# SLR Risks to Social, Economic, and Built Environment Palm Beach County, FL

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## Background

Florida's coastal communities are most exposed to the dual hazards of hurricanes and sea level rise (SLR). With low elevations and considerable ocean development, the potential damage from these hazards is significant.The operating assumption for risk management can be summarized as follows (Flanagan et al 2011):

$$Risk = Hazard \times (Vulnerability - Resources)$$

The development and application of qualitative risk indicies are a vital first step to focusing resources and future research on the most vulnerable locations. Palm Beach County (PBC), FL was chosen for assessment due to the availability of data and being on the forefront of climate driven hazards.

## Design

PBC's assessment was divided into three components:

1) Determination of hazard areas
2) Development of vulnerability indicies
3) Identification of risk clusters

Data was entered and processed with ESRI ArcMap 10.2. The MOM model was generated with the NOAA SLOSH Display program using the South Florida Basin for a Category 3 hurricane. All data was normalized with a Min/Max standarization and scaled to the US Census block level. Risk clusters were identified with the ESRI Spatial Analyst Optimized Hotspot tool.

## Data

Hurricane hazards were represented by the Storm Surge Maximum of the Maximum (MOM) from the NOAA Sea, Land, and Overland Surge from Hurricanes (SLOSH) model. SLR hazards were represented by the NOAA Office for Coastal Management 1 ft Mean Higher High Water (MHHW) innundation model.

The vulnerability indicies were divided into two portions: Social and Built Environment. The Social Index consisted of the 2010 Census and the 2014 American Community Survey. The Built Environment Index consisted of PBC property parcels, infrastructure and utilities availble from the Florida Geographical Data Library (FGDL), EPA Toxic Release Inventory, and FDEP public water treatment locations.

