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To cite this article: Nina Berlin Rubin *et al* 2024 *Environ. Res. Lett.* **19** 104026

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## Exploring antecedents to climate migration: sense of place, fear and worry, and experience

## OPEN ACCESS

RECEIVED  
19 December 2023REVISED  
1 August 2024ACCEPTED FOR PUBLICATION  
15 August 2024PUBLISHED  
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E-mail: [nberlin@stanford.edu](mailto:nberlin@stanford.edu)**Keywords:** climate migration, place attachment, place detachment, negative experience, coastal hazardsSupplementary material for this article is available [online](#)Original content from this work may be used under the terms of the [Creative Commons Attribution 4.0 licence](#).

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**Abstract**

The bond between people and the place they live has significant implications for their migration decisions. However, few studies have examined how this relationship endures in the face of experience with climate-related hazards and associated emotions, and whether detachment from place may be related to future migration. Here we address this gap using cross-sectional survey data from a representative probability-based sample of 1479 residents of Texas and Florida—areas frequently affected by coastal hazards—to investigate the interplay between place attachment, place detachment, negative hazard experiences, hazard-related fear and worry, and prospective migration. We found that place attachment and detachment were inversely associated with one another, and that hazard-related fear and worry was associated with higher place detachment. Results indicated that place detachment and hazard-related fear and worry were positively associated with prospective migration, while place attachment was negatively associated with prospective migration. The absence of place attachment and presence of detachment may lower psychological barriers to relocation in the face of climate change. Negative hazard experiences were not associated with place attachment, place detachment, or prospective migration. However, our post-hoc analyses found an indirect association between negative hazard experiences and prospective migration, mediated by hazard-related fear and worry. This suggests that psychological correlates of climate hazards, possibly arising from experiencing them, may inform people's sense of place and future migration decisions. Our findings highlight the salience of relationships with place in migration decisions and stress the importance of explicitly examining negative sentiments towards place in migration studies. These insights can both improve climate migration models and help tailor policies and programs aimed at supporting detached, fearful, and worried individuals in anticipation of future climate-related hazards.

**1. Introduction**

Residents of coastal areas face a myriad of adverse impacts stemming from climate change, including intensifying tropical storms, more frequent nuisance flooding [1], and subsequent detrimental effects on livelihoods, mental health [2], property, insurance costs, tourism, and recreation [3]. These impacts may evoke distressing emotions, such as fear and

worry about future climate hazards [4], particularly for individuals who have already endured them [5]. While past studies have underscored the inhibitory effect of place attachment—the functional and emotional bond a person has with where they live [6]—on mobility in the face of climate hazards [7–11], scant research has focused on the disruption of place attachment and the potential for detachment due to personal experiences with hazards and emotional

responses [8, 12–16]. This dynamic requires further exploration, particularly given potential implications for future migration from coastal areas.

In the context of climate change, climate migration models estimate that tens to hundreds of millions of people will be displaced from coastal areas by 2100 [17, 18]. These models, while crucial for informing decisions about infrastructure and social services, often overlook psychological factors such as connection to place, emotions, experience with hazards, and individual willingness and ability to move. Consequently, their predictions may lack behavioral realism, potentially limiting their utility for future planning.

This study responds to recent calls for additional scholarship on migration decision-making, particularly focused on the person-place relationship [15, 16]. It expands this area of inquiry by considering place detachment as a related factor [19, 20] and contributes to the limited research on how hazard-related sentiments and experiences may be associated with future climate migration [21, 22]. To address these gaps, we investigated potential antecedents to climate migration among residents of the United States (U.S.) Gulf Coast, a region frequently affected by hurricanes, coastal flooding, and tornadoes [23]. We assessed the relationship between place attachment and detachment, the association between hazard-related fear and worry and negative hazard experiences with place attachment and detachment, and how these factors may be associated with future migration in terms of the perceived appeal of migrating to lower hazard-risk areas and the likelihood of moving in the future. In doing so, our research contributes to the limited but growing body of evidence on the psychological dimensions of climate migration decision-making at the individual level, specifically as it relates to the person-place relationship [15], personal experience, and hazard-related emotions. We aim to provide a more nuanced understanding of the factors that may relate to residents' decision-making processes in the face of climate change, offering both theoretical value to improve future models of climate migration and practical insights to support residents of increasingly hazard-prone areas.

## 2. Psychological dimensions of climate migration

Migration decisions in the face of climate change are complex and context-specific [24–26], with economic, political, social, and environmental factors playing varying roles depending on the individual [27, 28]. A growing body of research shifts the focus of climate migration studies from concrete, material factors contributing to future migration (e.g. economic opportunity, projected inundation) to more qualitative, subjective considerations, such as sense of

place and past hazard experiences [7, 15, 16, 26, 29–32]. These investigations seek to further unravel the nuances of household mobility decisions via expanded social theories in an attempt to better capture and understand diverse patterns of human behavior [33, 34]. Although there is heightening acknowledgment of the immaterial psychosocial and experiential elements that influence migration decisions, these elements require further identification, as much remains to be understood about the specific factors that may underlie individual decision-making [35].

To this end, we explored three potential antecedents to future climate-related migration: sense of place (both positive and negative), personal experience with climate-related hazards, and fear and worry related to such hazards. Our selection of these factors was guided by prior evidence in the environmental psychology and climate migration literature, where studies have highlighted their potential significance in influencing migration decisions [8, 9, 36]. This selection was also informed by established theoretical frameworks, including protection motivation theory [37] and the theory of planned behavior [38], as well as the specific experiences and threats faced by coastal residents in our study area. Illuminating the environments, feelings, and experiences that may promote or discourage migration contributes to a deeper understanding of proactive climate migration from a behavioral-psychological perspective. To structure our exploration, we developed a conceptual framework to investigate the interrelationships among these factors and potential future migration. Each element and its respective relationships are discussed in turn below.

