Sea Level Rise Misconceptions in Broward County, FL

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Introduction

Global climate change stressors downscale to specific local vulnerabilities, thus requiring unique local adaptation strategies. In southeast Florida, sea level rise (SLR) is of specific concern, both as a present and as an impending threat, that requires a localized planning approach (Parkinson, 2009). Zhang (2010) estimated that 79% of Broward County's land area will be inundated between 1.5 and 3 m (4.9 to 9.8 ft) of SLR. Coastal populations are particularly at risk due to erosion, inundation and storm surge, but interior populations are also susceptible to rising water tables. Groundwater storage is reduced in the wet season, and SLR permanently limits storage capacity by lifting the aquifer closer to the ground surface.

Robust SLR adaptation options require significant economic costs that many people may not be willing to pay for if they do not perceive an actual risk. While actual risk can be calculated from physical data and statistical probabilities (Kaplan & Garrick, 2006), perceived risk differs because individual views are skewed by political, cultural, emotional, and timing filters (Leiserowitz, 2005). If perceived risk does not adequately line up with actual risk, the necessary strategies may not be implemented due to lack of public support (Raaijmakers *et al.,* 2008).

The objectives of this study are to **1) Identify perceived risk** to influences of SLR on storm surge, inundation, flooding, and society **2) Determine actual risk** based on an index of physical vulnerability data and **3) Compare perceived risk to actual risk** both spatially and socioeconomically to determine how closely residents' perception of risk matches their actual risk.

Methodology

In the study area, Broward County, FL, perceived risk data was collected via 28-question online surveys (N = 487) distributed via snowballing (Streeton *et al.*, 2004). Questions included, "What is the elevation where you live?" and "How far would you have to dig in the ground to get to water?" Actual risk was determined by obtaining true values and indexing vulnerability to storm surge, residential property loss, and groundwater storage. A preliminary statistical analysis was conducted to identify spatial trends in terms of perceived risk being underestimated, realistic, or overestimated.

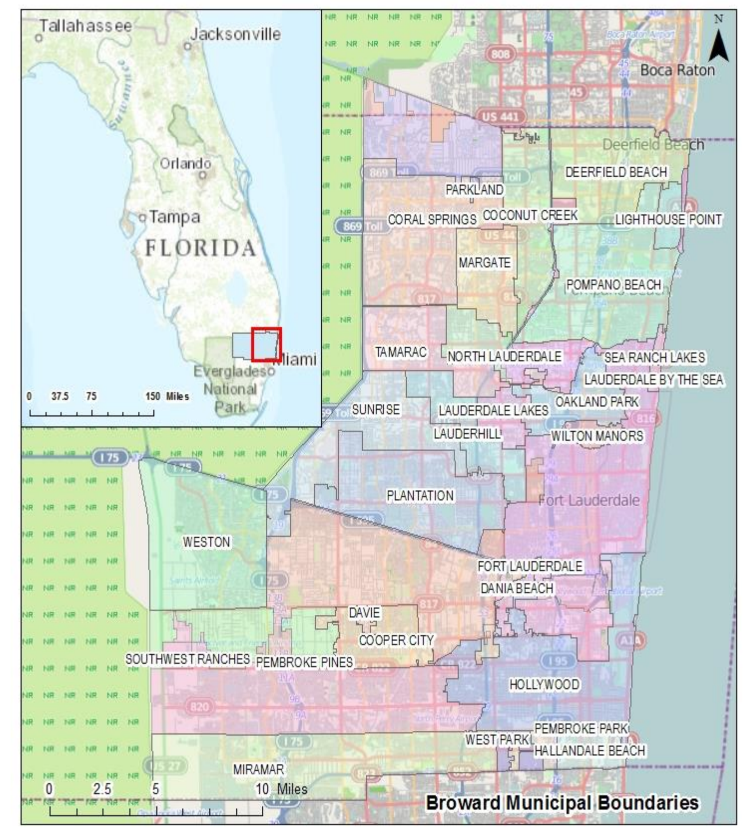
Survey Geocoding – Respondents were given the option to provide their street; zip code was required (there were 475 street level responses). For the county street layer, vectors with the same street name same zip code were dissolved and input to an *Address Locator*. Respondents locations were geocoded to street/zip code midpoints. Multiple data sources for streets (US census, Broward county GIS, Florida Department of Transportation (FDOT), ESRI) were used to verify locations.

