Profile of flood prone population in San Juan

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Introduction

Puerto Rico:

- Located in the storm prone Caribbean.
- Area of 3,435 square miles.
- 111 miles long by 39 miles wide.
- Geography causes rivers to overflow resulting in floods after heavy rains.
- Capital is San Juan.

San Juan:

- Most densely populated region.
- Most populated municipio in the island (380,149).
- As rivers overflow the urban sprawl suffers the burdens of flooding.

Flooding in San Juan:

- Both rich and poor suffer from flooding.
- 19,375 (25.2%) of 76,974 that live in flood zones are below the poverty line.
- Many cannot afford flood insurance.
- Many rely on government assistance, which is hard to obtain (López-Marrero and Yarnal, 2011).
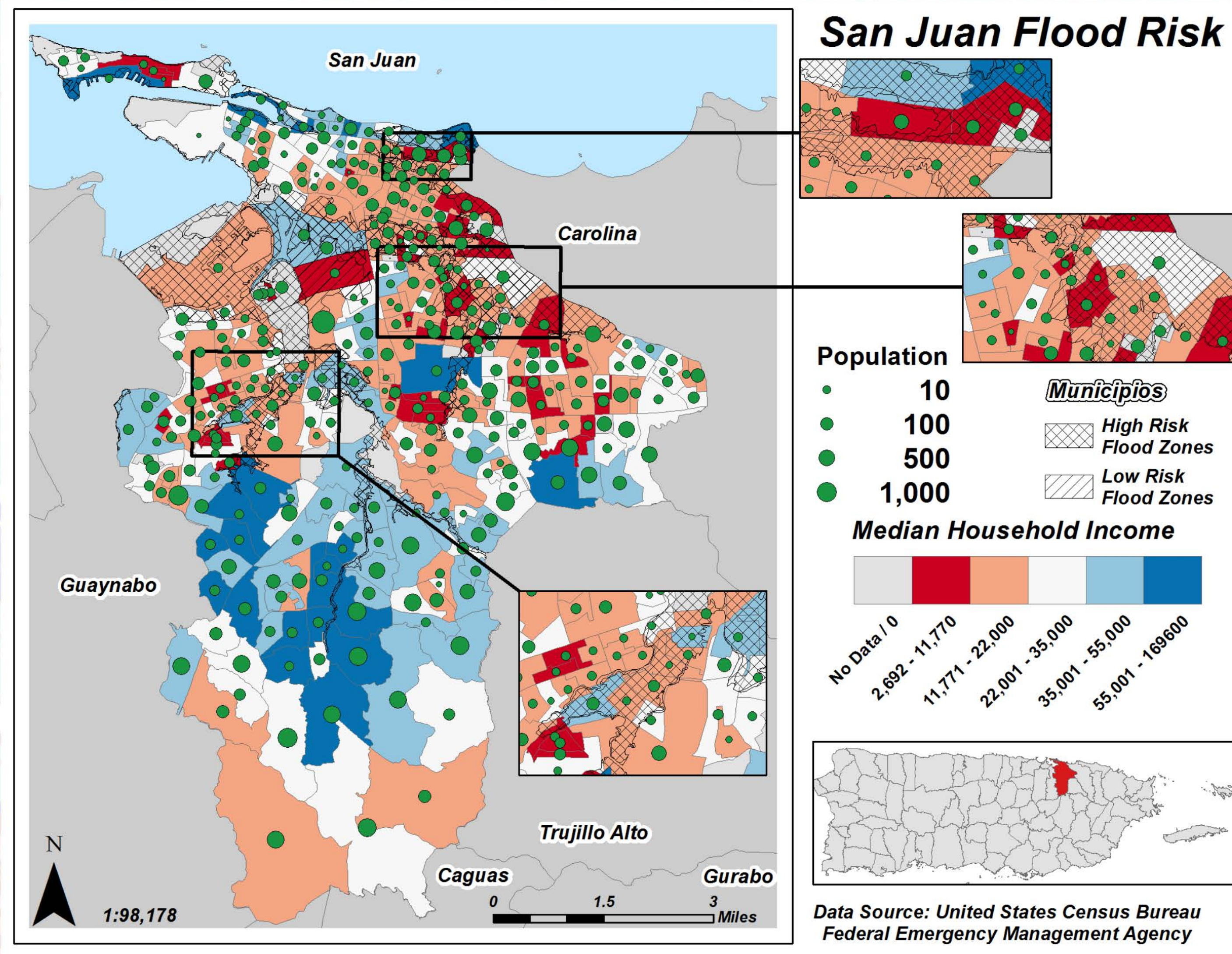
Dominicans in San Juan:

- Poorest and biggest foreign-born group.
- Population in San Juan is 34,760.
- Not eligible for any government assistance due to not being citizens.
- Many live within their own enclaves (Funkhouser and Ramos, 1993).
- Many are located in flood zones for cheaper housing.

Study Site

The study site is the municipio of San Juan which is located in the north of Puerto Rico, it is 48 square miles. This municipio is the economic and political heart of the San Juan Metropolitan Area and Puerto Rico. The rapid increase in the urban growth of the San Juan Metropolitan Area was a result of the industrialization process which became known as Operation Bootstrap. This growth extended rapidly into the neighboring municipios creating the San Juan Metropolitan Area. For the purpose of the study, San Juan is divided into Block Groups and Census Tracts as defined by the United States Census Bureau.

Hypotheses

H1- A qualitative analysis by satellite image of flood zones will give a better estimation of the people at risk when compared to tools such as the intersect tool or tabulate intersection tool (Figure 1).

H2- The population at risk of flooding will have an equal mix of low and middle class population while the higher classes will not be as much risk of flooding.

H3-The Dominican clusters will have a high risk of flooding when compared to other groups.

San Juan Flood Risk

Population
- 10
- 100
- 500
- 1,000

Municipios
- High Risk Flood Zones
- Low Risk Flood Zones

Median Household Income
- No Data / 0
- 2,692 - 11,770
- 11,771 - 22,000
- 22,001 - 35,000
- 35,001 - 55,000
- 55,001 - 169,600

1:98,178

Data Source: United States Census Bureau Federal Emergency Management Agency

Clusters at Risk

Census Data → Flood Data → Clip -> Intersect → Qualitative Analysis → 0 = No population 1 = include all 2 = Re-calculate → Multiply by average hh size → Estimate of At Risk Population

Census Data → Join → Moran Cluster Tool → Group Cluster → Tabulate Intersection Tool → Area Percentage → Estimate of At Risk Population

Total Pop in Cluster: Arabs 5,470 | Cubans 51,397 | Central Americans 6,235 | Dominicans 105,802 | Europeans 36,670 | Puerto Ricans 16,035 | Spanish 36,020 | South Americans 27,143

Limitations

- Lack of Block group data for Dominicans.
- American Community Surveys Margin of Error.
- Number of unaccounted Dominicans in the clusters.
- Census 2010 Block files are useless due to the population shifts since 2008.