### 2.1. Sense of place

#### 2.1.1. Place attachment, personal experience, and place detachment

Place attachment, an element of sense of place, embodies the affective and cognitive connection between individuals and their environment [6, 39, 40]. This concept has often been explored in environmental psychology along two dimensions: how place relates to the formation of one's identity (place identity) and subsequent place-related behaviors (place dependence) [41, 42]. The relationship between a person and place is dynamic: continually negotiated as personal and environmental circumstances change, and requiring constant re-evaluation and reassessment as life unfolds [39]. Climate change can alter the fundamental characteristics of a place that contribute to attachment, such as natural amenities, weather, and property [32, 43].

Recent research indicates that traumatic or distressing place-based experiences like climate-related hazards may disrupt one's sense of place, resulting in distancing, aversion, negativity, or a souring of this relationship [12–14, 44]. After devastating tornadoes

affected Missouri and Alabama in 2011, McKinzie [19] found that the destruction of meaningful landmarks caused some residents to express a 'negative sense of place' (p. 5). The desolation of the landscape and the physical scars on a community left by climate-related hazard events can leave residents disoriented, unmoored, and disconnected from once-familiar surroundings [12–14, 43].

This distancing from and negative feelings associated with place can be referred to as place detachment [19, 45, 46]. Limited research in climate change and hazard contexts explicitly explores place detachment [20]. Whereas place attachment tends to be conceptualized as engendering positive meaning and experienced as warm thoughts or emotions [19], place detachment involves the active process of not belonging or experiencing placelessness [47]. Agyeman *et al* [20] suggest that place detachment consists of a proactive, deliberate undertaking to emotionally prepare for leaving in response to climatic changes. Though initial evidence from post-disaster contexts documents place detachment as intentional and ongoing negative sentiments towards a place [19, 45, 46], the lack of empirical research and a validated scale for measurement leaves it unclear whether detachment is a distinct phenomenon with unique implications for ensuing cognition and behavior, or if it merely operates as an absence of place attachment. Additionally, while a few qualitative studies describe or allude to place detachment [19, 48], the underlying factors associated with detachment have yet to be explored. However, climate change, experiences with hazards, or the psychological ramifications of those experiences may prompt people to reconceptualize their environment and reconcile their lived experiences, fears, and anxieties with the changing backdrop. As a growing number of individuals experience climate hazards [49–51], understanding how the person-place relationship persists becomes crucial. New research is needed to investigate the prevalence of feelings of detachment from place, to explore its precursors, and to understand its consequences such as for migration.

### 2.1.2. Sense of place and migration

Recent work highlights associations between place attachment and climate hazard preparedness [9]—with studies finding a slight positive association between place attachment and a wider set of climate change adaptation behaviors including evacuation, purchasing insurance, and information-seeking [21]. This has prompted calls for additional research on how place attachment, or potential place detachment, relates to migration specifically [8, 15, 16]. While the relationship between place attachment and protective action more broadly is nuanced, place attachment appears to discourage mobility in the face of climate hazards [7, 9, 52]. Highly attached individuals tend to be less likely to accept relocation offers and less willing

to relocate from areas at high risk of flooding [53, 54], earthquakes [10], and other hazards [55, 56]. Elevated place attachment is associated with a greater likelihood of returning to disaster areas post-displacement (which could occur at varying time scales, from days to years [57]), risking recurring threats (though individuals may be more likely to take protective action, see [9, 58]). After Hurricane Katrina, a qualitative study of Ninth Ward neighborhood residents found that the vast majority of those who returned post-hurricane came back due to their attachment to the area's uniqueness and its centrality to their identity [59]. Conversely, low place attachment or lack thereof may encourage migration, with less attached individuals tending to have higher intentions to migrate after a disaster [8, 60].

In sum, the reticence of individuals to move from hazardous areas appears at least in part to be a result of place attachment. As impacts continue to escalate, we posit that more people will be forced to reassess their bond with their evolving environment, potentially leading to place detachment, which in some cases may precede migration. Further research is needed to elucidate the interconnectedness between place attachment and detachment, personal experience with climate hazards and associated emotions, and future migration in the face of climate extremes.

### 2.2. Experience, fear & worry, and migration

Beyond the potential ramifications for the person-place relationship, experience with hazards and sentiments related to these hazards may have consequences for behaviors like migration. A recent meta-analysis assessing factors associated with individual adaptation to climate change more broadly found a modest but positive association between personal experience and adaptation [21]. Negative hazard experiences may cause or be associated with psychological distress, including fear, worry, or rumination [12–14, 61–63]. There are a few studies that explore climate migration in relation to personal experiences and the psychological consequences associated with climate hazards, including coastal hazards [21, 64, 65] and wildfire and wildfire smoke [29, 66]. Bukvic *et al* [36] found that prior hazard experience, stress, and concern were significant factors that contributed to the willingness of households affected by Hurricane Sandy in 2013 to consider relocation. Correll *et al* [67] found that, among residents of the Mississippi River Delta in Louisiana, those considering moving reported more flooding experience than those who intended to stay. In light of these findings, additional research on migration in the context of negative hazard experiences is necessary to clarify how experiences may contribute to or demotivate migration.

