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The role of proximity to waterfront in residents' relocation decision-making post-Hurricane Sandy

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ABSTRACT

The experience with Superstorm Sandy advanced the dialogue on the long-term response options that would minimize risks and ensure livability in high-risk coastal environments. One strategy considered permanent relocation of homes from flood-prone areas. However, little is known about the factors that might influence a homeowner's decision to relocate, how their home's proximity to the shoreline may affect their risk perceptions and willingness to relocate. This paper explores the role that proximity to the oceanfront plays in relocation decision-making. It examines geospatial determinants collected as a part of a 2013 household survey conducted post Hurricane Sandy and their relationship with survey responses and socioeconomic predisposition. The analysis uses geospatial data to assess the proximity attributes of participating households. The proximity parameters were statistically compared to the socioeconomic profile and survey responses. The results demonstrate that the location of surveyed households, even though adequately dispersed to the oceanfront proximity, had only a minor effect on the willingness to relocate, suggesting that non-geophysical factors, such as household-level confidence in the ability to adapt and continue habitation in such locations, values, and other qualitative personal factors play a larger role. The findings also show that participants living closer to the bay are more likely to consider relocation if exposed to repetitive flooding and offered participation in buyout program.

1. Introduction

Coastal cities have been increasingly affected by coastal hazards. Scientists project that these events will occur with an increasing frequency and magnitude in some areas due to accelerated sea-level rise and larger populations living on the coast (Bender et al., 2010; Villarini and Vecchi, 2013; Kim et al., 2014). The sea level rise impacts will be more pressing on long-term horizons, while changes in storminess, wave activity, and resulting increase in episodic flooding (Knutson et al., 2010; Irish et al., 2014; Zanuttigh et al., 2015) and erosion will be more damaging to coastal built environments in the immediate future (McNamara et al., 2015). Future episodic and chronic flooding will exert a significant pressure on social, environmental, economic, and built systems (Alexander et al., 2012) and, as such, could compromise the livability of coastal urban centers (Frey et al., 2010; Nicholls and Cazenave, 2010; Sallenger et al., 2012). Geospatial proximity to hazards influences individual's perception of risk and risk-based decision making (Brody et al., 2004; Haynes et al., 2008; Maderthaner et al., 1978; Severtson and Burt, 2012). However, it is unclear how proximity to risk affects individual homeowner's willingness to consider relocation, especially after exposure to a major disaster. This paper analyzes resident's post-Sandy perceptions about relocation against distance measures from coastal hazards (oceanfront and bay side distance), as well as house elevation.

1.1. Hurricane sandy as a wakeup call

Hurricane Sandy hit the United States (U.S.) Eastern Shores in October 2012, and caused significant storm surge, storm tide, and damaging waves. It brought extensive flooding to New York, New Jersey, and Connecticut (Blake et al., 2013). It resulted in 147 fatalities in the U.S. with 72 direct deaths mostly due to storm surge and fallen trees, and 87 indirect deaths caused by power outages, making Sandy the deadliest U.S. tropical storm in Northern states since Hurricane Agnes (1972) (Blake et al., 2013). The damages to housing stock were also extensive. Five-million residences and 324,000 housing units were damaged or destroyed, and 22,000 fully uninhabitable in New Jersey and 305,000 in New York (Blake et al., 2013). The overall loss in the U.S.

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was estimated to be $65 billion (NOAA, 2013; Rosenzweig and Solecki, 2014). Some coastal jurisdictions such as Monmouth and Ocean County in New Jersey and Staten Island and Rockaway in New York, as well as the majority of barrier islands experienced disproportional damages due to extensive inundation with water, sand, debris, and change in sediment deposition and overall landform (Blake et al., 2013). The Hurricane Sandy disaster served as a wakeup call for many communities on the Eastern Seaboard, especially considering the low expectation that an event of such magnitude could occur in highly-urbanized metropolitan areas like NY City and New Jersey. It highlighted the risks of living along the coast, unique urban socioeconomic and physical vulnerabilities, as well as the long-term challenges associated with accelerated sea-level rise. The increased awareness about the vulnerabilities of infrastructure, transportation networks, residents, services, and critical facilities resulted in the proliferation of various initiatives and programs, some focused on adaptation and disaster risk reduction, some on integrated strategies, some on structural and soft measures, and some on relocation via buyout programs.

1.2. Response options

To reduce short-term and long-term risk of coastal hazards like Hurricane Sandy, coastal communities can take a variety of actions: a) protect their assets and population via structural or non-structural interventions; b) accommodate changing conditions by improving coping strategies, and c) retreat or relocate away from the shoreline through property acquisition, buyouts, or relocation programs (Nicholls and Tol, 2006; Klein et al., 2007; IPCC, 1996). The preferences for different strategies will depend on the local context such as political and public support, financial and technical resources, institutional capacities, affluence, and sociocultural determination to continue habitation in the increasingly challenging environment. It will be also influenced by the progression of impacts influenced by other local characteristics such as topography, hydrology, ecosystem, land use, built environment, natural resources, tourism, navigation, and presence of other hazards. Due to the complexity of hazard risks in some areas, such as barrier islands and those with complex networks of interconnected waterways, the available adaptation options may be limited either to the combination of strategies or relocation. Even though relocation may be the most appropriate option for low-lying coastal areas, like barrier islands, the implementation of this strategy may be only possible after coastal governance and institutional frameworks integrate it with other planning and development objectives (Abel et al., 2011).