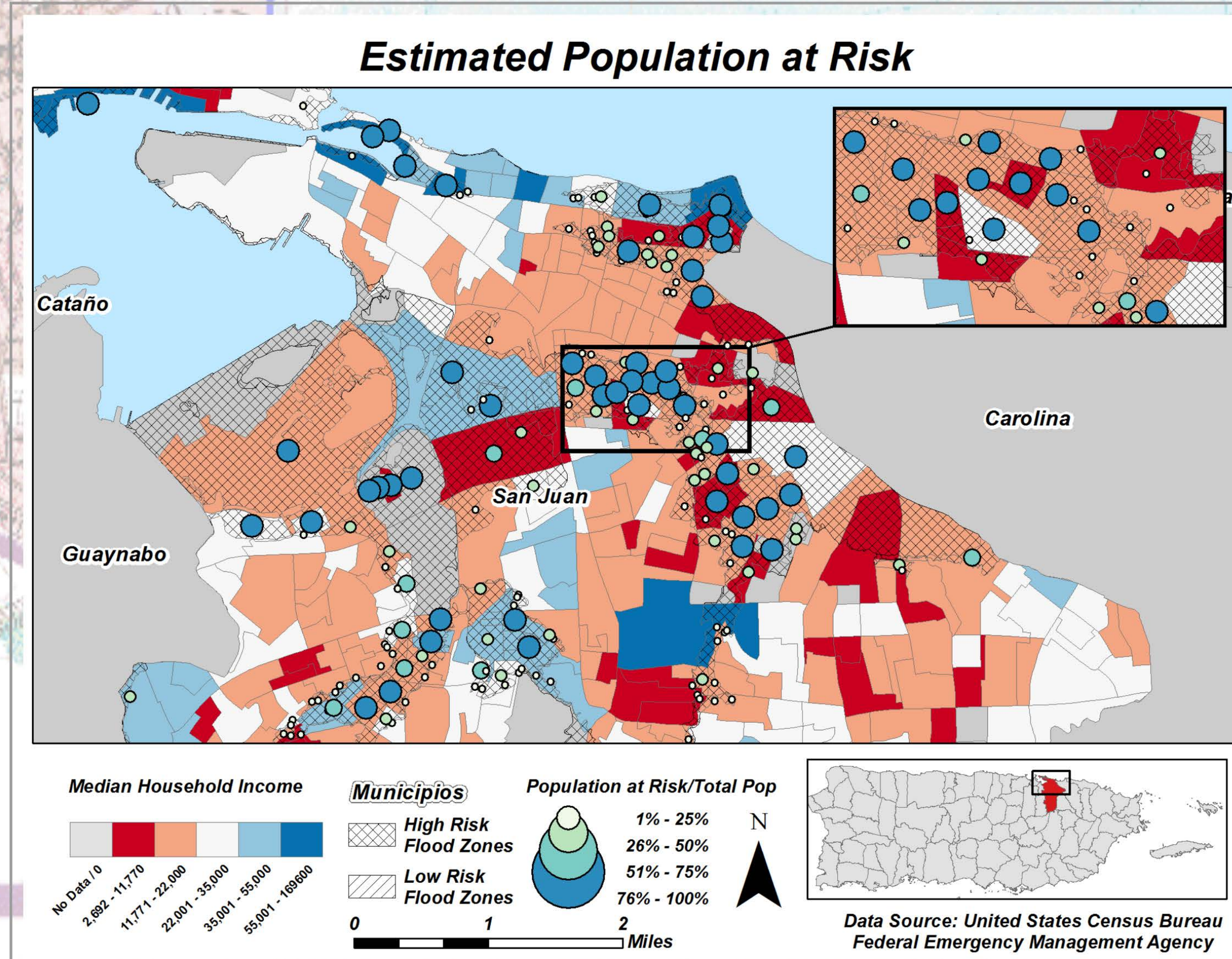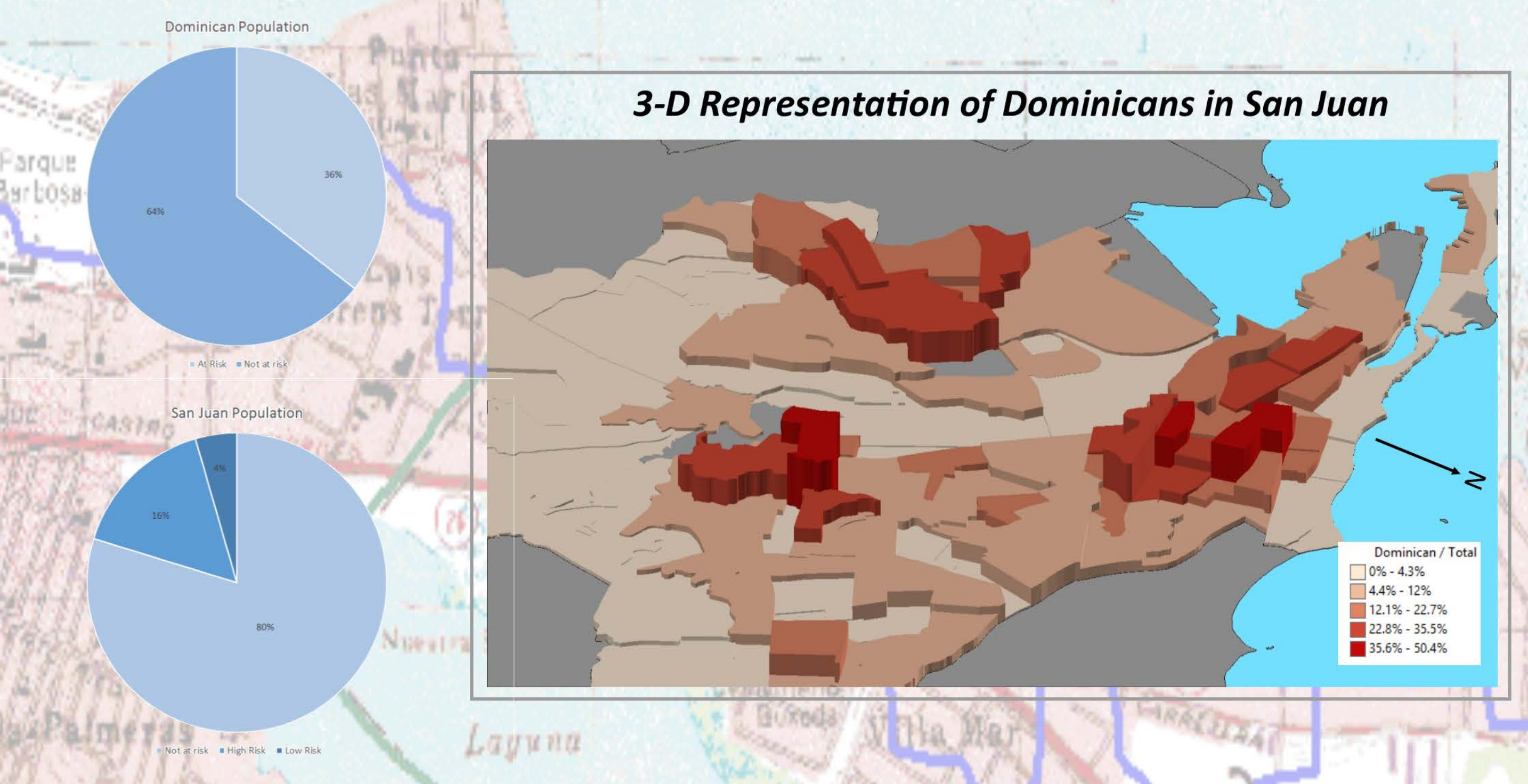