Emotions are increasingly recognized as driving individual behavior [68, 69], particularly when decisions are being made under uncertainty [70]. In the climate change context, prior research shows

mixed evidence on the direction of the link between emotions and individual adaptation to climate change, with some studies finding that emotional responses promote individual behaviors and others finding a negative association or lack of a relationship, depending on the domain and type of emotion [21, 71]. Prior evidence demonstrates a strong association between negative affect and individual intentions to adapt to climate change such as hazard preparedness and policy support [21]. Here, we focus on fear and worry about climate hazards given prior research demonstrating the prevalence of these emotions among hazard-affected communities [72]. Evolutionary perspectives recognize fear and worry as mechanisms that stimulate action to cope with threats, thereby conferring a clear fitness advantage [73]. Despite the unpleasant nature of experiencing worry, worry may in some cases motivate protective actions—in part due to people's desire to reduce worry [74]—though it also may hinder them (i.e. eco-paralysis) [75, 76] if individuals perceive outcomes are beyond their control [74]. Separately, fear-based communications have long been explored as potentially persuasive of protective action [77]; for example, fear has been shown to be positively associated with evacuation for coastal hazards [78]. Conversely, fear may also lead to maladaptive coping such as avoidance or denial of the threat [69]. How fear relates to migration behavior—which itself may be fear-evoking [79]—or whether fear may perhaps encourage immobility, requires further inquiry [80, 81]. The balance between the potential adaptive benefits and cognitive costs of experiencing fear and worry may have major implications for people's mobility decisions, yet this trade-off has not yet been explored in this setting [22]. The subjective experience of individuals living in areas at-risk for climate hazards and how the specific emotions they experience may be related to future mobility decisions requires additional attention [68].

### 3. Study aims and hypotheses

To address the research aims discussed above, we report findings from the most recent wave of data collected from an ongoing, prospective longitudinal study of a representative sample of 1479 Texas and Florida residents. We hypothesize that:

**H1.** Place attachment and place detachment will be negatively associated.

**H2.** (a) Negative hazard experiences and (b) hazard-related fear and worry will be positively associated with place detachment.

**H3.** (a) Place detachment, (b) negative hazard experiences, and (c) hazard-related fear and worry will be positively associated with prospective migration, while (d) place attachment will be negatively associated with prospective migration.

We also explore the associations between hazard-related fear and worry and negative hazard experiences with place attachment.

## 4. Methods

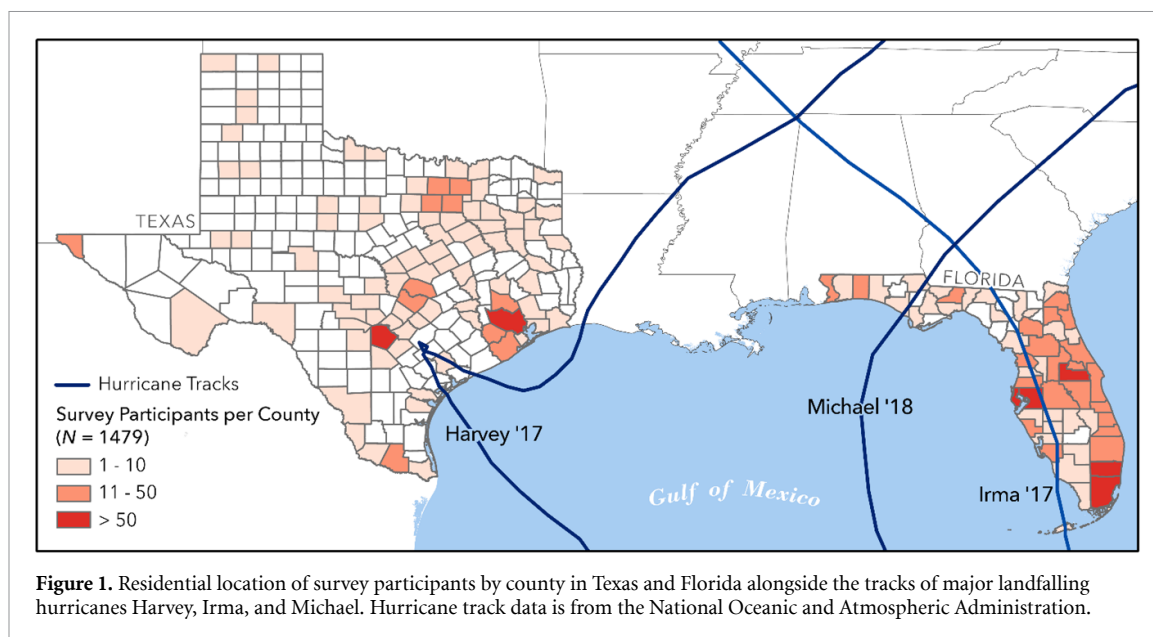
### 4.1. Field selection

The Gulf Coast region of the U.S. is already experiencing the impacts of climate change, including warmer temperatures, more frequent flooding, and increased hurricane activity [23]. Residents of Texas and Florida have faced dozens of billion-dollar weather and climate disasters in recent years, including major land-falling hurricanes [such as Harvey (2017), Irma (2017), and Michael (2018)], unprecedented and destructive flooding, severe heat waves, intense tornadoes, and extreme winter storms [51]. Despite these recurrent hazard events, the Gulf Coast region has had a higher population growth rate than the U.S. at large (26% versus a national average of 16% for 2010–2017, the most recent period available) [82]. Some of what motivates people to move to the Gulf Coast, such as proximity to outdoor recreation and natural amenities, will be directly and potentially negatively affected by climate change, while downstream effects on economic growth and culture may also be implicated over the next century [3]. As this region becomes increasingly threatened by climate change, it is imperative to understand residents' perceptions of the appeal of migrating to lower risk areas, as well as the factors and experiences that contribute to an inclination to move or to stay.

