on the feelings of residents and eco-anxiety. Such results are then discussed, and how people's feelings may lead them to take better adaptation actions.

2 Study area, methodology, and framework

2.1 Study area

The study was conducted in two different neighborhoods of St. Augustine (see Figure 1). The two neighborhoods, although very close geographically, have a number of differences that are caused by several factors. St. Augustine has a long history (for an American town), and is the oldest continuously occupied European-founded city in the continental United States, founded in 1565 with a Spanish mission. Partly due to this lengthy history, and partly due to its proximity to beautiful beaches and its natural scenery, the city has also been a tourist destination.

Figure 1. Overview of study area and locations of interest. Basemap source: Google (2022)

One of the neighborhoods, Lincolnville, is adjacent to and part of the historic part of the city, and thus has a long and complex past. It became the residence for freed slaves after the American Civil War and was considered a black neighborhood until fairly recently. As a consequence, it has strong connections with the Civil Rights movement due in part to a visit by Dr. Martin Luther King Jr. Davis Shores, on the other hand, is on the Anastasia Island portion of the city with more direct connections to the beaches. It has a much shorter residential history. Initial development took place during the 1920s and construction of many of the buildings occurred during the boom after World War Two and continued through to the 1970s and 1980s. This historical contrast also brings up a physical distinction. The two neighborhoods are separated by the Matanzas inlet and connected by the Bridge of Lions. On the mainland side sit many of the historical attractions for which St. Augustine is known, including the Castillo de San Marcos, St. George Street, Flagler College, and the site of the Nombre de Dios mission, to name a few, while the only major historic site on the Anastasia Island side is the St. Augustine Lighthouse. Although Lincolnville and the rest of the historic section are generally at a lower elevation and more affected by tidal flooding, Davis Shores has suffered much greater damage after the several hurricanes which have hit it since 2016.

The city has a historic seawall located on the west bank of the intercoastal waterway around the Bridge of Lions, constructed between 1695 and 1705, which was constructed between the Castle of San Marcos and the Plaza between 1695 and 1705 (see Figures 2 and 3). This structure lasted over a century, but had significantly deteriorated by 1821, and a new one was built between the 1830s and 1840s. The area around the seawall suffered considerable flooding caused by Tropical Storm Fay in 2008 and, eventually, a section of the structure collapsed during Tropical Storm Gabrielle in 2011. Construction of a new seawall commenced in 2014 (see Figure 2a and b). Hurricanes Matthew (2016) and Irma (2017) also resulted in significant flooding (Beach, 2018) and damaged some sewage control systems, shown in Figure 2c. The city currently experiences tidal or “nuisance flooding” 12-16 days per year during high spring tides, also known as “King Tides” (City of St. Augustine, 2018). This has resulted in a number of problems, including damage to residences and historic buildings, the erosion of roads, and overflow of sewage systems. The city has responded with a number of plans for countermeasures, including the Davis Shores Tide Check Valves, Macaris Stormwater Outfall Resiliency Retrofit, Master Stormwater Outfall Resiliency Retrofit Plan, and the Lake Maria Sanchez Flood Mitigation and Drainage Improvement Project. These plans involve completing a new sea wall to encompass a designated area of the historic downtown with a drainage lake in the middle, and replacing flapper valve outflow pipes with duckbill valve outflows (Beach, 2018) (Figures 2d-g). These countermeasures have had some success reducing the extent of flooding events (Beach, 2018), and there are also plans to raise the control boxes for sewage systems to reduce failure during future flood events. Despite these successes, there are a number of challenges that must still be overcome, including the approval of guidelines for historic sites, coverage of areas outside of the historic downtown, the cost of solutions, and political and public resistance to acknowledge the problems being caused by “sunshine flooding”.

Figure 2. a) New seawall built in 2014 (showing also the old seawall from the 19th century). b) A section of seawall not yet updated. c) A sewage control box which failed when flooded during hurricane Matthew. d) Reinforced walls of drainage lake. e) Site of overflow control for drainage lake, which is slated to be upgraded. f) Previously used flapper outflow. g) Duck bill valve (replacing earlier flapper valves)

Figure 3. Map of study area with areas of interest from Figure 2.

2.2 Interviews

Fifteen semi-structured interviews were conducted with 19 residents of the two neighborhoods of St. Augustine between May 15th and June 3rd of 2022 (some of the interviews included more than one interviewee, see Table 1). Of these, 5 interviews with 8 interviewees were conducted in the Lincolnville neighborhood, and 10 interviews with 11 interviewees in Davis Shores.

Semi-structured interviews were chosen, as explained earlier, given that Coffey et al. (2021) in their review of eco-anxiety found that studies so far have examined it only using quantitative methods, emphasizing the need for qualitative methods to add more nuance to the understanding of the complexities at work. Also, the topic of climate change is politically charged in the United States, and even mention of it can cause the end of a conversation with some people. In addition, the authors wanted the freedom to follow up on information that may have been outside of their knowledge at the outset of the conversation, but pertinent to the topic. Participants were selected via snowball sampling, with early participants (who were identified by a contact within the city government, a member of a local church and two business owners known to the lead author of the study) asked to suggest others within the community who would be willing and able to talk about the subjects of flooding and community life. This was important given the reticence to talk about issues of climate change, as indicated previously.

Each respondent was asked to either begin with their story of flooding and/or community in St. Augustine or respond to a series of 25 questions, plus several optional ones, including some basic information about the respondent and where they lived, questions about the neighborhood, flooding, and adaptation to it. A full list of these lead questions can be found in Appendix A. Follow up questions about the neighborhood dealt with both its physical and social aspects, its uniqueness to the residents, and their connection to it. Additional questions about the flooding were aimed to clarify about the high tide flooding and experience with hurricanes, and what kind of damage the flooding causes. Questions on

adaptation covered physical countermeasures, such as raising building and building sea walls, as well as social changes, such as migration or changes to daily life. After a few interviews, some of the questions were dropped as they appeared to be confusing to interviewees or were redundant. The respondents spoke mostly in terms of the triggers of the flooding, such as high tides, winds, and storms and thus the interviewer decided to drop the question regarding frequency as it appeared to be producing redundant answers. Another such pairing was the question of future plans for the city or neighborhood versus hypothetical plans if money was not an issue. As the interviewees tended to provide similar answers to both questions, the two were combined into the hypothetical.