## Built Environment Index

$$I_{BE} = U+P+T+P$$

**U**tilities:
- Water
- Electricity

**P**ollution:
- Superfund
- Brownfield
- RCRA

**T**ransportation:
- Road
- Rail

**P**arcel:
- Buildings
- Value

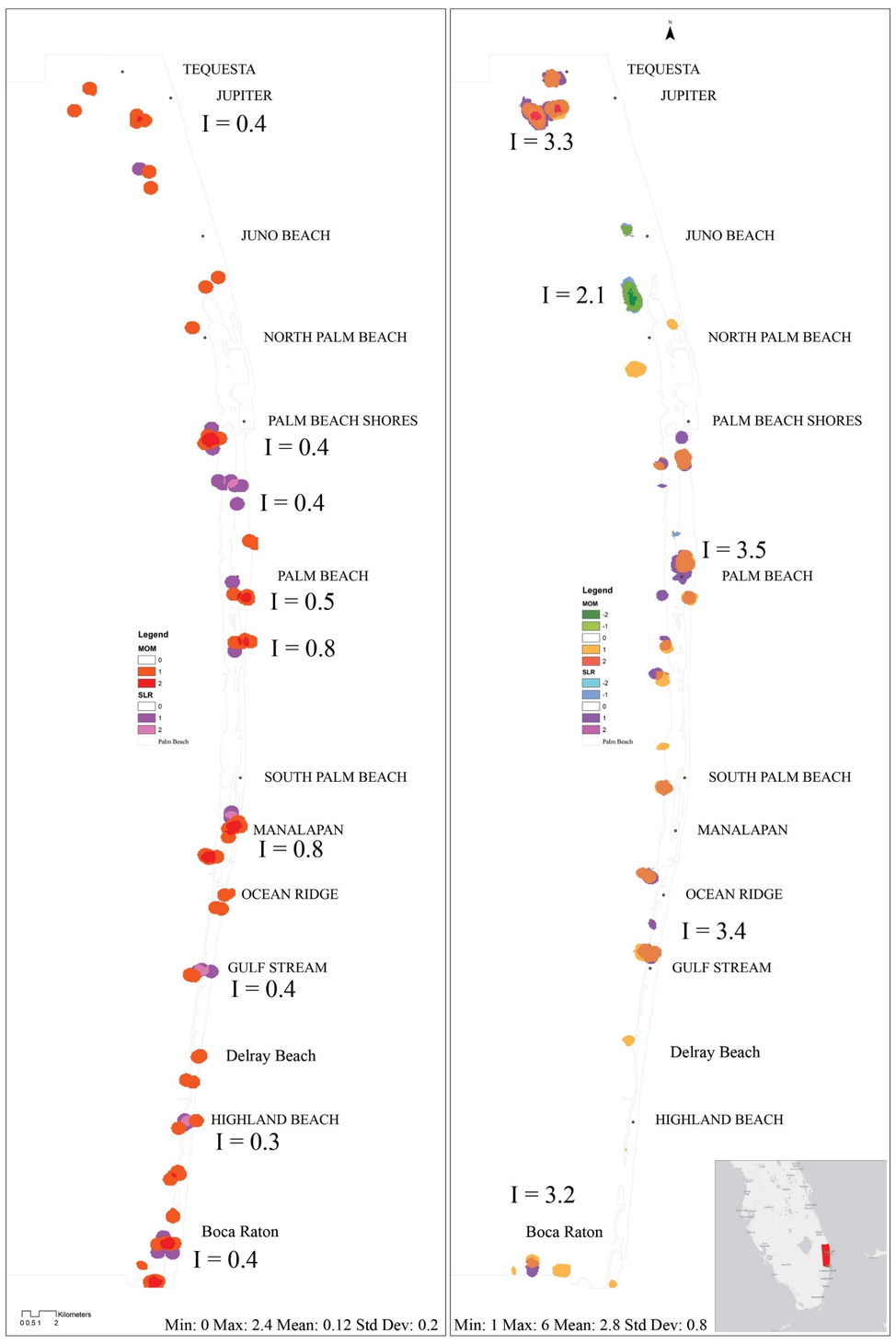


Figure 1 - "Hot Spot" analysis of Built Environment and Social indicies for Palm Beach County, FL. A score of 1 represents a medium correlation, 2 strong correlation. A negative value means a "Cold Spot" with the clustering of lowest scores, 0 no statistically significant clustering, and postive is a "Hot Spot" of clustering high scores. Average index scores for large hotpots is also shown.

## Social Index

$$I_S = S+H+D$$

**S**ocioeconomic:
- Income
- Poverty
- Employment
- Education

**H**ousehold:
- Age
- Single Parent
- Disability

**D**welling:
- Year Built
- Rent/Own
- Family Size
- Vehicle
- Commute

## Analysis

Between the hazard types there were considerble areas exclusive to one or the other (Table 1). The characteristics of these two regions are similar with 90% of the impacted parcels classified as Residential. Hurricane impacted parcels were spread evenly along PBC's coastline but SLR impacted parcels were concentrated near Boca Raton and Jupiter.

The scattered areas of hazard impcact contributed to the spatial range of hot spots for both of the indicies (Figure 1). The majority of the clusters appear to center on the coastal downtown areas of PBC urban areas. There does appear to be some variation between towns and the size of the cluster for both indicies and hazards.

Jupiter appears to have one of the largest clusters of high Social Index scores for both hurricanes and SLR. Some of the major contributing factors appear to be a low high school completion, low "Free and Clear" home ownership, small but significant unemployed population, high average home age, significant population below the poverty line, and longer average commute time.

For the Built Environment, the strongest components of the two large highest scoring hot spots near Palm Beach and Manalapan was parcel value and tax value. These areas appear to be affulent and the impacts of a hurricane or SLR would predominatly affect property rather than infrastructure.

| | Criteria | | | |
|---|---|---|---|---|
| Use Type | Cat 3 MOM | | 1 ft MHHW | |
| Commercial | 525 | 5% | 26 | 2% |
| Transportation | - | 0% | - | 0% |
| Government | 87 | 1% | 19 | 2% |
| Education | 14 | 0% | 2 | 0% |
| Recreation | 22 | 0% | 8 | 1% |
| Healthcare | 5 | 0% | 1 | 0% |
| Residential | 9,195 | 90% | 1,100 | 90% |
| Religious | 28 | 0% | 1 | 0% |
| Vacant | 291 | 3% | 69 | 6% |
| Total | 10,167 | 100% | 1,226 | 100% |

Table 2 - Comparison of parcels impacted by only one type of hazard. Overall the types of parcels impacted between the two hazards are very similar with residential areas comprising the majority.

## Conclusion

Overall the indicies applied appear to have identified a number of communities that may warrant further investigation for hurricane and SLR preparedness. Also considering the risk clusters that are independent of one or another hazard, prioritization of relevant projects or outreach may be fine tuned.

Given the standardized nature of the risk estimation, further development of this approach may seek to use modifiers or weights. Seasonality can be used as a weight for elderly populations at risk of heat related illnesses in the event of power loss following a hurricane. Local information regarding disaster response can also be used, such as weighting newer houses more favorably due to changes in building codes.

There are also a number of data sources that would further benefit this approach to risk assessment. In particular additional utility information such as distribution power lines or water pipes would be useful to direct disaster resilience investivations. As well as the relating of datasets to create a more appropriate index component. Determining where low roadways are located would assist in determing locations that could be isolated during a hurricane or King Tide.

## Reference

Flanagan, Barry E., et al. "A social vulnerability index for disaster management." Journal of Homeland Security and Emergency Management 8.1 (2011).