### 4.2. Participants

Survey responses were collected as part of a longitudinal cohort study of experiences with hurricanes and coastal hazards [62, 63, 83, 84] in Texas and Florida, shown in figure 1. Participants from these states were recruited from the Ipsos KnowledgePanel, which uses address-based sampling methods to recruit a statistically validated, representative, probability-based sample of U.S. households, including harder-to-reach populations such as those in rural communities, those with lower income, or those without Internet access. Data were collected from 22 December 2021, to 11 January 2022, with participants drawn from an ongoing cohort study that was expanded upon shortly after Hurricane Harvey and before Hurricane Irma (8 September 2017–11 September 2017). Participants ( $N = 1479$ ; 83.7% response rate) completed the survey online (with web access provided as needed) and received \$15–20 compensation. Median survey completion time was 18 min. All participants provided informed consent, and procedures were approved by the Institutional Review Boards from the authors' institutions (Stanford University, IRB-52 533, and the University of California, Irvine, IRB-2016-2827).





### 4.3. Measures

All key variables, except for negative hazard experiences, were derived from responses obtained in the most recent wave of data collection described above. Negative hazard experiences was constructed using panel data that integrates responses from three waves of data collection.

#### 4.3.1. Sense of place

We measured sense of place through place attachment and place detachment using six statements where respondents considered the place they currently lived.

##### 4.3.1.1. Place attachment

We assessed place attachment using four items representing place identity and place dependence from prior established scales of place attachment [42, 85]. Participants rated their agreement with the statements: ‘I identify strongly with this place’, ‘I am very attached to this place’, ‘This area is the best place for what I like to do’, and ‘No other place can compare to this place’, with responses ranging from *strongly disagree* (1) to *strongly agree* (5). We calculated the average of the responses (Cronbach’s  $\alpha = .89$ ).

##### 4.3.1.2. Place detachment

We assessed place detachment using two items from prior work examining detachment as a dimension of place attachment [48], social cohesion, and the built environment [86]. Participants rated their agreement with two statements: ‘There are other places that are more desirable to live in’ and ‘Given the opportunity, I would like to move away,’ with responses ranging from *strongly disagree* (1) to *strongly agree* (5). We calculated the average of the responses (Cronbach’s  $\alpha = .82$ ).

#### 4.3.2. Prospective migration

We assessed prospective climate-related migration (hereafter, prospective migration) using two dimensions: appeal of moving and hurricane-induced moving likelihood.

##### 4.3.2.1. Appeal of moving

We assessed the appeal of moving as related to climate-related hazard events (hereafter, appeal of moving) using two items: one for moving to a ‘place with a lower risk of experiencing a major storm (such as a hurricane or tornado)’ and another for moving to a ‘place with a lower risk of experiencing minor (nuisance) flooding’. Participants rated appeal on a scale from *not at all appealing* (1) to *extremely appealing* (5), and we computed the average response (Cronbach’s  $\alpha = .89$ ).

##### 4.3.2.2. Hurricane-induced moving likelihood

We assessed hurricane-induced moving likelihood using two items where participants reported the percent chance that they would move out of their community if their ‘home was severely damaged or destroyed because of a hurricane or its aftermath’ and if they or someone they knew were ‘seriously injured by a hurricane or its aftermath’, with responses ranging from 0% to 100%. We calculated the average of the responses (Cronbach’s  $\alpha = .85$ ).

#### 4.3.3. Negative hazard experiences

We assessed negative hazard experiences using a six-item checklist from three prior data collection waves [62]. The checklist included: property loss, home destruction, pet loss, personal injury, knowing someone injured, and knowing someone killed. We summed experiences at each wave (range 0–6) and cumulatively across waves (range 0–18).

#### 4.3.4. Hazard-related fear and worry

We assessed hazard-related fear and worry using two items adapted from prior research on outcomes in the aftermath of experiencing traumatic events [72, 87, 88]. Participants indicated the frequency in the past week that they ‘had fears about the possibility of a natural disaster affecting [their] community’ and ‘worry that a natural disaster will personally affect me or someone in my family in the future’, with responses ranging from *never* (1) to *all the time* (5). We calculated the average of the responses (Cronbach’s  $\alpha = .77$ ).

#### 4.3.5. Covariates

Existing evidence suggests that migration behavior may be sensitive to individual factors and demographic characteristics such as age, sex, homeownership status, and length of residency [35, 89–91]. Demographic information was collected by Ipsos, including length of residency (number of years lived in community), homeownership status (homeowner or non-homeowner), age, sex, income, race/ethnicity, and education level (college education or no college education).

#### 4.4. Analysis

We used StataMP (version 16.1) for all analyses [92], calculating descriptive statistics and a correlation matrix excluding covariates. Ordinary least squares regression was used to evaluate hypotheses. H1 was examined with a model predicting place detachment by place attachment. H2 involved two models predicting place detachment by negative hazard experiences (H2a) and hazard-related fear and worry (H2b) and predicting place attachment by fear and worry and negative experience. H3 was tested using four models (two for each prospective migration measure) to explore place attachment and detachment separately. The first and second models predicted appeal of moving by hazard-related fear and worry, negative hazard experiences, and place attachment (Model 1) and place detachment (Model 2), respectively. The third and fourth models predicted hurricane-induced moving likelihood by hazard-related fear and worry, negative hazard experiences, and place attachment (Model 3) and place detachment (Model 4), respectively. We pre-registered analysis for these hypotheses at the Center for Open Science (<https://osf.io/nq9hy>). Post-hoc general structural equation modeling was conducted to assess potential mediation of fear and worry on the relationship between negative experiences and prospective migration. All models controlled for length of residency, homeownership, age, sex, income, race/ethnicity, and education level. Significance was assessed at  $p < .05$  using two-sided tests.