Determining actual **elevation, depth to water table (DTW), hurricane evacuation zone, and flood zone** – These are the indicators for property loss, groundwater storage, storm surge, and flooding, respectively. Comparing actual risk values to estimations from survey responses requires downscaling data to the smallest area in which the respondent can possibly reside. Data was clipped to residential areas as designated by FDOT land use. Streets within the same zip code were concatenated, and a 200 ft buffer was created around each. The mean, standard deviation, and range of elevation, DTW, and surge zone were calculated for each street buffer using a zonal statistics tool. Values for all data were extracted to respondent points and evaluated against survey answers.

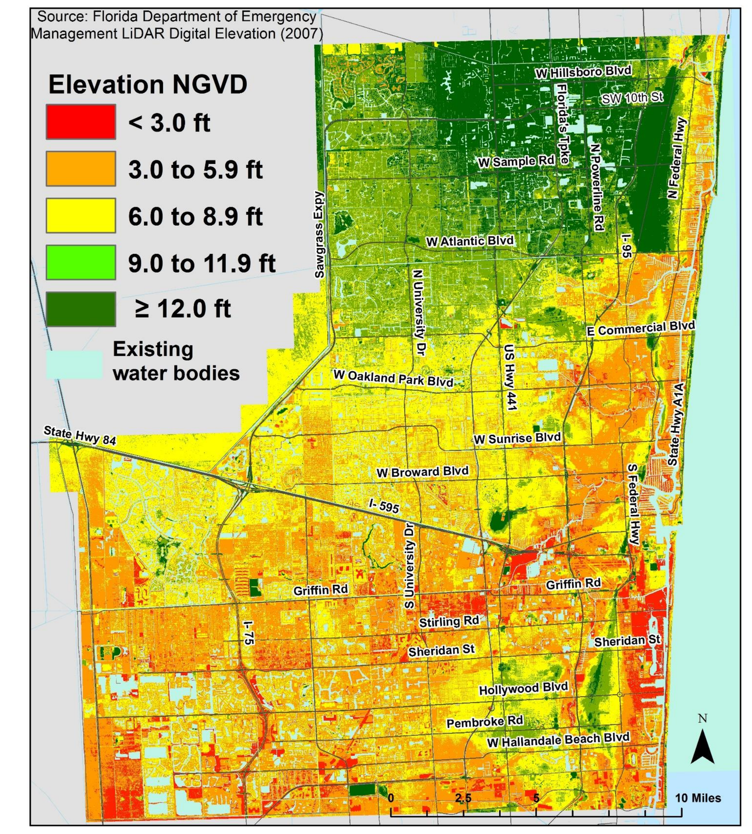
Indexing indicators for relative risk – Respondents were asked in Likert scale format to estimate personal risk to property loss, storm surge (SS), and flooding, in comparison to the rest of the county. To compare actual data to the survey answers, indexes were created for each of the three indicators. For SS, two feet of SLR were added to a category 5 Sea, Lake, and Overland Surges from Hurricanes (SLOSH) model and interpolated. The SS height was subtracted from elevation to calculate depth of surge as a raster surface. For the SS and elevation rasters, standard deviations were taken from the mean to create 5 categories of risk. For the DTW, there were only 5 categories, so these were used. Respondents were classified by each index.

Other Survey Answers – Answers related to demographics and opinions/concerns about SLR were aggregated and coded. A frequency analysis and contingency tables were used to assess the responses.

