

# Evacuation as a climate adaptation strategy for environmental justice communities

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**Abstract** With rising sea levels and possible storm intensification due to climate change, current United States urban coastal flood management strategies will be challenged. Due to limitations of current flood management strategies, evacuation is likely to become increasingly prominent in many coastal areas. Thus it is important to think critically about challenges for successful evacuation planning, particularly for vulnerable communities. This paper brings together the evacuation planning, climate change and environmental justice literatures. We describe the unique challenges that environmental justice communities face with evacuation, and identify best practice guidelines to improve the quality of evacuation planning for these communities. The guidelines presented, while not comprehensive, provide a framework for planners and policymakers to consider when developing evacuation plans, both for current and future climate conditions, and could improve the quality of evacuation planning.

## 1 Introduction

With rising sea levels and possible storm intensification due to climate change, we argue that coastal zone evacuation, while now seen primarily as an emergency measure, is likely to increase in importance as a flood management strategy for low-income communities. Thus, the

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challenges associated with evacuation planning under climate change need to be addressed. The goal of this paper is to integrate the evacuation planning, climate change, and environmental justice literatures to shed new light on this topic.

While the challenges of evacuation have been documented and analyzed in great detail in the hazards literature, this literature has been largely silent on the role of climate change and the additional challenges that climate change may bring to planning. The climate literature, on the other hand, has recognized the need for adaptation measures to address coastal flooding, but does not provide insight into the challenges of implementing specific adaptation strategies such as evacuation. Bringing these literatures together to address evacuation planning in environmental justice (EJ) communities will provide new insight into the issue and provide policy advice for coastal flood management.

The hazards and climate adaptation literatures emphasize the complex linkages between physical and social vulnerabilities, both in terms of high exposure and low adaptive capacity to manage and mitigate risks. In this paper, we focus on the unique challenges that EJ communities face because of these vulnerability linkages. EJ is a concept that emerged in the United States in the 1960s in recognition of undue environmental burdens placed on minority and low-income groups. The US Environmental Protection Agency defines environmental justice as “the fair treatment and meaningful involvement of all people regardless of race, color, sex, national origin, or income with respect to the development, implementation and enforcement of environmental laws, regulations, and policies” (EPA 2012). As described by the EPA, “This increased vulnerability may be attributable to an accumulation of both negative and lack of positive environmental, health, economic, or social conditions within these populations or communities” (EPA 2011).

Recent research on climate change has highlighted climate-related environmental hazards that may be higher in EJ communities, such as exposure to sea-level-rise or floods (Clark et al. 1998; Rygel et al. 2006; Kleinosky et al. 2007; Moth 2008; Lange et al. 2009; Ruth et al. 2009; Maantay and Maroko 2009; Martinich et al. 2012). EJ communities are more likely to face exposure to these hazards because of their location in marginal lands, as well as the higher prevalence of poor quality housing that cannot withstand hazards. Not only are they more exposed, but they are also more vulnerable for a variety of social, economic and political reasons (Blaikie et al. 2004). Because of the potential physical and social vulnerability of EJ communities, it is particularly critical to consider whether evacuation is an appropriate flood management strategy, how communities are involved in this decision-making process, and, if evacuation is to be part of an adaptation strategy, whether plans are as robust as possible.

We begin in Section 2 by discussing evacuation and presenting evidence that evacuation is likely to be a more common flood management strategy in the future. Section 3 identifies unique issues for EJ communities. Section 4 situates evacuation planning within the climate adaptation literature. In Section 5 we suggest several policy and planning recommendations to address the challenges of adaptation planning in EJ communities.