Eco-anxiety cannot, obviously, be accurately measured, particularly through the use of qualitative interviews. To obtain some indication of such levels, the authors carefully transcribed the interviews (all of which were recorded), and annotated any words indicative of emotions that were connected through the narratives to action or inaction to adaptation, and such an analysis will be later described in the results. It should be noted that it can be difficult to separate the eco-anxiety resulting from education, frequent experiences and media exposure from a general increase in climate risk and disaster awareness (and there is much evidence that risk awareness about natural hazards in general has been increasing in recent times, see Esteban et al., 2016, 2018, Valenzuela et al., 2020). While it is impossible for the authors to completely remove all such influence, during the interviews emphasis was added to attempt to obtain answers based on the direct experiences of the interviewees related to flooding and adaptation.

Additionally, there was a meeting with several city officials and review of city documents related to SLR and flooding adaptation planning which was not included in the analysis with the resident interviews, but is relevant to and informs interpretations.

Table 1. Summary information of interviewees

Number	Gender	Area	Age	Home Status	Income Level	Hazard Level
1	F	Lincolnville	50-64	Owner	Medium	High
2	M	Davis Shores	35-49	Owner	High	Medium
3	F	Davis Shores	35-49	Renter	Low	High
4	M	Davis Shores	65+	Owner	High	Low
5	F	Davis Shores	35-49	Owner	Medium	High
6	M	Lincolnville	50-64	Owner	High	Low
7	F	Lincolnville	50-64	Owner	High	Low
8	M	Lincolnville	65+	Owner	High	Low
9	F	Lincolnville	50-64	Owner	High	Low
10	M	Davis Shores	65+	Owner	High	Medium
11	F	Davis Shores	65+	Owner	Medium	High
12	M	Davis Shores	65+	Owner	Medium	High
13	F	Davis Shores	50-64	Owner	Medium	High
14	M	Lincolnville	35-49	Renter	Medium	Medium
15	M	Davis Shores	18-34	Renter	Low	Medium
16	F	Davis Shores	50-64	Owner	Medium	Medium
17	F	Lincolnville	65+	Owner	Low	Medium
18	F	Lincolnville	65+	Owner	Low	Medium
19	F	Davis Shores	35-49	Renter	Low	High

2.3 Framework

The present research uses a model for interpreting adaptation to climate change, including abandonment or migration, modified from Gibbons et al. (2006), which looks at the historical abandonment of Holland Island in the Chesapeake Bay of the United States. It adds the role of the community, institutions, and eco-anxiety from external predictions and experience as forces which can affect the outcome of adaptation choices and actions made by individuals on their own and communities as a whole. Recent work on eco-emotion coming from both lived experiences and external predictions, such as that by Stanley et al. (2021), raises questions of how these emotions relate to both individual and collective actions. As many communities along the Atlantic coast of the United States are dealing with these problems, sometimes without any state or federal coordination, it is important to investigate the interaction among individuals, communities such as neighborhoods, and city governments. Although Holland Island was a different scenario in many ways, it

represents the least desired outcome for a community, to be abandoned, and by modeling what process can lead to abandonment, it allows the planning of avoiding that outcome.

The framework shown in Figure 4 indicates how people in a given area would be affected by climate change, which would manifest itself as an increase in the intensity of storms (and consequent flooding due to rainfall or storm surges) and overall SLR which would lead to salt water intrusion, the conversion of wetlands, erosion, and tidal flooding. This would in turn lead to increased risks and a decrease in safety, or to increase financial costs that would have an impact on personal economics, hence also impacting households and the wider community within a city. Also, it can lead to a decrease in the availability of resources, which can affect the capacity of a community to adapt (with this capacity also being majorly influenced by institutions). These direct experiences with climate change impacts, together with the contribution of news broadcasts, both from places around the planet and the areas themselves, and predictions by scientists, would lead to eco-anxiety, manifested through various emotions. These emotions of eco anxiety would directly impact the adaptation strategies that would be implemented, be they in situ adaptation or relocation (internally or externally). The result of the adaptation strategies implemented could result in a stable community, or lead to its abandonment or collapse. It should be noted that there are, obviously, other factors outside of climate that can affect the stability of a coastal community, such as war or force majeure events (including for instance massive tsunamis). As with any model, the reality is always far more complex than the linear relationship shown, though nevertheless the proposed model is arguably an improvement over that introduced by Gibbons et al. (2006).