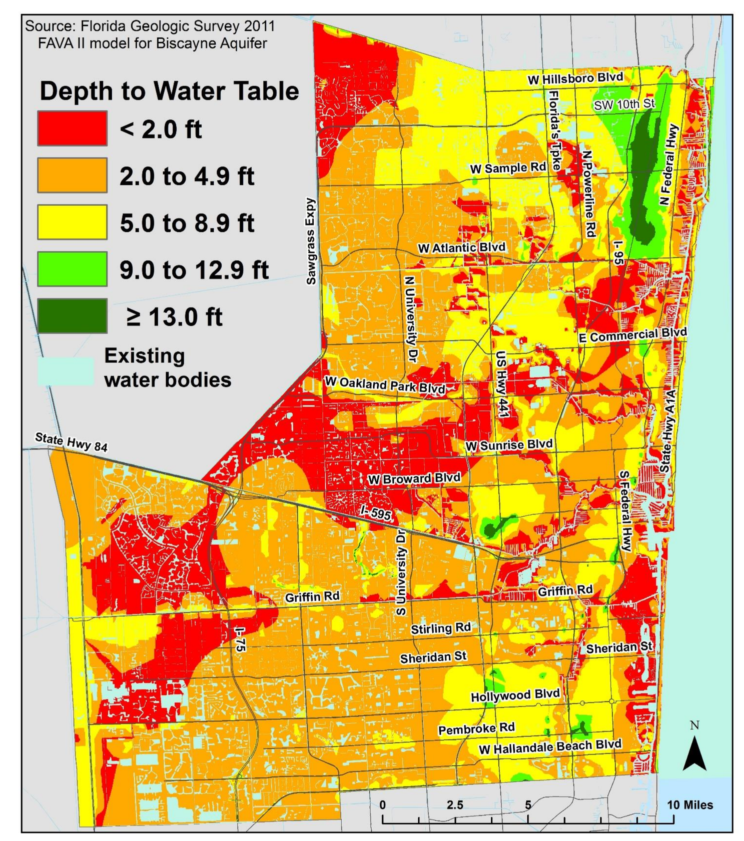
Study Area



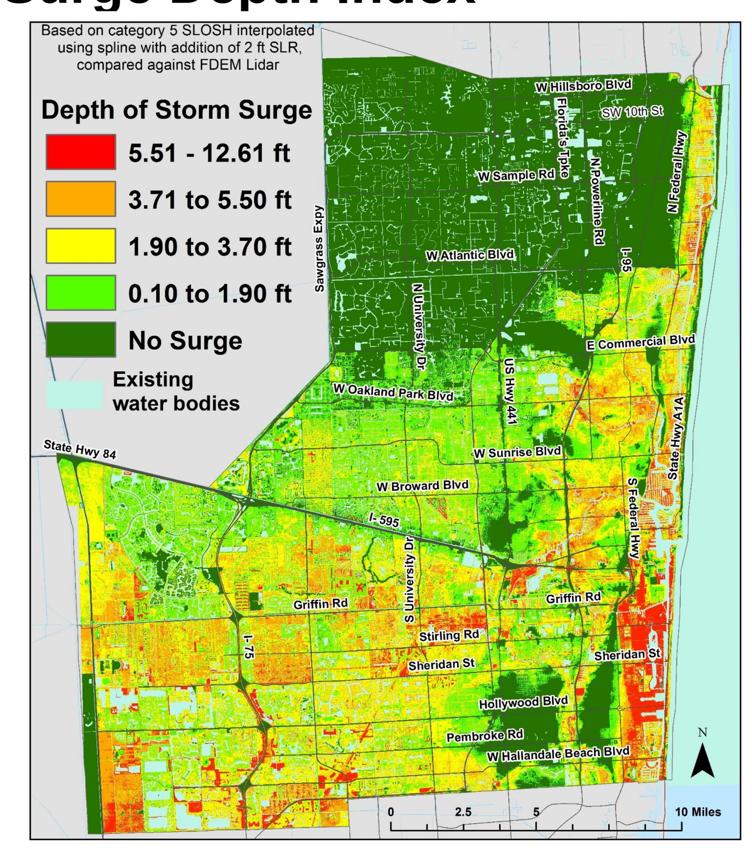
LiDAR Elevation Index



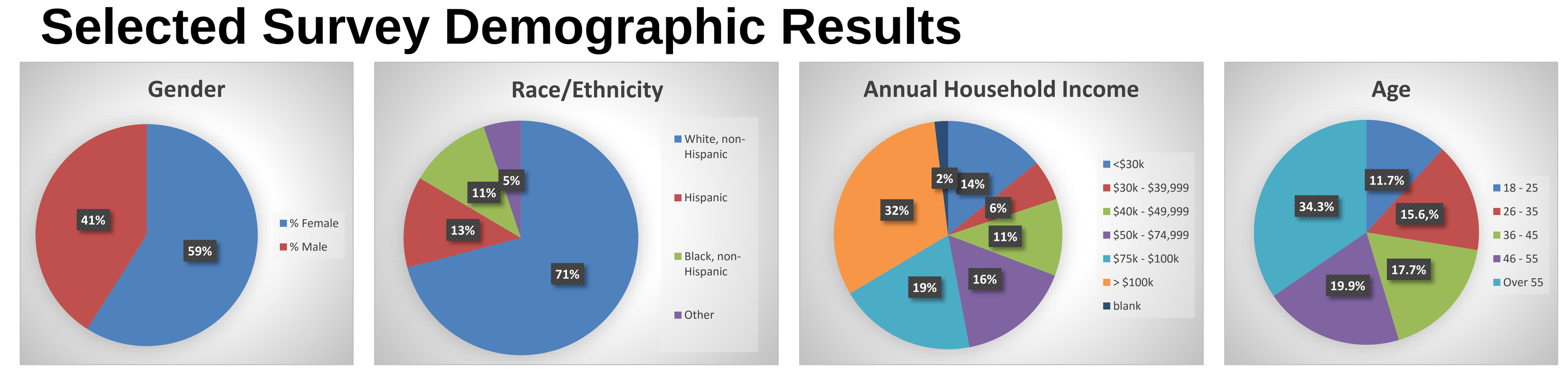
Groundwater Index



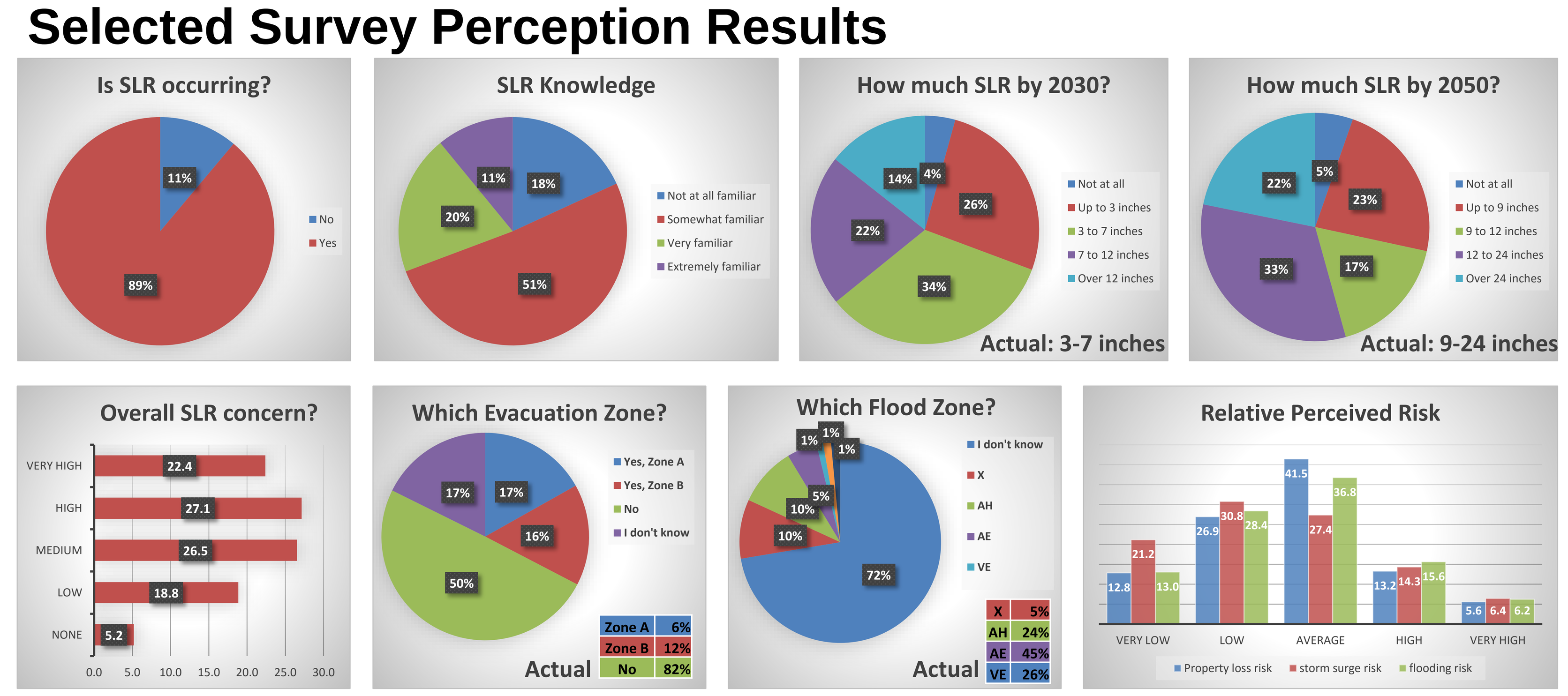
Surge Depth Index



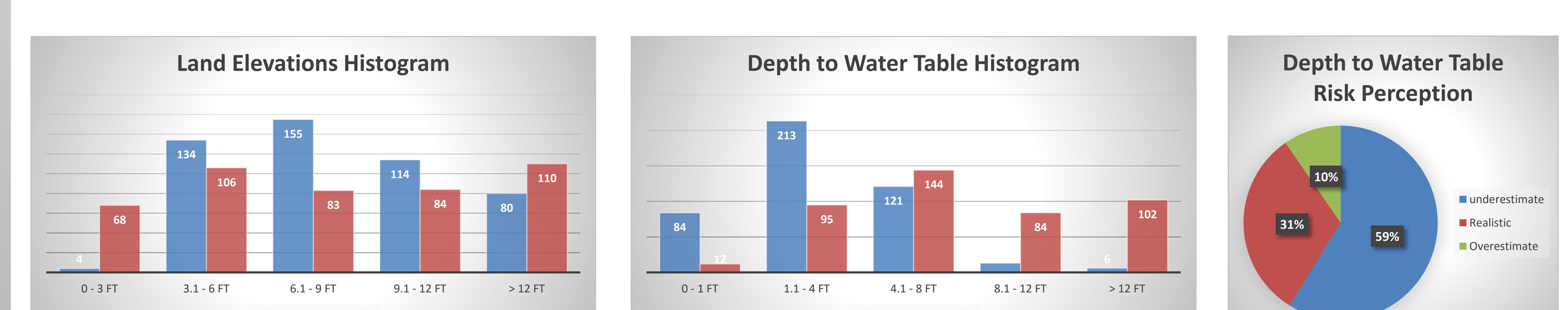
Selected Survey Demographic Results



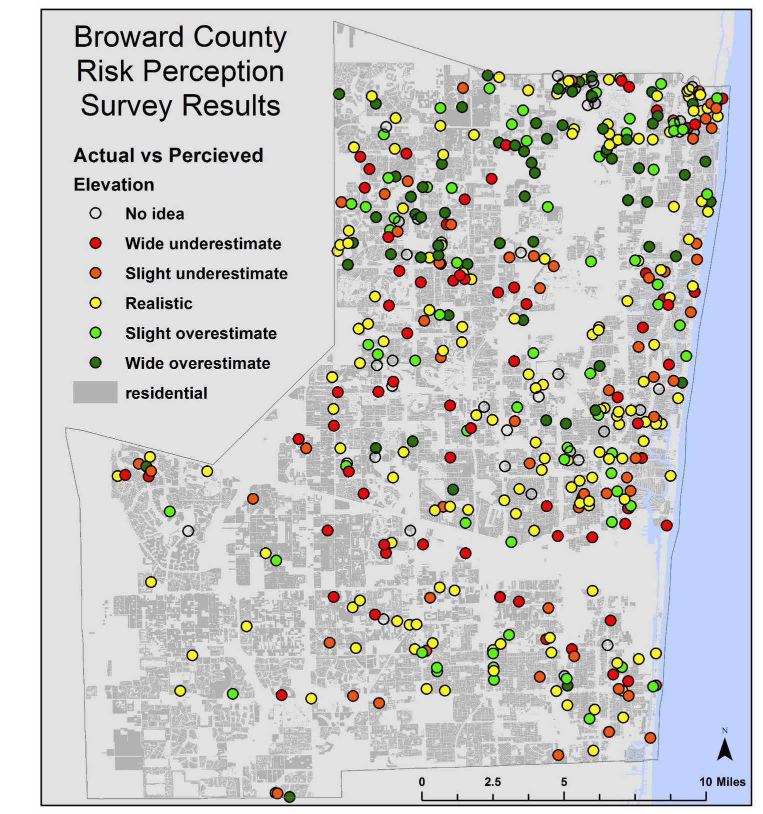
Selected Survey Perception Results