Ipsos iteratively constructed study-specific post-stratification weights used in all models. Following

data collection, panel-level design weights were adjusted to represent state (Florida and Texas, respectively) adult populations based on American Community Survey (2020) benchmarks [93]. Probability estimates relied on demographics including sex by age, age, race/ethnicity, household income, education level, and metropolitan status. Missing responses were imputed using imputation methods as detailed in the supplementary materials.

## 5. Results

### 5.1. The sample

The final weighted sample ( $N = 1479$ ) was 53.2% female-identifying, with a mean age of 51.5 years and average income of between \$50 000 and \$100 000. Nearly one-third of the sample (30.7%) had a bachelor’s degree or higher. The sample was 55.0% non-Hispanic White, 27.6% Hispanic, 12.1% Black, non-Hispanic, and 5.3% other, multiple races, non-Hispanic. The majority (79.9%) of the sample owned their home and on average reported having lived about 19 years in their community.

As shown in table 1, panelists on average reported relatively low levels of hazard-related fear and worry ( $M = 1.62$ ,  $SE = 0.04$ ). Of the sample, 28.7% reported prior negative hazard experiences: 15.5% reported one negative hazard experience and 13.2% had two or more negative hazard experiences. Panelists on average reported moderate levels of both place attachment ( $M = 3.39$ ,  $SE = 0.04$ ) and place detachment ( $M = 3.08$ ,  $SE = 0.04$ ). In terms of prospective migration, panelists tended to think moving to an area of reduced risk of climate-related hazards was a little appealing ( $M = 1.93$ ,  $SE = 0.05$ ) and on average reported there was a 9.8% chance they would move away if they were severely affected by a hurricane. We present correlations among the variables in table 2.

### 5.2. The relationship between place attachment and detachment

Results alongside the conceptual diagram of hypothesized relationships are presented in figure 2. The model assessing the association between place attachment and place detachment demonstrated support for Hypothesis 1. Results showed that place attachment and detachment had an inverse association; place attachment had a negative association with place detachment ( $B = -0.58$ ; 95% CI:  $-0.69, -0.47$ ;  $p < .001$ ).

### 5.3. Predictors of sense of place

Table 3 presents factors associated with place attachment and place detachment. As indicated in Model 2, results of the analyses supported Hypothesis 2b, indicating that greater fear and worry was associated with higher place detachment. Contrary to Hypothesis 2a, there was not a significant relationship between negative hazard experiences and place

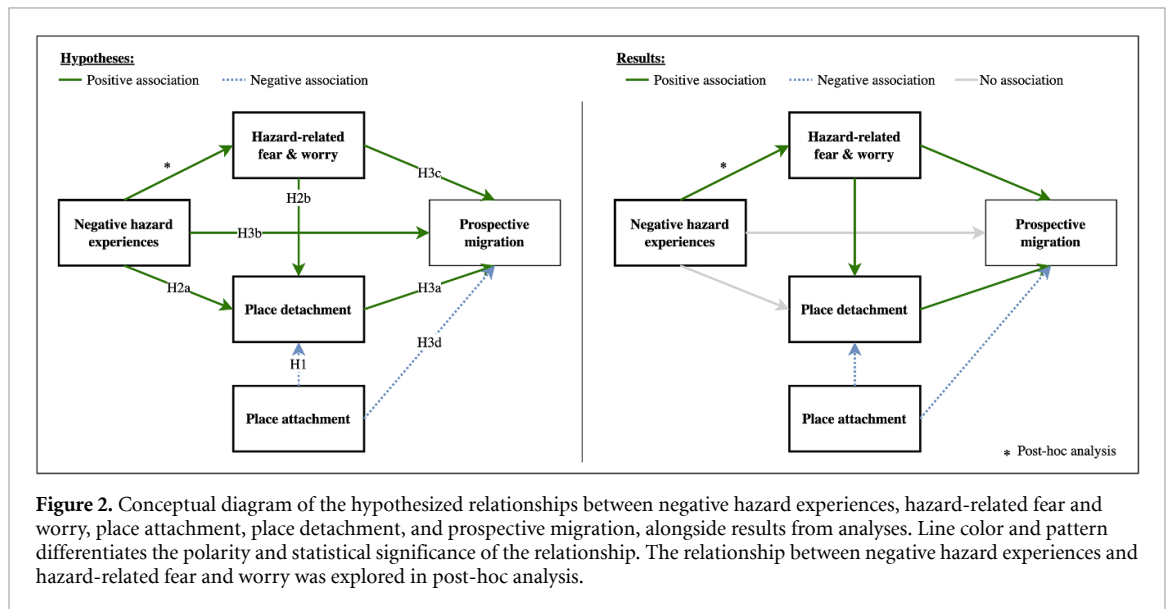
**Table 1.** Descriptive statistics for key study variables.

| Variable                            | Obs   | Range   | Mean | Standard Error |
|-------------------------------------|-------|---------|------|----------------|
| Fear and worry                      | 1479  | 1–5     | 1.62 | 0.04           |
| Negative hazard experiences         | 1479  | 0–11    | 0.59 | 0.07           |
| 0                                   | 71.3% |         |      |                |
| ≥1                                  | 28.7% |         |      |                |
| Place attachment                    | 1479  | 1–5     | 3.39 | 0.04           |
| Place detachment                    | 1479  | 1–5     | 3.08 | 0.04           |
| Appeal of moving                    | 1479  | 1–5     | 1.93 | 0.05           |
| Hurricane-induced moving likelihood | 1479  | 0%–100% | 9.83 | 0.86           |