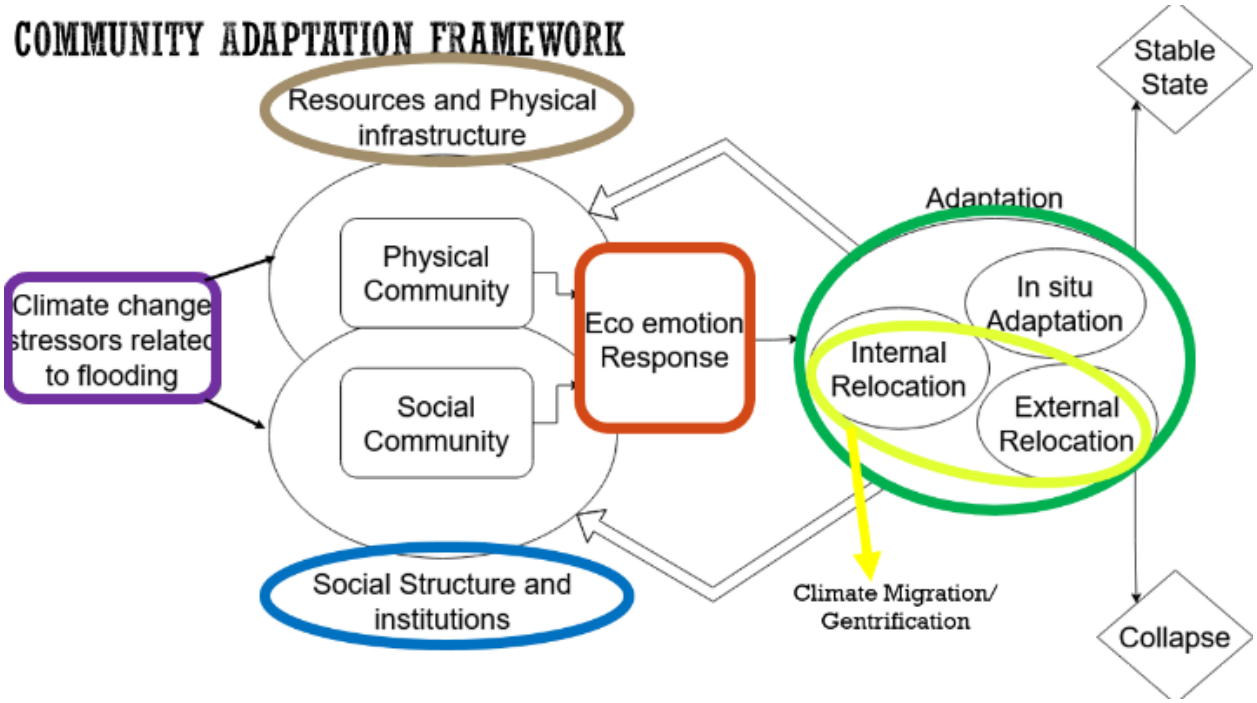

Figure 4. Framework used in the present study (proposed by the authors based on Gibbons et al., 2006).

3 Results

3.1 Past experiences with flooding

Some interviewees from Davis Shores spoke of past experiences with flooding, which reached a height of 2 or 3 feet (0.6 -0.9 m) within their homes. One interviewee in Lincolnville expressed that:

> *"King street floods, bridge (street) is one flood. And inside you go to Kuba street is a flood problem. You can't really go anywhere. We can walk into town. We don't have to, we don't have to go anywhere unless, you know, unless we have a doctor appointment or something, grocery store can wait to water retreat, you*

know. So I mean, it's a nuisance and I can see how it's worse for a lot of other people that need to go to work."

However, none of the Lincolnville residents which were interviewed for this study had experienced flooding within their homes in the past, which was attributed to greater attention given to the mainland portion of the city by local government. One resident felt that, "We pay taxes here (in Davis Shores) as part of the Historic District, but what they do with those taxes stops at the Bridge of Lions". Several other interviewees expressed similar thoughts, although this feeling was not universal. One resident had nothing but praise about the city and its effort towards residents, regardless of location.

Because of the greater impact of the storms in the Davis Shores, several residents expressed feelings of fear when hurricane season begins:

"I don't mess around when it comes to hurricanes anymore, not after Matthew. I learned the hard way. So when a real hurricane like Irma was coming, I made sure to bring all my belongings up at least three feet high. I have PTSD from the experience because I always worry about what if it's worse than before. I also get lots of sandbags and tape and calk the outside of my door."

3.2 Community

There seemed to be a difference in the interaction which people had with their neighbors in the two areas. In Lincolnville, many of the interviewees spoke of interactions between them and their neighbors occurring on or involving front porches. Houses in Lincolnville have very small front yards with porches which are close enough to the street, where it is easy to talk casually between someone on a porch and someone on the street. If they have parking space, it is often located to the side of the house. Most residents viewed this as a positive feature, adding to the closeness and friendliness of the community. In Davis Shores, houses typically have larger front yards. The parking is more often in front of the house and, if there are porches, they are set further back from the street. Residents reported that interactions with neighbors resulted more from walks through the neighborhood, either for exercise or for pets.

Many spoke positively about their communities, and the greater St. Augustine community. Overall, interviewees stated that their neighbors were friendly and welcoming. In both neighborhoods, residents told stories of how the community pulled together to rebuild after each storm. One resident spoke of how his business was only able to reopen because residents of Davis Shores came and helped clean and repair after Hurricane Matthew. Other residents, of both neighborhoods, mentioned people and businesses whose buildings were less affected by the storms offering hot meals to those who were toiling to rebuild. Several residents, who were not native to the area, reported finding the feeling of St. Augustine to be unique. Two sets of residents of Lincolnville in particular spoke about visiting St. Augustine on vacation and falling in love with this feeling, to the point that they felt compelled to move there.

"We moved here after coming to visit. People were just so friendly… When we moved here people were still so nice. Our neighbors who we just met helped us move boxes… Now we try to pay that attitude forward."

One unique interviewee was a longtime resident of Lincolnville. She felt that the black community had been pushed out through the process of gentrification through the 1980-2000s. She was the only resident to speak of the community with tones of fear, specifically mentioning that she worried for her safety and that this might negatively impact her ability to survive a storm as "no one from this community is going to check on me if I get into trouble with a storm."

"No one from this community is going to check on me if I get into trouble with a storm…. So I've been dealing with that for the last few years. It's gotten worse because you got people who are Airbnb and I've fought, you know, I've called code enforcement. I called police. They don't care because they don't live here. And then the police say, well, there's nothing we can do. We gotta catch 'em. So I started taking pictures so I can just, you know, I don't go out because as a black woman, I feel, believe it or not, and I know this is gonna sound weird. I feel in danger…. because my community is gone."

3.3 Adaptation countermeasures taken

3.3.1 Individual action

Individual action came down to responses to one of two problems: tidal flooding or preventing damage from the flooding and storm surges generated by hurricanes. Importantly, such responses were sharply divided between the neighborhoods; people in Davis Shores overwhelmingly talked more about the flooding of storm surges from hurricanes while people of Lincolnville were more concerned and affected by tidal flooding. It is worth mentioning that the historic style of many homes in the Lincolnville area is to build the houses about 3 feet above the ground whereas; until recently, most homes in the Davis Shores have foundations that are flat on the ground (see Figure 5). Although Lincolnville residents mentioned the storms as problems, none of them spoke about needing to improve the countermeasures for their houses. The problems they spoke about had more to do with long term climate trends, the difficulties caused by the frequent tidal flooding and flooding after minor storms, and having to navigate around certain areas or being unable to leave their neighborhood for fear of the salt water damaging their vehicles. Several interviewees mentioned the problem of increased use of concrete creating impermeable surfaces, increasing the flooding problem.