## 2 Increased reliance on evacuation

Evacuation can be defined as the “mass physical movement of people in a community, [which] is temporary in nature and emerges in order to cope with community threats, damages, or disruptions” (Quarantelli 1985). A key feature of evacuation is its temporary nature, although in reality, many people do not return after evacuations, either due to choice, or because there are insufficient resources to support their return, particularly in a U.S. context where populations are particularly mobile (Stallings 1991; Elliott and Pais 2006; Li et al. 2010). Evacuation

can be distinguished from “retreat,” which is the permanent relocation away from an area of high risk, and represents a planned strategy as opposed to unintentional abandonment after evacuation. Retreat may be the most appropriate response to some climate-related hazards, but for the foreseeable future, a significant proportion of the United States population will continue to reside in high-risk coastal areas (Strauss et al. 2012). Society tends to respond very strongly to policies promoting forced retreat, suggesting that while it may become a necessary adaptation strategy in the future, it is unlikely to be a prominent strategy in the near-term (see for example the backlash to the French retreat policies after the 2010 storm Xynthia) (IPCC 2014). One of the goals of comprehensive evacuation planning is to ensure that evacuation is truly temporary in nature, and the barriers to return are addressed as part of the planning process.

Risk reduction and protection investments are more cost effective than relying on emergency management, and can be considered the preferred approaches to flood management (Multihazard Mitigation Council 2005; Levy and Gopalakrishnan 2010). Globally, it is estimated that every dollar spent on disaster risk reduction could save four to ten dollars in recovery costs, in addition to leading to fewer lives lost (University College of London 2002). Thus, we do not argue that evacuation is an ideal management strategy; rather, we claim that increasingly, risk reduction efforts for flood management will be insufficient and hazards will exceed existing protective structures.

Traditionally, design standards protect against tolerable risk thresholds, for example 1-in-a-100-year flood events. With this level of protection, evacuation only becomes necessary for rare events. However, with climate change, the frequency of such events is likely to increase. Vermeer and Rahmstorf (2009) project that sea level could rise 20–40 cm by midcentury and as high as 100–200 cm by the end of the century. Tebaldi et al. (2012) calculated changes in recurrence intervals of 100-year events in 2050 and found that along the East coast, new recurrence intervals could range from 2 to 75 years (Tebaldi et al. 2012).

In light of the high level of protection needed to meet these standards under future climate scenarios, it appears unlikely that structural protection can be expanded to provide adequate coverage at acceptable social or ecological costs, an assumption consistent with the Sea Level Rise National Coastal Properties Model developed by the EPA and collaborators (Neumann et al. 2010; Martinich et al. 2012). In fact, we observe a trend in the opposite direction, with structural measures playing a smaller role due to environmental concerns, including erosion downstream, as well as insufficient funding (Leatherman 1996; Valverde et al. 1999). Other options, such as beach nourishment, are also too expensive to invest in on a large scale. One study estimated that beach nourishment for the East coast of the United States could cost \$14.5–26.7 billion over the next century, and this only included a one-time nourishment of major recreational beaches, leaving other coastal areas unprotected (Leatherman 1996).

Other components of a comprehensive flood management strategy, including flood insurance or flood-proofing of buildings play an important role, but do not preclude evacuation. Residents may still have to temporarily leave their homes, as these mechanisms are designed to protect property, not eliminate flooding. Evacuation is frequently considered an option of “last resort” after protection has failed, and an “emergency” has occurred. If evacuation alone is the primary strategy without investments in these complementary strategies, many of the underlying drivers of vulnerability are likely not being addressed, and it could be considered an adaptation failure. Social vulnerability includes all of “the characteristics of a person or group and their situation that influence their capacity to anticipate, cope with, resist and recover from the impact of a natural hazards” (Blaikie et al. 2004, 11), and adaptation measures must address both physical and social drivers of vulnerability to be effective (Turner et al. 2003; Adger 2006). In certain circumstances, evacuation could even be considered maladaptation, if

it creates a false sense of security while allowing for increased vulnerability (Barnett and O'Neill 2010).