**Table 2.** Correlations among key study variables.

| Variable                               | 1.      | 2.    | 3.       | 4.      | 5.      | 6.   |
|--|---------|-------|----------|---------|---------|------|
| 1. Fear and worry                      | 1.00    |       |          |         |         |      |
| 2. Negative hazard experiences         | 0.33**  | 1.00  |          |         |         |      |
| 3. Place attachment                    | −0.07   | −0.01 | 1.00     |         |         |      |
| 4. Place detachment                    | 0.18**  | 0.11* | −0.49*** | 1.00    |         |      |
| 5. Appeal of moving                    | 0.36*** | 0.18* | −0.18**  | 0.45*** | 1.00    |      |
| 6. Hurricane-induced moving likelihood | 0.33*** | 0.20* | −0.15**  | 0.18*** | 0.28*** | 1.00 |

Note: \* $p < .05$ ; \*\* $p < .01$ ; \*\*\* $p < .001$ .



**Figure 2.** Conceptual diagram of the hypothesized relationships between negative hazard experiences, hazard-related fear and worry, place attachment, place detachment, and prospective migration, alongside results from analyses. Line color and pattern differentiates the polarity and statistical significance of the relationship. The relationship between negative hazard experiences and hazard-related fear and worry was explored in post-hoc analysis.

detachment (see Model 2). Fear and worry and negative hazard experiences showed no association with place attachment (see Model 1).

**5.4. Sense of place, fear and worry, negative hazard experiences, and prospective migration**

Table 4 displays results for the models predicting prospective migration by place attachment, place detachment, hazard-related fear and worry, and negative hazard experiences. In support of Hypothesis 3a, place detachment had a positive association with prospective migration. Place detachment was related to both higher appeal of moving (see Model 2) and higher hurricane-induced moving likelihood (Model 4). Conversely, in support of Hypothesis 3d, place attachment had a negative association with prospective migration. Higher place attachment was

associated with lower appeal of moving (see Model 1) as well as lower hurricane-induced moving likelihood (Model 3). In support of Hypothesis 3c, across models including place attachment or place detachment, hazard-related fear and worry had a positive association with prospective migration. Hazard-related fear and worry was associated with higher appeal of moving and higher hurricane-induced moving likelihood. Results did not show support for Hypothesis 3b; negative hazard experiences was not significantly associated with prospective migration. Findings related to the sociodemographic variables are discussed in the supplementary materials.

**5.4.1. Mediation analyses**

Post-hoc stepwise regression analyses demonstrated a significant association between negative hazard



**Table 3.** Model coefficients for regression models predicting place attachment and place detachment, separately.

| Variable                    | Model 1: Place attachment |                              | Model 2: Place detachment |              |
|-----------------------------|---------------------------|------------------------------|---------------------------|--------------|
|                             | <i>B</i>                  | 95% Confidence Interval (CI) | <i>B</i>                  | 95% CI       |
| Fear & worry                | −0.11                     | −0.24, 0.02                  | 0.19**                    | 0.06, 0.33   |
| Negative hazard experiences | 0.02                      | −0.05, 0.09                  | 0.01                      | −0.05, 0.08  |
| Age                         | 0.01***                   | 0.01, 0.02                   | −0.01***                  | −0.02, −0.01 |
| Income                      | 0.04                      | −0.02, 0.11                  | −0.01                     | −0.09, 0.08  |
| Sex (female = 1)            | 0.04                      | −0.10, 0.19                  | 0.07                      | −0.11, 0.24  |
| College education (yes = 1) | 0.15                      | −0.01, 0.31                  | 0.09                      | −0.10, 0.29  |
| Race and ethnicity          |                           |                              |                           |              |
| Black, non-Hispanic         | 0.06                      | −0.18, 0.29                  | 0.06                      | −0.27, 0.40  |
| Hispanic                    | 0.35***                   | 0.17, 0.53                   | 0.05                      | −0.16, 0.25  |
| Other, non-Hispanic         | 0.50**                    | 0.15, 0.85                   | 0.00                      | −0.40, 0.40  |
| Length of residency         | 0.01***                   | 0.01, 0.02                   | −0.001                    | −0.01, 0.004 |
| Homeownership (yes = 1)     | −0.01                     | −0.24, 0.21                  | −0.26                     | −0.52, 0.00  |
| Constant                    | 2.36***                   | 1.91, 2.81                   | 3.48***                   | 2.99, 3.97   |
| Observations                |                           | 1479                         |                           | 1479         |
| <i>R</i> <sup>2</sup>       |                           | 0.13                         |                           | 0.09         |

Note: \**p* < .05; \*\**p* < .01; \*\*\**p* < .001. Reference groups for sex was male; for race/ethnicity was White, non-Hispanic; for education was received no college education; for homeownership status was not a homeowner.

experiences and both measures of prospective migration across models including place attachment or place detachment when hazard-related fear and worry was not included. Potential mediation of this relationship by hazard-related fear and worry was thus explored using general structural equation modelling.

Post-hoc analyses found fear and worry fully mediated the relationships between negative hazard experiences and appeal of moving and hurricane-induced moving likelihood, respectively, across models including or place detachment (see supplementary materials for detailed results and figure).

## 6. Discussion

Our study illustrates the interconnectedness of sense of place, hazard-related fear and worry, negative hazard experiences, and prospective migration among Texas and Florida residents in the U.S. Gulf Coast. This enhances our understanding of some of the factors relevant to future migration decisions, including climate hazard experiences, psychological correlates (sense of place, fear and worry), and demographic differences. Results underscore the significance of the person-place relationship and identify detachment from place as a potential precursor to migration in the context of coastal hazards, contributing to literature on the psychological factors involved in climate migration decision-making [61–63, 76] and adaptation to climate change more broadly [21].