Figure 5. Left. House typical of Davis Shores area. The porch covers a relatively small area in the front, the house is set back roughly 15 meters from the road, and the foundation sits directly on the ground. Right. House typical of Lincolnville neighborhood. The porch stretches the length of the front with room for sitting, the house is set back 5 meters from the street, and the foundation of the house is raised on stilts. Photo from Google Street View with permission of owner.

3.3.2 Communal action

Many residents stated that they were not part of any community groups, although most were aware of neighborhood groups. Only two male residents identified themselves as having been part of organized community groups. One had been a part of a business owners' organization for Anastasia Island, but had withdrawn as he perceived his participation as being pointless due to the lack of interest on the part of city government for the input of business owners connected to Davis Shores and the island. He said,

> *"We're part of that historical district and we're under their laws and regulations, but we get cut off at the Bridge of Lions. Ah, so let's say everyone downtown can have an outside beverage for the 4th of July. Well, they block the line off there at the bridge, but we're still part of that tax bracket that gets charged for being able to do so. We have to pay for downtown services. We have to pay for the electronic, mechanical trash compactors that they have in the street or the street sweepers that only do downtown. They have pressure washers that do just downtown. So trying to fight them to get things done over here was going in the wrong direction. They wanted to add parking. They wanted to split the street here and add parking in the center of the streets, going down to one lane. If you look outside right now, you can see why that's a really, really bad idea."*

This individual was the most vocally and specifically critical of the city and their management of growth. The other person who was engaged in community groups was an active member of a local church group, and additionally volunteered to help with an unassociated homeless shelter. He expressed that this connection and the care that he put into

the city made him feel more connected. Interestingly, although these two residents both had advanced university degrees, they openly expressed skepticism at the idea of anthropogenic climate change, yet had undertaken the most effort to implement personal adaptation, in terms of upgrades and construction to their properties. Other residents expressed a desire for more communal action and participation in the process with the government, but also expressed frustration with how interactions with the government, particularly city meetings, happen and a lack of ideas about what could be done to make it better. A number of interviewees, however, were very clear that they wanted more direct communication. Two in particular said that what they wanted is not to feel like the city is passively updating them by having meetings that are hidden or conducted badly just to be done, but want to feel that the city is actively keeping them informed and connected.

> *"Because of the political will to deny that climate change even exists, and the inability for people to get elected every four years to have a long-term view, it's hard for them to develop a 30-year plan for a city or state. We have complications in our country that are different from countries like Denmark, with multiple jurisdictions, politics, and economics. It becomes sometimes so hard that it's impossible to accomplish. That's where we're at, and so we'll have to let Mother Nature tell us what's going to happen. … I've tried to stay away from organizations."*

3.4 Emotion and experience

As indicated earlier, the interviews were carefully transcribed to find any words indicative of emotions that were connected through the narratives to action or inaction to adaptation. In that sense, interviewees provided information relating to feelings in a variety of ways. Two of particular interest to the questions of migration specifically mentioned feelings of Post-Traumatic Stress Disorder (PTSD) associated with storm seasons or news of storms after their experiences with Hurricane Matthew. One was a lifelong resident of the Davis Shores. She spoke of the shock of experiencing two storms in such a short span of time (Hurricane Irma hit nearly one year after Hurricane Matthew), when her perception was that the last storm to hit with such destruction was in the 1960s. She has since relocated outside of the official city limits, although still within the greater St. Augustine area, due to the storms. She mentioned that, when looking for a new house, she paid greater attention to elevation and flood zones and also mentioned that this information was not freely given by realtors and was difficult to obtain. Despite the trauma, she said that she would never want to leave St. Augustine:

> *"When I see it (hurricane warnings), it causes traumatic stress disorder. When I see flooding scenes of flooding in other areas, no matter where it is, yeah. I just get this, I don't know, makes my heart race. It makes me anxious. And all I can think about is those poor people, all I can think about is you've lost."*

The other who mentioned PTSD also expressed a desire to leave the Davis Shores, but was not currently able to for financial reasons. She similarly expressed that although she came to St. Augustine in high school, it was the first place that ever felt like home and that she would not choose to leave the city, and seek merely to relocate away from the areas of greater risk, hoping to eventually find a place outside of the flood zones.

Questions of what residents would like to see done brought responses of confusion and uncertainty, particularly when directed at the question of flooding. Many had no idea what could be done to alleviate the flooding to the neighborhoods, as a whole outside of the countermeasures currently being implemented. A few brought up sea walls and drainage systems. Others mentioned the idea of gates to block water from coming into the inlet. Two brought up the use of pumps to be used during high tides that coincide with storms. One particular question provoked worry and anxiety in most residents. When asked what they thought would happen to the city if some of the higher projections for SLR by 2100 were to come to pass, many residents seemed to think that the city would not be able to survive without drastic adaptation action being implemented, highlighting the anxiety felt.

3.5. Problems identified, inequity and environmental justice

Many residents felt that there was a lack of information being given to residents when moving into new houses, and that this was particularly problematic in St. Augustine and the surrounding areas, as there is such a high rate of new residents. Even some longtime residents expressed surprise that there was not a requirement to inform people that they were moving into a flood zone, or that efforts were made to increase awareness of the implications of moving into such

places. Additionally, many residents felt that there was a lack of forthright information on what the city is doing to combat flooding and what its plans for the future are. Almost every single interviewee expressed an interest in being more included in the planning, both because they felt that that would increase diverse representation of interests and as residents may have valuable input on how problems could be solved.

Although the interviewees of Lincolnville barely spoke of Davis Shores at all, most residents of Davis Shores spoke of downtown, with a majority mentioning the idea that the city government disproportionally considers the safety and protection of downtown areas over Davis Shores areas. Many connected this with the idea that the downtown area is the economic engine of the city, given that it generates much tourism. Many from the Davis Shores area spoke of their neighborhood as being the place where families and young people live, with downtown being seen as an area of investors.