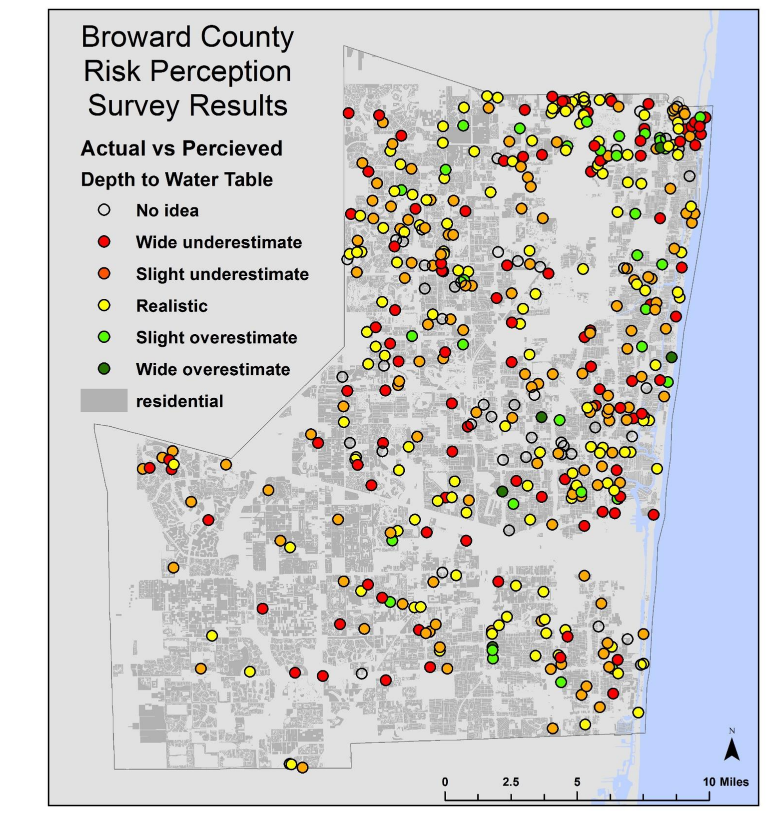
Selected Comparison Results



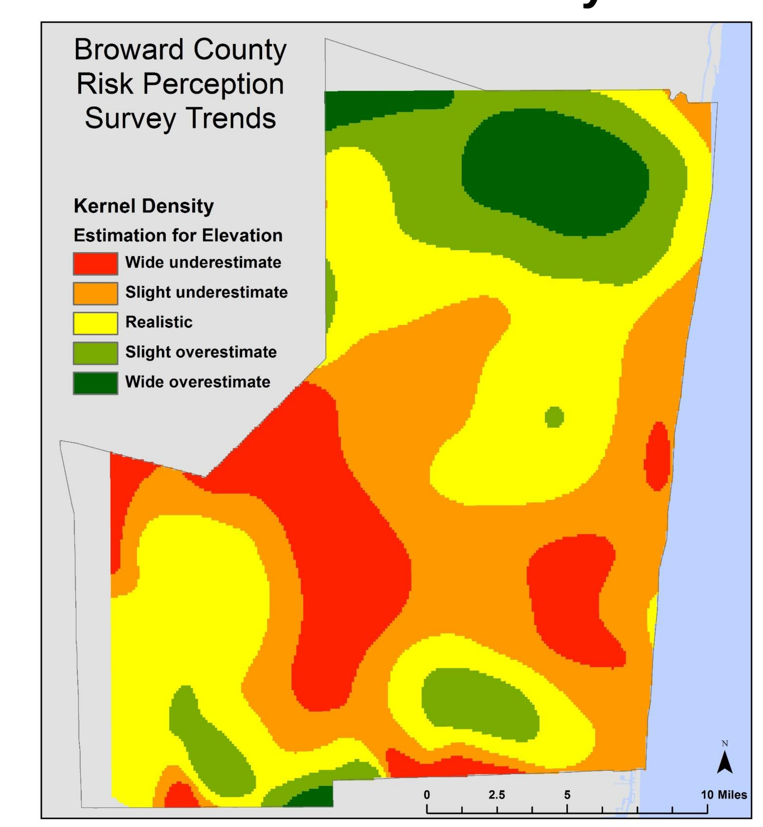
Perceived Risk for Inundation



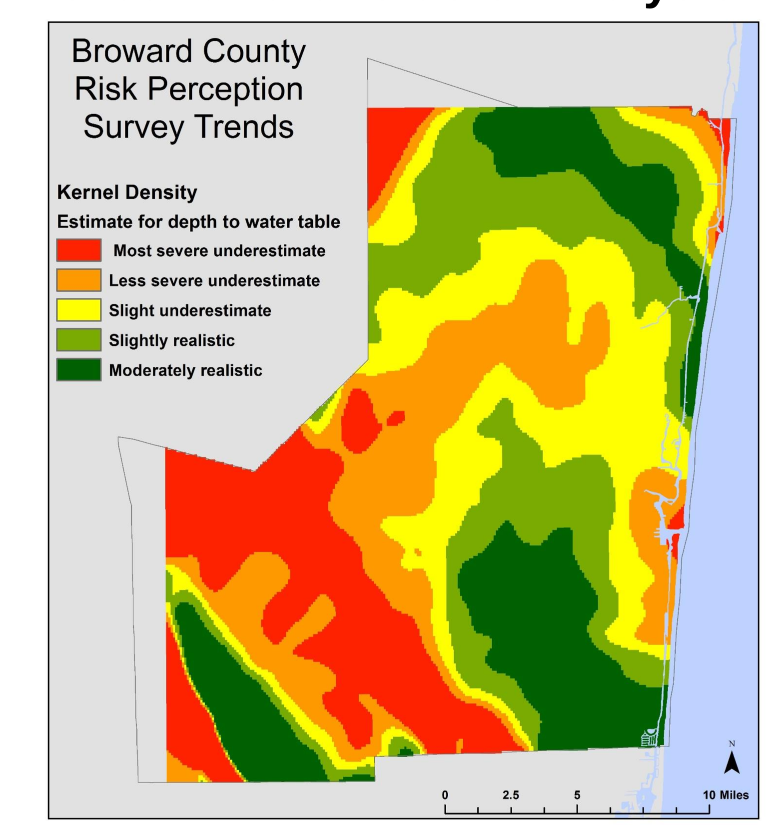
Perceived Risk for Groundwater



Inundation Cluster Analysis



Groundwater Cluster Analysis



Discussion & Conclusion

Initial results indicate misconceptions and an overall lack of awareness in terms of source and magnitude of risk. While 80% of respondents were homeowners, 72% did not know their flood zone. Several respondents answered open response questions with statements such as "Florida will be underwater." The amount of property loss that will be seen in the next 50 years is minimal. The biggest short term threat from SLR is increased flooding due to compromised drainage and decreased aquifer storage. A higher storm surge that moves further inland is the next main SLR impact. For elevation risk bias, there was an even number of respondents that overestimated and underestimated their risk, but nearly all underestimated risk for DTW. There was a statistically significant trend moving south from overestimation to underestimation. For DTW, this trend went from east to west.

In terms of climate change impacts, effective communication is lagging behind scientific knowledge (Moser, 2010). Inconsistencies between perceived and actual risk may hinder public support for costly SLR mitigation strategies. Results can pinpoint areas in which to focus on increasing awareness. Further research will include risk bias assessment methods including principal component analysis and multivariate analysis.

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