Findings reveal nuances in the person-place relationship, indicating a potential negative association between attachment and detachment. This preliminary evidence stresses the need to explicitly consider negative sentiments towards place, expanding on existing research on climate-related disruptions

to place attachment [12–14, 19, 48]. Environmental changes can transform not only physical landscapes and landmarks, but also the emotions and meanings between a person and their residence [32, 94], thus potentially affecting the multiple dimensions of attachment. Future research should employ longitudinal methods to causally examine the relationship between place attachment and detachment, as well as to further expand our understanding of the factors that inform attachment and detachment.

Our study links high place attachment to a lower appeal of moving to safer areas and a lower likelihood of moving if severely impacted by a hurricane, and conversely, high place detachment to a higher appeal and likelihood of moving. Individuals with higher place attachment tended to find the prospect of living in a lower hazard-risk area less appealing and reported that they were less likely to move out of their community were they to experience significant losses in a hurricane, as compared to those with lower place attachment. Likewise, place detachment demonstrated opposite tendencies. These findings corroborate past research demonstrating the role of place attachment as roots that inhibit mobility in the face of hazards [7], while expanding this discussion to consider how a distancing of oneself from place or loosening of bonds may serve as an independent determinant of future migration.

Hazard-related fear and worry was positively associated with place detachment and prospective migration; thus, detachment could serve as a coping mechanism for climate hazards [19] and a potential precursor to future migration. Negative sentiments about climate-related hazards may facilitate the loosening of ties between a person and their place of residence, possibly by affecting place dependence

Table 4. Model coefficients for regression models predicting prospective migration.

| Variable                    | Appeal of moving |            |         |             | Hurricane-induced moving likelihood |              |          |               |
|-----------------------------|------------------|------------|---------|-------------|-------------------------------------|--------------|----------|---------------|
|                             | Model 1          |            | Model 2 |             | Model 3                             |              | Model 4  |               |
|                             | B                | 95% CI     | B       | 95% CI      | B                                   | 95% CI       | B        | 95% CI        |
| Place attachment            | -0.21***         | -.31, -.11 | —       | —           | -2.41*                              | -4.23, .59   | —        | —             |
| Place detachment            | —                | —          | 0.38*** | .30, .45    | —                                   | —            | 2.64***  | 1.17, 4.11    |
| Fear & worry                | 0.40***          | .25, .54   | 0.35*** | .22, .47    | 7.41***                             | 5.01, 9.8    | 7.15***  | 4.88, 9.42    |
| Negative hazard experiences | 0.04             | -.05, .13  | 0.03    | -.05, .10   | 1.64                                | -.25, 3.53   | 1.56     | -.51, 3.62    |
| Age                         | -0.003           | -.01, .002 | -0.0001 | -.01, .001  | 0.11*                               | .01, .22     | 0.12*    | .01, .22      |
| Income                      | 0.03             | -.04, .09  | 0.02    | -.03, .08   | -0.43                               | -1.66, .79   | -0.52    | -1.73, .68    |
| Sex (female = 1)            | 0.09             | -.07, .25  | 0.06    | -.09, .20   | 2.52                                | -.33, 5.36   | 2.23     | -.64, 5.11    |
| College education (yes = 1) | 0.03             | -1.5, .22  | -0.03   | -.19, .13   | -2.79                               | -6.11, .52   | -3.40*   | -6.65, -1.14  |
| Race and ethnicity          |                  |            |         |             |                                     |              |          |               |
| Black, non-Hispanic         | 0.40             | .08, .72   | 0.36**  | .09, .64    | 1.49                                | -3.68, 6.66  | 1.18     | -4.28, 6.64   |
| Hispanic                    | 0.49***          | .29, .68   | 0.40*** | .20, .59    | -0.08                               | -3.87, 3.71  | -1.05    | -4.80, 2.71   |
| Other, non-Hispanic         | 0.53**           | .14, .93   | 0.43*   | .06, .79    | 1.61                                | -7.76, 10.98 | 0.41     | -8.48, 9.29   |
| Length of residency         | 0.004            | -.001, .01 | 0.002   | -.003, .006 | -0.02                               | -.11, .08    | -0.04    | -.14, .05     |
| Homeownership (yes = 1)     | -0.15            | -.38, .08  | -0.05   | -.27, .16   | -2.83                               | -7.01, 1.35  | -2.11    | -6.31, 2.10   |
| Constant                    | 1.81***          | 1.28, 2.35 | 0.01    | -.45, .47   | 2.81                                | -6.96, 12.58 | -12.06** | -19.97, -4.16 |
| Observations                | 1479             |            | 1479    |             | 1479                                |              | 1479     |               |
| R <sup>2</sup>              | 0.22             |            | 0.32    |             | 0.17                                |              | 0.18     |               |

Note: \*  $p < .05$ ; \*\*  $p < .01$ ; \*\*\*  $p < .001$ . Reference group for sex was male; for race/ethnicity was White, non-Hispanic; for education was received no college education; for homeownership status was not a homeowner.

or place identity [85]. While feelings of fear and worry may be discomfoting and unwelcome, in this case, these negative emotions may motivate behavior rather than encourage avoidance or denial (though whether this behavior is truly adaptive requires further study) [74, 95, 96]. Additional research is necessary to determine whether the association we found between fear and worry and prospective migration may be moderated by other potential mechanisms such as efficacy or control beliefs.