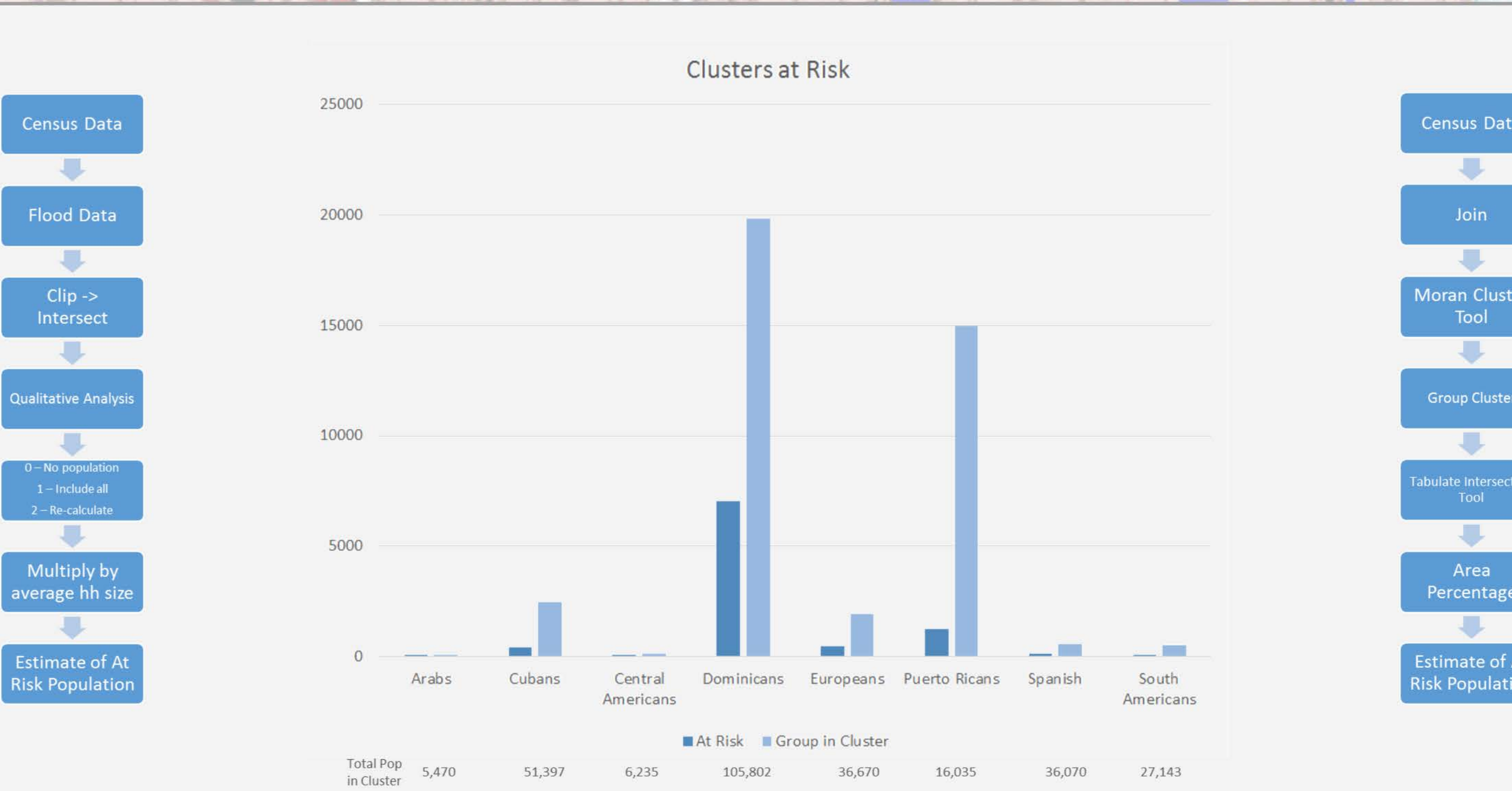*Figure 1: Tabulate Intersection tool*
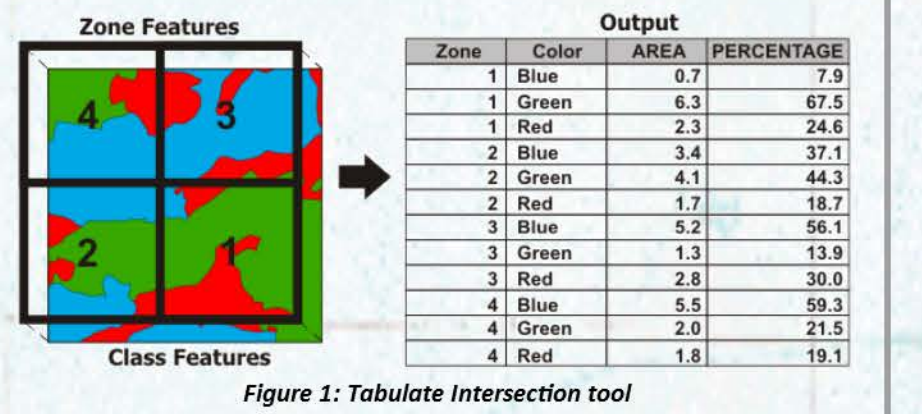
Results