### 3 Evacuation in EJ communities

Socio-economic characteristics of certain communities make evacuation particularly likely. We argue that evacuation is likely to be more common in EJ communities because investment in protection is less likely. Infrastructure investment decisions are often made using cost-benefit analysis, which favors immediate benefits over long-term pay-offs, creating bias against investment in risk protection, particularly in light of the high levels of uncertainty associated with climate impacts (Hallegatte 2009; IPCC 2014). Lower valued properties are less likely to be worth investing in, particularly by the private sector, and so protective infrastructure investments may be less likely in EJ communities. Alternatively, if these investments are made, it often leads to increased property values and gentrification, pushing lower income residents out of the neighborhood (Bullard 2007; Gamper-Rabindran and Timmins 2011). A recent analysis of sea level rise and social vulnerability in the United States found that areas of high social vulnerability are less likely to be protected, particularly in the Gulf Region, where the model predicted that over 99 % of highly socially vulnerable people live in areas that are not protected (Martinich et al. 2012). Although governments may consider a broader range of factors when planning investments, including equity and distributional concerns, the EJ and social vulnerability literature suggests that often this is not the case due to issues of power, influence and marginalization (Dow 1992; Adger 2003, 2006; Pelling 2003).

Competing priorities may make flood management solutions more challenging to implement in EJ communities. EJ communities are frequently situated in areas with heavy industry or other land uses (Pastor et al. 2001). The interests of residents may not be the same as commercial or industrial interests, and historically, commercial and industrial interests have often proven more powerful (Towers 2000; Pellow 2001). The presence of heavy industry can also cause long-term problems if hazardous waste is released during floods. In addition, many EJ communities have very little green space available to place new infrastructure (Heynen et al. 2006). Structural solutions in these instances require relocation of existing property or infrastructure.

Not only are EJ communities more likely to need to evacuate than more privileged communities, but there is a large body of literature documenting the additional challenges they may face evacuating successfully (Eisenman et al. 2007; Spence et al. 2007; Toldson et al. 2011). Here a number of these barriers are summarized, highlighting the ways that physical vulnerability and social vulnerability reinforce each other in many circumstances.

EJ communities are likely to rely more heavily on public transportation than other communities, which can make evacuation difficult, due to low vehicle ownership as well as less reliable transport options (Eisenman et al. 2007; Renne et al. 2008). Concerns regarding pets can also serve as a barrier for evacuation, especially for those who lack personal transportation (Whitehead et al. 2000; Heath et al. 2001; Edmonds and Cutter 2008). Fears regarding theft and the safety of their property, as well as job security can act as key deterrents of evacuation for many residents (Eisenman et al. 2007; Baker 1991; Dow and Cutter 2000; Elder et al. 2007). Many residents in EJ communities work marginal jobs with low job security. Without job security, residents may fear that they will lose their job if they are unable to work during an evacuation. In addition, low-income residents may lack the financial resources to rebuild in the event of property loss, making residents more risk averse.

Research has shown that many minorities are reluctant to accept risk information as credible until it has been confirmed through their social network, which can cause delays in response to risk warnings (Spence et al. 2007). Thus when planning evacuations in communities that are likely to be less trusting of government, it is essential to partner with other sources of authority that are more likely to be trusted. For example, research has shown that church groups play a critical role in communicating hurricane warnings in New Orleans, particularly for the Vietnamese community (Eisenman et al. 2007; Airriess et al. 2008). Local organizations can also help to assess community needs and concerns to help government better prepare for an evacuation (Renne et al. 2008; Paolisso et al. 2012; Liu and Schachter 2007).

Due to close-knit kin networks in many minority communities, the additional burdens associated with coordinating extended families tend to affect EJ communities more than other communities (Clark et al. 1998; Eisenman et al. 2007; Elder et al. 2007). In a Denver flood, Latino families were found to rely more heavily on their kin for information and assistance than their Anglo-American counterparts, even after accounting for differences in economic status (Drabek and Boggs 1968). Similar results were found for minority residents after Hurricane Andrew in Florida and Hurricane Katrina in New Orleans (Morrow 1999; Eisenman et al. 2007).