Despite the challenges, relocation represents an effective coastal-flooding hazard mitigation (Drabek, 1986; Tobin and Peacock, 1982; Perry and Lindell, 1997; Williams, 2013) and climate change adaptation strategy (Adger et al., 2007; Warner, 2009; Tacoli, 2009; Gemenne, 2010; Barnett and Webber, 2010; McLeman and Smit, 2006; Leighton et al., 2011; Warnecke et al., 2010; King et al., 2014). Case studies describe the complexity of relocation process in numerous communities (Alaska Climate Change Sub-Cabinet, 2010; Cronin and Guthrie, 2011; Patel, 2006; Campbell et al., 2005; Maldonado et al., 2013). The 3rd National Climate Assessment report (USGCRP, 2014) urges additional consideration of relocation due to accelerating sea level rise, coastal storms, erosion, and inundation. Up to half of socially-vulnerable coastal areas may experience forced displacement resulting from insufficient resources for structural protection and lack of political support for proactive relocation (USGCRP, 2014). Much is known about disaster evacuations and displacement, especially from the riverine flood-prone areas, both in the U.S. (Davidson, 2005; Buss, 2005), and internationally (Nigg and Tierney, 1993). Hurricanes Andrew, Katrina and Sandy initiated a spur in research on displacement decision-making, acquisition and buyout programs, and population movement (Groen and Polivka, 2010; Landry et al., 2007; Elliott and Pais, 2006; Smith and McCarty, 1996). Also, more is known about the drivers of relocation and which factors seem to be important in disaster-related mobility decision-making, such as race/ethnicity, wealth, home-ownership, education, age, gender, marital and homeownership status, and employment (Black et al., 2011; Landry et al., 2007). But there is still a need to advance dialogue on relocation as an adaptation strategy, optimal implementation strategies, mechanisms of public participation, and policy support (Blanco et al., 2009; Gromilova, 2014; Warner et al., 2013).

Relocation, also referred to as managed retreat (Alexander et al., 2012), has been received with mixed opinions in New York (Kaplan, 2013; Roy, 2013) and New Jersey (Attrino and Spoto, 2015) and has gained limited attention in coastal Alaska and Louisiana (Maldonado et al., 2013). Nevertheless, as the accelerated and more persistent coastal flooding is becoming a more pressing problem, it is prompting some communities such as Alaskan remote villages to consider relocation due to decreasing Arctic sea ice, thawing permafrost, repetitive flooding (Bronen, 2015; CAKE, 2011; GAO, 2003; ACCAP, 2009). Other examples include the frequently flooded Kamgar Putala slum in India which was relocated to a new housing community in Pune located outside the flood prone area (Cronin and Guthrie, 2011); a community in Grantham, Queensland (Australia) which was quickly relocated after the 2011 devastating flash flooding (Okada et al., 2014); and Isle de Jean Charles in Louisiana which was relocated due to land loss (Lowlander Center, 2015). However, research on anticipatory or preventive, as well as more extensive collective relocation is prevalently lacking.

The factors that influence a homeowner's decision to participate in such a program, however, are complex and not well understood (Bukvic et al., 2015). Managed retreat programs are considered drastic methods of decreasing risk by some (Greer and Binder, 2016), and can impose negative impacts on the residents through loss of sense of community, loss of culture, economic hardship, and psychological distress (Binder et al., 2015). However, some communities, most notably in rural Alaska and Louisiana, successfully overcame potentially negative impacts by active engagement in the planning and implementation process (Maldonado et al., 2013).

Buyouts have been proposed to effectively manage retreat (Kousky, 2014). The most notable home buyout program was established by the Governor Andrew Cuomo in New York State in 2013 and offered eligible homeowners the pre-storm value of their house pre-Sandy, plus other monetary incentives to increase the participation rates (Governor's Office of Storm Recovery, 2016). Homeowners were eligible for an additional ten-percent of their pre-storm home values if they jointly signed up to sell their property within the continuous neighborhood blocks, and for the five-percent increase if they relocated within the same jurisdiction, but outside of the high-risk zone (Governor's Office of Storm Recovery, 2016; Kaplan, 2013). The uptake of buyout programs varied across different communities. In Oakwood Beach on Staten Island, the program was highly successful with 180 homeowners participating (Fee, 2015), while in some other neighborhoods people were committed to staying in place (Kaplan, 2013). In Nassau County, officials opted out of the buyout program due to concerns with the loss of housing stock, loss of tax revenue, and perceived low levels of interest (Bonilla, 2016; McDermott and Ryan, 2013). The Blue Acres Buyout Program in New Jersey similarly offered homeowners options for relocation out of the disaster-prone areas. The program offered pre-storm market value to more than 500 homeowners affected by Hurricane Sandy and eventually achieved enrollment of 200 homeowners at a cost of $300 million to obtain their properties (Blue Acres Buyout Program, 2016).

1.3. Role of proximity

Proximity plays an important role in risk perceptions of various hazards (Lindell, 1994; Peacock et al., 2005) and related actions people are willing to take to mediate their hazard exposure (Lindell and Hwang, 2008). For example, in the case of proximity to a nuclear