Social Vulnerability to Coastal and Inland Flood Hazards: A Comparison of GIS-Based Spatial Interpolation Methods

Marilyn C. Montgomery, Department of Geography, University of South Florida, Tampa, FL, USA

Jayajit Chakraborty, Department of Geography, University of South Florida, Tampa, FL, USA

ABSTRACT

Previous research on exposure to flood hazards suggests that individuals characterized by low social vulnerability are more likely to reside in coastal flood hazard zones than individuals of higher social vulnerability, but few studies have examined if similar exposure patterns can be observed in inland flood hazard zones. This paper examines differences in environmental justice implications between coastal and inland flood hazard zones in Tampa Bay, Florida, based on implementation and comparison of five different GIS-based interpolation methods. The results of the authors’ study indicate that individuals with traits of low social vulnerability are more likely to reside within either coastal or inland flood hazard zones than areas outside flood zones, and socially vulnerable individuals are more likely to reside within inland flood zones than coastal. They also observe that choice of spatial interpolation method does not significantly affect which socio-demographic groups are most exposed to coastal and inland flood hazards.

Keywords: Areal Interpolation, Coastal Hazards, Dasymetric Mapping, Environmental Justice, Flood, Geographic Information Systems (GIS), Risk, Vulnerability

INTRODUCTION

Environmental justice (EJ) research in the U.S. has focused on seeking the evidence to determine if racial/ethnic minorities and socioeconomically disadvantaged groups are disproportionately exposed to various environmental hazards and risks. While numerous previous studies have examined social and spatial inequities in the distribution of technological hazards such as air pollution, hazardous waste, or industrial manufacturing facilities, relatively little research has been conducted on unequal exposure to natural hazards. However, Hurricane Katrina and the subsequent failures of government in responding to this disaster have prompted researchers to examine the social equity implications of disasters caused by geophysical phenomena. Specifically, the disproportionate exposure of the most socially

DOI: 10.4018/jagr.2013070104
vulnerable groups in New Orleans, Louisiana, to the most hazardous flooding in the aftermath of Hurricane Katrina has initiated inquiry of the EJ implications of exposure to flood hazards. While flood hazards are usually considered to be natural hazards, urban planning and flood mitigation activities are purely anthropogenic. Consequently, recent EJ studies have emphasized the need to examine the geographic distribution of flood risks with respect to the racial/ethnic and socioeconomic characteristics of local residents (e.g., Fielding & Burningham, 2005; Johnson, Penning-Roswell, & Parker, 2007; Maantay & Maroko, 2009). An EJ-oriented research approach is necessary to investigate whether certain groups of society are disproportionately exposed to natural hazards, as well as if their resiliency to natural hazards is enhanced with public resources.

As with Louisiana, Florida is a state that is highly susceptible to flood hazards. Florida received the highest rank for flood risk from the Federal Emergency Management Agency (FEMA), followed by California, Texas, and Louisiana, based on a composite score computed from floodplain area and the number and value of households within floodplains (Federal Emergency Management Agency [FEMA], 1997). Florida’s low topography and densely populated coastal areas, combined with natural wetland alterations and floodplain development, have created elevated levels of flood risk in many counties of the state (Brody, Zahran, Maghelal, Grover, & Highfeld, 2007). Urban areas of lower elevation are often undesirable places to live because of increased risk of flooding hazards. Ueland and Warf (2006) examined the correlation between socially vulnerable groups and low topography using a large sample of U.S. southern cities. Their findings indicated that low-lying areas were characterized by residences of socially vulnerable people in most cities. Conversely, in Fort Meyers, Florida, areas of lower topography were found to be populated mostly by less socially vulnerable residents. These results can be explained, in part, by the fact that property values usually increase as elevation decreases in Florida, and coastal areas are characterized by lower topography. Coastal property values may be higher than their inland equivalents, but all flood insurance rates are lower than those that would be set by private insurance companies (Bagstad, Stapleton, & D’Agostino, 2007), since flood insurance in the U.S. is federally subsidized through the National Flood Insurance Program (NFIP). Although the NFIP is designed to mitigate costs from damages to property incurred by flooding by making flood insurance affordable to all who require it, this program has been criticized because it promotes development in floodplains (Bagstad et al., 2007; Brody et al., 2007). In the U.S. and especially in Florida, governmental structures such as NFIP and dense coastal development have created an environment that is susceptible to flooding and related disasters.

Previous research on exposure to flood hazards in the U.S. (e.g., Bin & Kruse, 2006; Ueland & Warf, 2006) suggests that individuals of higher socioeconomic status (lower social vulnerability) are more likely to reside in coastal areas than individuals of lower socioeconomic status (higher social vulnerability). Few studies, however, have examined if similar exposure patterns can be observed in inland areas that are typically characterized by higher proportions of socially vulnerable individuals. It is apparent that in Florida, coastal areas are characterized by higher property values and individuals of higher socioeconomic status. More research is necessary, however, to determine the socio-demographic characteristics of inland flood zones and compare them to those in coastal flood zones.

An additional challenge associated with EJ analysis is that individual or household level data on socio-demographic characteristics necessary to evaluate at-risk areas and populations are not publicly available. Consequently, EJ studies have relied mainly on information collected by the U.S. Census Bureau and other agencies that are commonly aggregated at the level of pre-defined administrative boundaries or census enumeration units. However, the shape and size of the geographic area exposed to an environmental hazard is unlikely to match the
Related Content

A Geo-Decisional Tool for the Management of the Agricultural Development Fund Under the Green Morocco Plan
[www.igi-global.com/chapter/a-geo-decisional-tool-for-the-management-of-the-agricultural-development-fund-under-the-green-morocco-plan/214486?camid=4v1a](www.igi-global.com/chapter/a-geo-decisional-tool-for-the-management-of-the-agricultural-development-fund-under-the-green-morocco-plan/214486?camid=4v1a)

Unified Rule Approach and the Semantic Enrichment of Economic Movement Data
[www.igi-global.com/chapter/unified-rule-approach-semantic-enrichment/64002?camid=4v1a](www.igi-global.com/chapter/unified-rule-approach-semantic-enrichment/64002?camid=4v1a)
Optimal Methodology for Detecting Land Cover Change in a Forestry, Lakeside Environment Using NAIP Imagery
[www.igi-global.com/article/optimal-methodology-for-detecting-land-cover-change-in-a-forestry-lakeside-environment-using-naip-imagery/218205?camid=4v1a](www.igi-global.com/article/optimal-methodology-for-detecting-land-cover-change-in-a-forestry-lakeside-environment-using-naip-imagery/218205?camid=4v1a)

A GIS Methodology for Assessing the Safety Hazards of Abandoned Mine Lands (AMLs): Application to the State of Pennsylvania
[www.igi-global.com/chapter/gis-methodology-assessing-safety-hazards/68256?camid=4v1a](www.igi-global.com/chapter/gis-methodology-assessing-safety-hazards/68256?camid=4v1a)