At the same time, strong social networks among minorities may provide support during the recovery process and increase the resilience of EJ communities (Clark et al. 1998). In the language of social capital, minority communities tend to exhibit more “bonding” social capital, but less “bridging” and “linking” social capital (Costa and Kahn 2003; Hawkins and Maurer 2010). This bonding social capital can provide support during and after evacuations, with neighbors helping neighbors and emergent “prosocial” behavior developing as coping strategies, as has been well-documented in the case of Hurricane Katrina, as well as more broadly in response to tornadoes and wildfires (McGee and Russell 2003; Rodriguez et al. 2006; LaLone 2012).

If evacuation is likely to be a more common flood management strategy in the future, especially for EJ communities, planners and policymakers need to design strategies to ensure that evacuations are as effective and equitable as possible. The following section describes evacuation as part of the adaptation planning process, and the final section presents a few recommendations for incorporating evacuation into adaptation planning that hopefully can address some of these effectiveness and equity concerns.

#### 4 Evacuation in a climate adaptation planning process

The literature widely acknowledges that evacuation can be part of adaptation strategies, and in light of the inability to protect all areas, it is important to consider seriously in the planning process (McLeman and Smit 2006; de Bruin et al. 2009; JICA 2010; Porio 2011; Zagonari 2013). Some countries have moved forward with incorporating evacuation into comprehensive plans. For example, the Netherlands has developed a flood management system that relies on protection as a first-line defense. In the event that this fails, flood-proofing measures are employed, and ultimately, evacuation is planned (Ministry of Transport et al. 2009). The Japanese International Cooperation Agency (2010) recommends provision of both flood-proofing of buildings and evacuation plans in areas where no structural protection will be provided. An Australian study in a rural inland community found that, among the many options, flood management could best be improved by better marking evacuation routes and enhanced flood-warning systems (Keogh et al. 2011). However, the latest IPCC report finds

that overall there is little consideration of changes in services related to evacuation in city-level adaptation plans to-date (IPCC 2014).

Although the literature discusses evacuation in the context of adaptation planning, it does not directly compare it to other strategies, or explicitly address the challenges of implementing evacuation as an adaptation strategy. We were only able to identify a few studies that specifically compared evacuation with other adaptation options for flood management in EJ areas. Zander et al. (2013) found that Australian Aborigines did not want to relocate from the coast, and instead wanted better roads and early warning systems for evacuation, although these were less desirable than protection from flooding. Kirshen et al. (2012) and Douglas et al. (2012) used focus groups to discuss adaptation options with an EJ community in East Boston, Massachusetts. They found that residents were concerned about the appropriateness and feasibility (logistical and political) of many adaptation options for their community. Comparatively, evacuation fared well in the community's assessment. Retreat was viewed very negatively because they could not identify alternate areas with access to public transit and affordable housing. Seawalls would block access to the coast, and landlords could not be relied on to invest in flood-proofing. Of course, this preference for evacuation could be driven by a lack of complete information on the costs of evacuation, as this area has not historically faced evacuation. However, these findings are consistent with research from Scotland (Kenyon 2007), which showed that sea walls and other hard structures are among the least preferred options.

Compared to other planning processes, a challenge for adaptation planning is the uncertainty of the future climate. The uncertainty of the size and timing of impacts at the local level, when other demands on resource allocation and planning are perceived as more imminent and better understood makes decision-making difficult (Hallegatte 2009; IPCC 2014). The literature on adaptation planning suggests developing robust strategies that function acceptably well under all future uncertainties and risks and/or flexible strategies that can be adjusted as the climate changes (Yohe 2009; National Research Council 2010; Stakhiv et al. 2010; Hall et al. 2012; Kirshen et al. 2014). By focusing on these types of actions, decision-makers can move beyond the potential paralysis created by uncertainty and ensure risk is managed even in the face of uncertainty. Evacuation fits these criteria because it does not preclude the pursuit of other options. It may be appropriate as part of a tiered strategy, adding additional robustness to a strategy that also includes protection. These benefits of evacuation need to be balanced with the challenges for evacuation, with the goal of addressing both present evacuation challenges as well as future adaptation needs.