Many residents, particularly of Davis Shores, felt that the city needed to focus more energy on fixing and maintaining some of the flood protection measures already in place, such as cleaning drainage outflows of oysters and debris, and widening drainage ditches. However, it should be noted that one resident felt that the city did an excellent job, and while many were critical of the city, they did acknowledge that it may be doing a better job than most and that maintenance is a problem everywhere as it is not as exciting as building new things.

Insurance was frequently cited by respondents as something that could either increase or alleviate anxiety, depending on a few factors. The perception of it not being consistently applied was expressed as a source of anxiety, and this made it hard to know whether the respondent is adequately preparing for future disasters. A lack of transparency was viewed in much the same way. Certain kinds of insurance associated with storms not being mandatory was seen as a problem, particularly as new residents may suffer as a result. Some expressed anxiety over the fact that possessions that might be damaged would not be covered by insurance, causing an undue burden on lower income residents. Renters spoke of not being fully covered by insurances and losing significant value due to storms. Some home owners within the Davis Shores described situations in which others were more inclined or felt forced by circumstances to sell properties because receiving the full reimbursement for the work to rebuild took longer than they could afford. This is a clear disservice to the disadvantaged and in some ways may have helped jump start gentrification and home price increases in the area.

3.6. Disappearing community, uncontrolled growth and gentrification

Almost every single resident spoke of the problem of uncontrolled growth in St. Augustine. Many spoke of it in terms of traffic, while others mentioned building practices and increased risk from the expanding population. Many residents spoke of the gentrification of parts of the city and a few indicated that this could result in the destruction of the community with one respondent, a black lifelong Lincolnville resident, speaking in terms of it being purposefully done in the past and being done purposefully again. Many residents spoke of it in terms of the difficulty of families and people of middle to lower income being unable to afford to live in the area, due to a combination of depressed wages and soaring rents, but some also expressed fear of public assisted housing and what that might do to the area.

As reported by one longtime resident of Lincolnville, the black community there disappeared in stages. First, a lack of solidarity allowed homes of long-standing families to be bought which eroded the cohesion of the community. Then, services such as grocery stores, meeting places, and home goods disappeared. With the loss of services, families with children left for places that could serve them. This possibly mirrors what is happening in Davis Shores as businesses catering to locals disappear, some mentioned that there used to be grocery stores in walking distance that have disappeared, in favor of places catering to tourists which have prices that are not attainable with local salaries. This disappearance of people followed by services and community function also seems to align somewhat with the historic disappearance of islands in the Chesapeake Bay, particularly as reported about Holland Island in the early 20th century (Gibbons et al. 2006).

However, it should be noted that in these cases (the disappearance of the black community in Lincolnville and current gentrification processes), the communities that disappeared were/are being replaced with new ones. These communities often do not have the wisdom of long experience that the communities they replaced may have had as regards to how to respond to their environment. What remains to be seen is how whatever communities exist now or in the future will adapt to sea level rise and other climate stressors, and how eco-anxiety will inform such processes (and whether it will lead to a sustainable future community or the abandonment of the neighborhood).

3.7. Place attachment

When asked what is special about their neighborhood and St. Augustine, very few people talked about the physical features of the city, such as specific historic sites and locations. Contrary to some of the literature on place attachment (Giuliani 2003, Hidalgo et al. 2001, Lewicka 2011) most people identified with the city of St. Augustine rather than their individual neighborhoods. In line with much of that same literature, the majority of the talk about people's connection centered on social rather than physical aspects. A few of the interviewees mentioned that the sense of history of St. Augustine was important to them, and several in Lincolnville spoke of the importance of maintaining a sense of history and how it gave them a feeling of "stewardship," as one interviewee in particular put it of their house, rather than a true ownership. However, despite the nature of St. Augustine as a tourist destination, famous for its beaches and historic locations, most people spoke more of the importance of a certain feel to their neighborhoods. People spoke of a sense of safety, kindness, and generosity of the people in their area as an important reason that they may have moved there to begin with and reason to stay.

In all areas, the closeness in the community and the ways in which members interact with each other was an important reason to stay in the place they are in, despite the perceived inconveniences or even danger. Members seemed more likely to participate in recovery efforts after the worst effects of flooding as there was a perception of reciprocation if they were the victims of extreme events and also of kindness during less intense pressures, which likely offset anxiety somewhat.

4 Discussion

4.1 Community is an important reason for people to stay

Every single respondent answered in some way about the unique qualities of St. Augustine, even though they may have different ideas of what those are, and that these were a reason to stay. Several responded that a perceived change in the community, whether it be a political, demographic, or economic would constitute important reasons to leave the community, more than the inconveniences of tidal flooding or the difficulties of recent tropical storm activity (this general reticence of people to leave an area is in line with anecdotal evidence of other communities elsewhere (Takagi et al., 2021; Esteban et al, 2019; Jamero et al., 2018). To make clear, people may be forced by the economic circumstances of a storm to leave, but the fear of the storms does not seem to be a reason for most to leave, though they may be more prone to move within the greater community area to somewhere less prone to the effects of the storms. Climate gentrification, the process by which poor residents are forced out of their neighborhood by difficulties created by climate change, in this case tidal flooding, to be replaced by those with more financial means that can increase their resilience, may be a particular risk to places like St. Augustine. Gentrification is something that worries many communities, but in a place like St. Augustine where it is still economically desirable to buy houses due to tourism and the local charm, but also people are leaving due to the economic stress of dealing with storms and increased prices, it takes on a slightly different character. As communication within the community is an important part of mitigating the effects of storms through sharing of best practices, the breakdown of this communication poses the potential of increasing the overall risk to the area. Additionally, if there are more vacation properties, there are fewer actual hands on-site to help with rebuilding and community members supporting each other after storms, which several interviewees spoke of as essential for recovery. A lack of support, such as insufficient insurance response or uncertainty about it, could make economically imperiled residents more likely to leave individual neighborhoods or the city as a whole, speeding up this process where policies to support them could slow it down.

4.2 Effectiveness of individual vs collective action and adaptation

Individual action is an important aspect of adaptation to SLR and this could be seen in the case of St. Augustine. Although none of the respondents have raised their own homes, many have spoken of neighbors doing so in an effort to rise above the next flood. Additionally, all members of the Davis Shores neighborhood spoke of taking some temporary measures, such as using particular types of tape to use when sealing windows and doorways against rising water during storms and using sandbags, provided by the city, to redirect water.