New estimates by qualitative analysis, reduce the high risk population from 128,742 to 59,995. The tabulate Intersection calculated 59,941, giving merit to the qualitative analysis. For the low risk population, the new estimate cut down the original estimate of 83,583 to 16,979. By using the tabulate intersection tool, a new estimate of 13,747 was calculated. In total, the population calculated via qualitative analysis was 76,974 out of the total population at risk of 380,149 (20.2%). These numbers help **accept** the first hypothesis.

The economic profile of the people at low risk of flooding was estimated to have a mean of 22,084, well above the poverty line. A minimum value of 2,692 and maximum of 58,173 was also present in the block groups. This symbolizes that the low-risk zones have a mutual mix of poor and rich. For the high risk zone, a mean of 26,956, with a minimum range of 2,692 and maximum of 169,602 was present. This proves that flood risk in San Juan is not limited to the poor but also affects the rich. These results are evidence enough to **reject** the second hypothesis.

For the Dominicans, out of the calculated 19,822 living in three major clusters in the municipio of San Juan, 7,053 (35.6%) were at risk of flooding. In these clusters, the Dominicans represent 19,822 (18.7%) out of the total population (105,802). The graphs show that the Dominicans are the biggest group at risk of flooding in San Juan when going by their clusters. The next closest group are the Europeans at (23%). When it comes to the cluster tool and comparing it to other groups, the Dominicans, with their higher numbers, are the most dominant group at risk of flooding. This is reason enough to **accept** the hypothesis.

3-D Representation of Dominicans in San Juan

Dominican / Total
- 0% - 4.3%
- 4.4% - 12%
- 12.1% - 22.7%
- 22.8% - 35.5%
- 35.6% - 50.4%

Estimated Population at Risk

Median Household Income
- No Data / 0
- 2,692 - 11,770
- 11,771 - 22,000
- 22,001 - 35,000
- 35,001 - 55,000
- 55,001 - 169,600

Municipios
- High Risk Flood Zones
- Low Risk Flood Zones

Population at Risk/Total Pop
- 1% - 25%
- 26% - 50%
- 51% - 75%
- 76% - 100%

Data Source: United States Census Bureau Federal Emergency Management Agency

Recommendations

- Questionnaires to identified population in flood zones.
- New government measures to promote flood insurance.
- Inform the communities about flooding.
- Offer assistance regardless of citizenship status.

Future

- Expand to other municipios in metropolitan area.
- Python Script automation.
- Create universal toolbox.
- More accurate estimates.

References

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López-Marrero, T., Yarnal, B. 2010. Putting adaptive capacity into the context of people's lives: a case study of two flood-prone communities in Puerto Rico. *Natural Hazards 52.* 277-297

Jha, A., Bloch, R., and Lamdon, J. 2012. Cities and Flooding: A guide to integrated urban flood risk management for the 21st century. *The World Bank.*

Funkhouser, E., Ramos A., F. 1993. The Choice of Migration Destination: Dominican and Cuban Immigrants to the Mainland United States and Puerto Rico. *The International Migration Review 27 (3).*

Dominican Clusters at Risk

Dominicans by Total Population
- Dominican
- Total Population

Municipios
- High Risk Flood Zones
- Low Risk Flood Zones

- San Juan Census Tracts
- Dominican Clusters at Risk
- San Juan Dominican Clusters

Data Source: United States Census Bureau Federal Emergency Management Agency