## 5 Implications of climate change for evacuation planning for EJ communities

In this section we identify several ways that climate considerations should influence flood management and evacuation planning to address the concerns raised in this article regarding EJ communities.

### 5.1 Inform and engage EJ communities in decisions about adaptation

As cities begin to engage in an adaptation planning process and make decisions about where to invest resources in protection and where not to, EJ residents have a right to both be informed and engaged in the decision-making process. Environmental justice is about the *process* of environmental decision-making, not simply the vulnerability of specific populations. Even if full protection of all EJ communities is not possible, if residents are aware of the long-term



plans for their community, they can make informed personal decisions, including the decision to move to other, more protected or less flood-prone neighborhoods. It will also allow residents to prepare evacuation plans ahead of time, helping reduce the challenges for evacuation during an emergency.

In spite of the challenges inherent in participatory adaptation planning, evidence suggests that EJ communities, if provided with information in an appropriate fashion, are capable of engaging in a planning process. However, care must be taken to ensure that this engagement is meaningful and not a token measure. Research suggests that public officials are particularly skeptical of the ability of the public to consider long-term adaptation measures and compared to other planning processes, decisions are more likely to be made independently (Few et al. 2007). To avoid this, planners and policymakers need to begin a participatory process early, and present community members with sufficient information to effectively engage in planning. This will require additional resources, as participatory planning is a lengthy process necessitating dedicated staff and resources (Tingsanchali 2012).

### 5.2 Begin incorporating evacuation into transport planning now, even if significant flooding is not projected in the near-term

Because of the long-term nature of transportation infrastructure investments, it is important to consider future evacuation needs now, even if flooding is not project in the near-term (IPCC 2014). Current evacuation routes should be modeled under different climate scenarios and their feasibility under current and future conditions analyzed. If current routes insufficiently meet needs, it may be necessary to develop alternate evacuation routes. Even if routes do not need to be modified immediately, land use policies should prioritize conservation for potential future routes. This is particularly important in less-developed areas. If potential routes are not available, alternative evacuation approaches should be identified, such as by boat (Johnson 2005). With such alternatives, safety and feasibility must be carefully considered, as evacuation may only be feasible before storm conditions intensify.

### 5.3 Plan for the impact of lack of experience due to changing climate trends on evacuation decision-making

Residents of communities that have not historically experienced flood risks do not have the past experience shown to be critical to evacuation-decision-making. One of the only factors consistently shown to influencing decision-making about evacuation is past experience (Baker 1991; Dow and Cutter 2000; Rohrmann 2000; Whitehead et al. 2000; Peacock et al. 2005; McGee 2011). The evidence on the impact of past experience on evacuation is mixed. On the one hand, if residents have survived multiple storms in the past without evacuating, they may be more likely to believe they will be fine and be less likely to heed warnings (Baker 1991; Peacock et al. 2005; Eisenman et al. 2007). On the other hand, people with more experience may have more information about how to evacuate, making it easier to decide to leave (Peacock et al. 2005). In general, though, those who know what to do in an evacuation (in large part through past experience) are more likely to decide to evacuate, presenting a challenge for inexperienced communities.

For areas where few people are likely to have past experience with evacuation, one of the only ways to address this challenge is to provide information ahead of time in formats that are accessible to all residents, including the most vulnerable. In light of this limitation, it is concerning that EJ communities face higher barriers accessing information about how to evacuate. Issues include lack of reading skills to understand evacuation maps, speaking a

language other than English at home, and a lack of trust of public officials (Cordasco et al. 2007; Spence et al. 2007; Zarcadoolas et al. 2007; Brodie et al. 2006; Elder et al. 2007). Providing educational materials and instructions in multiple languages can help ensure that the needs of non-English speaking residents are met. Meeting these needs may require additional staff training, or collaboration with native speakers, as emergency management staff likely lack sufficient language skills to meet all needs (Airriess et al. 2008).