These are important, but many people spoke more passionately about the effects of the communal action in recovery after disasters, rather than individual action. Their description of recovery efforts centered on the collaboration with insurance companies, construction companies, and interactions with neighbors, in contraposition to preparatory actions, where collective action seemed to factor little into preparatory actions outside of information sharing on best practices. Could harnessing community action in preparation increase St. Augustine's resiliency?

The interviews hint that there is a connection between social infrastructure and social safety nets and how an individual reacts to triggers for eco-anxiety. More support from these systems may be the cause of less negative reactions in individuals experiencing eco-anxiety. Because of this, government programs or policies which increase the social safety net or, maybe more importantly in small towns because of their smaller resource pools compared to cities, encourage the formation and strengthening of social infrastructure may reduce the negative effects of eco-anxiety, increasing the resilience to sea level rise exacerbated flooding.

4.3 Is climate change denial an adaptive or maladaptive trait?

Knowledge of climate change may be important for effective adaptation and for spurring pro-mitigation action, although there may be something useful in a certain cognitive dissonance in denying climate change.

The two respondents who showed the most proactive adaptive action were the two who were most vocally skeptical of climate change, as stated earlier in section 3.3.2. These two had a number of common and different traits. Both had an engineering background, which may speak to both their proficiency and financial capability. Both had engaged in community efforts at one point, although one left a more formal or official type of engagement from feelings of frustration while the other felt empowered by such activities. These feelings extended to their views on the city, with one expressing frustration with the city's actions and the other speaking of what an effective job the city was doing. When asked about a theoretical rise of 1 m - 2 m SLR, most other respondents were dubious as to whether the city could survive, but these two, though skeptical of the premise, thought that it would be possible given enough work and time.

Such evidence indicates that the ability to adapt may not rely so much on actual knowledge about climate change, but rather the ingenuity and technical expertise of individuals and their wider communities in conjunction with a belief that solutions are possible. This has also been shown elsewhere, and in the Philippines, for instance, even impoverished communities in small islands have been able to adapt to frequent tidal flooding brought about by land subsidence (Jamero et al., 2017), highlighting how adaptation to slower SLR process is possible. Nevertheless, there is the risk that some practices may be maladaptive, in the sense that they may solve immediate problems but make future adaptation more difficult (Jamero et al., 2018). In that sense, it would appear that having knowledge about climate change and SLR process are likely to result in a more optimized adaptation process, with measures taken progressively over time.

4.4 Eco-anxiety as a trigger for adaptive action (or inaction)

Different kinds of emotions can lead to different outcomes of adaptation (as seen in the community workshops conducted by Crichton et al., 2020, in Samoa). The feeling of hopelessness can lead to inaction, where a problem that is perceived as solvable can trigger a more positive adaptation stance (Crichton et al., 2020). In the present research, the authors found that different responses can be seen in conjunction with various emotions of eco-anxiety, including inaction and individual action. However, community coordinated adaptation (with community here meaning smaller, self-identifying groups within the city) could not be seen in action, but more as a desire that individuals would like to see happen (although note that, as shown in Figure 2, the city is taking some adaptation action). Essentially, individuals would like to see more coordination.

When talking about their past experiences with flooding, individuals generally manifested emotions related to stress, worry, hopelessness, and frustration. When talking about community action, individuals expressed hope that future action addressing the slower effects of sea level rise would be done better (remembering the positive example of past experiences with storms), but expressing frustration with the level of community action and the interaction between communities and city government. Again, such frustration leads to stress, fear, and a detachment from being involved in community action. This highlights how, while eco-anxiety can make individuals understand the need for climate adaptation to take place, a feeling of frustration at the community, or wider city level, can lead to them thinking that the problems are unsolvable.

Such findings are similar to those in Crichton et al. (2020), where communities that thought problems were solvable were more positive about their capacity to adapt than when they felt the problems were unsurmountable.

5 Conclusions

SLR is not a problem for the future, but rather communities around the planet are already having to adapt to it and climate change, and this is evident in the case of St. Augustine, which is already increasingly suffering from regular tidal flooding due to its low-lying elevation.

It is important to understand the feelings of those affected by climate change and the effects of tidal flooding due to ongoing SLR to be able to encourage appropriate adaptation action. This is particularly the case in a country such as the USA, which has a large area and where it may not be possible for the federal -or even state- government to take action throughout its territory, and where thus individual or community action might be necessary. Through the interviews that were conducted the authors found that the tidal flooding and recent experiences with hurricanes have placed strains in two communities within St. Augustine.

The authors found that the residents of two communities in St. Augustine exhibited feelings of eco-anxiety due to ongoing climate stressors (in the form of past experience with major hurricanes and constant tidal flooding due to the cumulative effects of SLR). Despite such anxiety, the feeling of community is strong, and individuals either do not wish to relocate, or if they do, it is only within the city to areas perceived as being less at risk. People wishing to relocate (within the city) worried about an increase of risk in the future, appeared to exhibit higher stress levels and worried that the community was disappearing, where those more willing to stay often had higher levels of technical expertise or had a feeling that the community was strong enough to adapt. However, individuals may be forced to move because of the realities of their economic situation. This increases the risk to the remaining members of the community, increasing their anxiety and willingness to leave. Essentially, it appears that when the feeling of eco-anxiety becomes overwhelming, individuals may "give up" and choose to relocate instead, emphasizing why this emotion needs to be carefully managed through community actions and support at the city (or even higher) authority levels.

While previous quantitative research on eco-anxiety has typically aimed to measure the degree of the anxiety, highlighting one response outcome deriving from it, a growing body of work is acknowledging the complexity of both the emotions and the response. The contribution of the present research is indeed to show that there is a more nuanced human response to this emotion. The interviews highlight that people may feel emotionally overwhelmed by a number of factors, particularly a lack of support in the present for issues that are already affecting them and too much knowledge of what may come without imagining the support necessary to overcome it.