Surprisingly, analysis did not demonstrate a direct association between negative hazard experiences and place attachment, detachment, or prospective migration. However, upon further investigation through post-hoc analyses, an indirect relationship emerged between negative hazard experiences and prospective migration, mediated by hazard-related fear and worry. This implies that though negative hazard experiences may not directly relate to future migration behavior, they may have an impact through their association with hazard-related fear and worry. Thus, psychological responses (including emotions) may matter more for sense of place and migration than objective threat exposure alone. People experience hazards differently, and the building blocks of attachment vary [44]. Factors like adaptive capacity, social support, and financial security may enable some to buffer their psychological response to climate hazards and maintain place attachment, while others may have become habituated to the risk [97, 98], both of which could inhibit migration [11] and could be the subject of future studies.

Insights from this study can inform interventions and policy for climate change adaptation and resilience. Greater recognition of the person-place bond and its consequences for mobility is critical to better supporting individuals on both ends of the spectrum: those who are rooted in place and living in hazard-prone areas, as well as those experiencing detachment from place or diminished psychological well-being, who may be ready to move on [20]. Acknowledging that residents in climate hotspots may feel detached, afraid, and worried—particularly among those who may have previously experienced climate hazard events—might help facilitate improved on-the-ground immediate support, while also opening the door for longer-term discussions about promoting resilience and adapting in the face of escalating hazards. More research is needed to further explore the process of detachment and its implications for migration and other behaviors.

It is important to acknowledge that migration requires tremendous investment, effort, and access to capital [99], and that the dimensions explored here are merely a few among many other factors, such as familial, economic, and political, that inform household migration decision-making [25]. We recognize that many of such variables that are salient to

migration decision-making and sense of place, such as social networks and socio-economic factors like employment type and geographic area (i.e. urban versus rural), are not accounted for in this study. Our models explain a portion of the variability observed in future migration decisions, which could have large implications at the population level over time. Further study is needed to explicitly explore the role of agency and sociodemographic characteristics in facilitating migration or broader adaptation to climate change [100]. Conversations about relocation and displacement must prioritize justice and equity, considering historic and enduring racial injustice and access to resources [101, 102]. Ethical and culturally-informed practices should be employed for households electing to remain in place or unable to move in areas increasingly affected by climate change [103].

### 6.1. Limitations

This study leverages representative samples of individuals living in two states frequently affected by coastal hazards and incorporated sampling weights to facilitate population inferences to these states. Despite strengths, several limitations exist. The use of surveys to explore these concepts does present biases, though the Ipsos KnowledgePanel seeks to minimize potential sources of bias by using address-based sampling methods and stratified, rigorous recruitment strategies. Our sampling frame was limited to Florida and Texas, thus inhibiting generalization to the populations of other coastal regions. Exploration of these concepts among populations in different settings and using different methodologies such as qualitative interviewing would be beneficial to understand the prevalence and transferability of the relationships explored here to other geographic and hazard contexts. Lack of a validated place detachment scale led us to use two measures from the place detachment dimension of a place attachment scale [48] as a proxy, potentially introducing common-method variance. Our survey measures are limited, using closed-ended responses and a small number of items, and we were unable to control for all potential confounding variables such as media exposure. Future work should explore methods to study the detachment process and test associations in diverse hazard contexts and populations. Developing a construct-specific scale that explicitly focuses on negative sentiments towards place or the loosening of bonds with place would be valuable for future inquiry into how the person-place relationship may be shaped by climate change impacts. This would also enhance our understanding of whether attachment and detachment are merely inverses of each other or are distinct concepts with unique origins and implications for individuals experiencing them as our results might suggest. Finally, our cross-sectional data prevents causal inferences; longitudinal studies capturing sense of

place over time could better explore relationships and would also facilitate true mediation analyses. Longer study durations could track migrating households over time, addressing limitations inherent to using measures of prospective migration.

## 7. Conclusion

It is essential to gain a better understanding of how and when people begin considering migration in response to climate-related hazards to help illuminate the circumstances and emotions that promote migration and to identify individual thresholds for migration. Determining such psychological and experiential correlates may benefit efforts aimed at enhancing resilience among populations in areas increasingly affected by climate change. Additional research at the migration and behavior interface will enable us to better support relocation efforts for those motivated to move by identifying the complexities and circumstances that contribute to migration. Developing targeted interventions and support services to address such factors is imperative. Our research emphasizes the persistence and stickiness of people who wish to remain in place despite threats, highlighting the present need for long-standing support and services in at-risk areas.

## Data availability statement

The data cannot be made publicly available upon publication because they contain sensitive personal information. The data that support the findings of this study are available upon reasonable request from the authors.

## Acknowledgments

We would like to thank Drs. Roxane Cohen Silver and E Alison Holman for their contributions, including conceptualization and providing access to data for this study from earlier waves of data collection. We would also like to thank Dr Ying Wang and Wendy Mansfield from Ipsos for their assistance with survey programming and administration. We would like to acknowledge the Behavioral Decisions and the Environment group at Stanford University for their feedback on this work.

## Funding

Support for this project was provided by the National Science Foundation (NSF) (RAPID Grant #1760764, Roxane Cohen Silver; RAPID Grant #1811883, Gabrielle Wong-Parodi & Roxane Cohen Silver; RAPID Grant #1902925, Roxane Cohen Silver; RAPID Grant #2030139, Gabrielle Wong-Parodi

and Dana Rose Garfin); the National Center for Atmospheric Research (Gabrielle Wong-Parodi); and the Stanford University School of Earth & Environmental Sciences (Gabrielle Wong-Parodi).

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