#### 5.4 Consider the increased frequency of flooding when estimating costs and comparing evacuation to other options

While the initial costs of evacuation may compare quite favorably to other flood management options, it is important to consider the increasing frequency of flooding in the future. While we still expect evacuation to play an important role in flood management, cities should fully consider the associated costs before dismissing alternatives. The true economic costs of evacuation may be higher than they initially appear once the full costs of reconstruction and recovery are incorporated. For example, estimates of the cost of recovery for New Orleans and the Gulf Coast range from 160 to 300 billion dollars (Flynn 2007). Recovery can also have additional hidden costs. For example, financing recovery may require reallocation of funding from other social and economic priorities, leading to long-term lower social welfare outcomes (Warner et al. 2010).

Economic costs are not the only costs of evacuation; the evacuation and recovery process can have social and emotional costs for communities and individuals. Because of the vulnerable socio-economic status of many EJ communities, flooding events may lead to permanent damage and loss of economic, social and cultural vitality unless sufficient attention is placed on the recovery process ahead of time. Social identities and structures impact the response to disasters and ability to recover, and the recovery process may not be experienced evenly by all community members (Elliott and Pais 2006). Analysis of New Orleans' recovery suggests that there were large racial disparities in the economic and health outcomes of New Orleans' residents after Hurricane Katrina, with Black residents experiencing more health problems, lower emotional health, and greater financial challenges (Toldson et al. 2011). In addition, it has been shown that the initial response to the disaster and clear communication regarding a long-term vision of recovery has a significant influence on who returns and rebuilds in a community after a disaster (Kim and Soo Oh 2013). Traumatic events act as catalysts for change, and can restructure both the vulnerability and resilience of a city (Gotham and Campanella 2011). The recovery and rebuilding process can reinforce existing vulnerabilities, due to differential coping abilities and available resources to recovery, or it can provide opportunities for addressing long-standing structural barriers to resilience and lead to stronger communities. Ensuring that the recovery process leads to greater resilience and does not reinforce existing vulnerabilities requires a proactive recovery plan that focuses on the needs of vulnerable populations and underlying drivers of vulnerability.

## 6 Conclusions

Our analysis shows that evacuation is currently one of the most common approaches to coastal flood management in the United States, and under climate change, is likely to continue to be a dominant strategy. Even though there is a high probability that evacuation will become a more common flood management strategy for EJ communities under future climate conditions, there is very little literature addressing the unique issues that EJ communities face. Our analysis



suggests that poorly planned, or ‘reactive’, evacuation will create severe challenges for EJ communities. Given that evacuation needs to be incorporated as an element in long-term adaptation strategies, ‘proactive’ evacuation plans are needed. This will require concentrated and careful preparation in dialogue with EJ communities and specific policies to ensure the specific needs of vulnerable groups are met.

A plan that relies solely on evacuation will be insufficient, and could even be considered maladaptative by increasing the vulnerability of communities to hazards. Therefore, evacuation planning needs to be undertaken in the context of a more comprehensive adaptation planning process that addresses underlying vulnerabilities and seeks to build the resilience of individuals, communities and the environment. Measures to increase protection, flood-proof homes, and provide insurance are all necessary complements to evacuation and should be part of an adaptation plan.

As planners and policymakers begin to prepare for climate impacts, it is critical to learn from past experience with evacuations in EJ communities. Because many areas without past experience of flooding will be at risk in the future, this may not happen automatically, and requires attention to these issues by planners and policymakers. The recommendations presented here, while not comprehensive, provide a framework for consideration when developing evacuation plans, both for current and future climate conditions, and could improve the quality of evacuation planning.

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