Adaptive action (or inaction) is a complex process that is influenced by individual capability, institutional support, and resources available. A certain level of eco-anxiety, which may be seen as a negative emotion, can nevertheless elicit positive adaptation actions. Although knowledge of climate change is important at the top governmental level, there may not necessarily be a problem if there is a lack of knowledge about the problem at the individual level, and instead building expertise at the community level on how to develop effective solutions targeted to specific neighborhoods may be more important for successful adaptation. Nevertheless, it is still not clear whether short-term reactive adaptation solutions (by individuals or communities unaware or unwilling to acknowledge climate change) may lead to suboptimal or maladaptive long-term term solutions (as opposed to a more carefully planned adaptation pathway approach).

Acknowledgements

This study was supported by the University of Tokyo and Waseda University.

Author contributions (CRediT)

EIG[1]: Conceptualization, Data curation, Formal Analysis, Funding acquisition, Investigation, Methodology, Resources, Software, Visualization, Writing – original draft, Writing – review & editing. ME[2]: Conceptualization, Funding acquisition, Methodology, Supervision, Validation, Writing – original draft, Writing – review & editing. MO[3]: Conceptualization, Funding acquisition, Supervision, Writing – original draft. GV[4]: Conceptualization, Software.

Declaration of interests

The author reports no conflict of interest.

References

Ágoston, C., Urbán, R., Nagy, B., Csaba, B., Kőváry, Z., Kovács, K., ... & Demetrovics, Z. (2022). The psychological consequences of the ecological crisis: three new questionnaires to assess eco-anxiety, eco-guilt, and ecological grief. Climate Risk Management, 37, 100441.

Beach, J. L. (2018) Saving 450 Years of History in the Nation's Oldest City: A Look at Flood Mitigation Projects http://www.citystaug.com/document_center/Publicworks/Stormwater/2017TideCheckValveProject.pdf Accessed 3rd October 2018.

Boluda-Verdu, I., Senent-Valero, M., Casas-Escolano, M., Matijasevich, A., & Pastor-Valero, M. (2022). Fear for the future: Eco-anxiety and health implications, a systematic review. Journal of Environmental Psychology, 101904.

Carter, N. T. (2005). New Orleans levees and floodwalls: hurricane damage protection. Library of Congress Washington DC Congressional Research Service.

Cassotta, S., Derkesen, C., Ekaykin, A., Hollowed, A., Kofinas, G., Mackintosh, A., Melbourne-Thomas, J., Muelbert, M.M.C., Ottersen, G., Pritchard, H., and Schuur, E.A.G. (2019). Chapter 3: Polar regions. In IPCC Special Report on the Ocean and Cryosphere in a Changing Climate [H.-O. Pörtner, D.C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, M. Nicolai, A. Okem, J. Petzold, B. Rama, N. Weyer (eds.)]. In press. https://www.ipcc.ch/site/assets/uploads/sites/3/2019/11/SROCC_FinalDraft_Chapter3.pdf

Clayton, S. (2020). Climate anxiety: Psychological responses to climate change. Journal of anxiety disorders, 74, 102263.

Clayton, S., & Karazsia, B. T. (2020). Development and validation of a measure of climate change anxiety. Journal of Environmental Psychology, 69, 101434.

Coffey, Y., Bhullar, N., Durkin, J., Islam, M. S., & Usher, K. (2021). Understanding eco-anxiety: A systematic scoping review of current literature and identified knowledge gaps. The Journal of Climate Change and Health, 3, 100047.

Crandon, T. J., Scott, J. G., Charlson, F. J., & Thomas, H. J. (2022). A social–ecological perspective on climate anxiety in children and adolescents. Nature Climate Change, 12(2), 123-131.

Crichton, R., Esteban, M. and Onuki, M. (2020) Understanding the preferences of rural communities for adaptation to 21st century sea-level rise: a case study from the Samoan islands, Climate Risk Management 30, 100254.

Dahl, K.A., Spanger-Siegfried, E., Caldas, A., and Udverdy, S., et al. (2017) Effective inundation of continental United States communities with 21st century sea level rise. Elemta Science of the Anthropocene, 5: 37, https://doi.org/10.1525/elementa.234

DuPuis, E. M., & Greenberg, M. (2019). The right to the resilient city: Progressive politics and the green growth machine in New York City. Journal of Environmental Studies and Sciences, 9, 352-363.

Esteban, M., Takagi, H. Jamero, L., Chadwick, C., Avelino, E. Mikami, T., Fatma, D., Yamamoto, L., Thao, N. D., Onuki, M., Woodbury, J. D., Valenzuela, V. P., Crichton, R. (2019) Adaptation to Sea Level Rise: Learning from Present Examples of Land Subsidence. Ocean and Coastal Management, pp. 104852.

Esteban, M., Bricker, J., San-Carlos Arce, R., Takagi, H., Namyi, Y., Chaiyapa, W., Sjogren., A. and Shibayama, T. (2018) Tsunami Awareness, A comparatives assessment between Japan and the USA, Natural Hazards 93 (3), 1507-1528.

Esteban, M., Valenzuela, V. P., Matsumaru, R., Mikami, T., Shibayama, T., Takagi, H., Nguyen, D. T., De Leon, M. (2016) Storm Surge Awareness in the Philippines Prior to Typhoon Haiyan: a Comparative Analysis with Tsunami Awareness in Recent Times, Coastal Engineering Journal. Vol. 58 No. 1

Fullilove, M. T. (1996). Psychiatric implications of displacement: Contributions from the psychology of place. American journal of psychiatry, 153, 12.

Giuliani, M. V. (2003). Theory of attachment and place attachment (p. 137). na.

Gibbons, S. J. A., & Nicholls, R. J. (2006). Island abandonment and sea-level rise: An historical analog from the Chesapeake Bay, USA. Global Environmental Change, 16(1), 40-47.

Hidalgo, M. C., & Hernandez, B. (2001). Place attachment: Conceptual and empirical questions. Journal of environmental psychology, 21(3), 273-281.

Innocenti, M., Santarelli, G., Faggi, V., Castellini, G., Manelli, I., Magrini, G., ... & Ricca, V. (2021). Psychometric properties of the Italian version of the Climate Change Anxiety Scale. The Journal of Climate Change and Health, 3, 100080.

IPCC (2019). Summary for Policymakers. In: IPCC Special Report on the Ocean and Cryosphere in a Changing Climate [H.- O. Pörtner, D.C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, M. Nicolai, A. Okem, J. Petzold, B. Rama, N. Weyer (eds.)]. https://report.ipcc.ch/srocc/pdf/SROCC_SPM_Approved.pdf

IPCC (2021). Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press. In Press.

Jamero, L., Onuki, M. and Esteban, M., Billones-Sensano, X. K., Tan, N., Nellas, A., Takagi, H., Thao, N. D. and Valenzuela, V. P. (2017) Small island communities in the Philippines prefer local measures to relocation in response to sea-level rise, Nature Climate Change 7, 581-586

Jamero, L., Onuki, M., Esteban, M. and Tan, N. (2018) Community-based adaptation in low-lying islands in the Philippines: Challenges and lessons learned, Regional Environmental Change, 8, 2249-2260.

Johnson, C. (2018), How much does tidal flooding cost Charleston? Nobody really knows. The Post and Courier. https://www.postandcourier.com/news/how-much-does-tidal-flooding-cost-charleston-nobody-really-knows/article_a4f40bc8-f28d-11e8-82b1-c31684c36947.html

Lewicka, M. (2011). Place attachment: How far have we come in the last 40 years?. Journal of environmental psychology, 31(3), 207-230.

Lindsay, R. (2021). Climate Change: Global Sea Level. Climate.gov, https://www.climate.gov/news-features/understanding-climate/climate-change-global-sea-level, Accessed 12/21/21.

Maran, D. A., & Begotti, T. (2021). Media exposure to climate change, anxiety, and efficacy beliefs in a sample of Italian university students. International Journal of Environmental Research and Public Health, 18(17), 9358.

NOAA Center for Operational Oceanographic Products and Services. (n.d.) Sea level trends. [online: https://tidesandcurrents.noaa.gov/sltrends/] Accessed April 18, 2021.

Ojala, M., Cunsolo, A., Ogunbode, C. A., & Middleton, J. (2021). Anxiety, worry, and grief in a time of environmental and climate crisis: A narrative review. Annual review of environment and resources, 46, 35-58.

Pihkala, P. (2020). Eco-anxiety and environmental education. Sustainability, 12(23), 10149.

Ristroph, E. B. (2019). Avoiding maladaptations to flooding and erosion: a case study of Alaska Native Villages. Ocean & Coastal LJ, 24, 110.

Scannell, L., & Gifford, R. (2010). Defining place attachment: A tripartite organizing framework. Journal of environmental psychology, 30(1), 1-10.

Stanley, S. K., Hogg, T. L., Leviston, Z., & Walker, I. (2021). From anger to action: Differential impacts of eco-anxiety, eco-depression, and eco-anger on climate action and wellbeing. The Journal of Climate Change and Health, 1, 100003.

Sweet, W. V., Marra, J. J., & Dusek, G. (2016). State of US high tide flooding and a 2017 outlook. Supplement to State of the Climate: National Overview for May 2017, Published online June 2017

Sweet, W.V., Hamlington, B.D., Kopp, R.E., Weaver, C.P., Barnard, P.L., Bekaert, D. , Brooks, W., Craghan, M., Dusek, G., Frederikse, T., Garner, G., Genz, A.S., Krasting, J.P., Larour, E., Marcy, D., Marra, J.J., Obeysekera, J., Osler, M., Pendleton, M., Roman, D., Schmied, L., Veatch, W., White, K.D., and Zuzak, C. (2022): Global and Regional Sea Level Rise Scenarios for the United States: Updated Mean Projections and Extreme Water Level Probabilities Along U.S. Coastlines. NOAA Technical Report NOS 01. National Oceanic and Atmospheric Administration, National Ocean Service, Silver Spring, MD, 111 pp. https://oceanservice.noaa.gov/hazards/sealevelrise/noaa-nos-techrpt01-global-regional-SLR-scenarios-US.pdf

Takagi, H., Esteban, M., Mikami, T., Pratama, M. B., Valenzuela, V. P. B. and Avelino, J. E. (2021) People's perception of land subsidence, floods and their connection: A note based on recent surveys in a sinking coastal community in Jakarta, Ocean and Coastal Management 211, 105753.

Taylor, S. (2020). Anxiety disorders, climate change, and the challenges ahead: Introduction to the special issue. Journal of Anxiety Disorders, 76, 102313.

USGCRP (2018)/ Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, 1515 pp. doi:10.7930/NCA4.2018

Valenzuela, V. P., Esteban, M., Takagi, H., Thao, N. D. and Onuki, M. (2020) Disaster awareness in three low risk coastal communities in Puerto Princesa City, Palawan, Philippines, International Journal of Disaster Risk Reduction, 46, 101508. https://doi.org/10.1016/j.ijdrr.2020.101508

Weiss, J. L., Overpeck, J. T., & Strauss, B. (2011). Implications of recent sea level rise science for low-elevation areas in coastal cities of the conterminous U.S.A. Climatic Change, 105(3-4), 635–645. doi:10.1007/s10584-011-0024-x

Whitmarsh, L., Player, L., Jiongco, A., James, M., Williams, M., Marks, E., & Kennedy-Williams, P. (2022). Climate anxiety: What predicts it and how is it related to climate action? Journal of Environmental Psychology, 83, 101866.

Appendix A

Table A. List of interview questions

Name
Length of time living in the area
Neighborhood
Consider SLR?
Is flooding a major problem for you? For the city?
Are you a part of community groups?
How often is the flooding?
What is the cause of flooding?
Should residents be involved in planning?
How should residents participate with government?
What kind of values would you want to see included in planning?
Do you think the city is doing a good job?
Do you think the state or federal government is doing anything?
With high predictions of SLR, can the city survive? What should they do?
If money was not an issue, how would you plan for the community?
How connected do you feel towards the community?
Do you think your neighbors feel as connected?
How has the area changed?
Has flooding gotten worse?
Better to have strong prediction or diverse planning?
What are the challenges at the city level and personal level to making changes?