Using Bivariate Mapping to Explore Social Vulnerability and Life Expectancy

Jessica Joiner, MPH

Florida Department of Health

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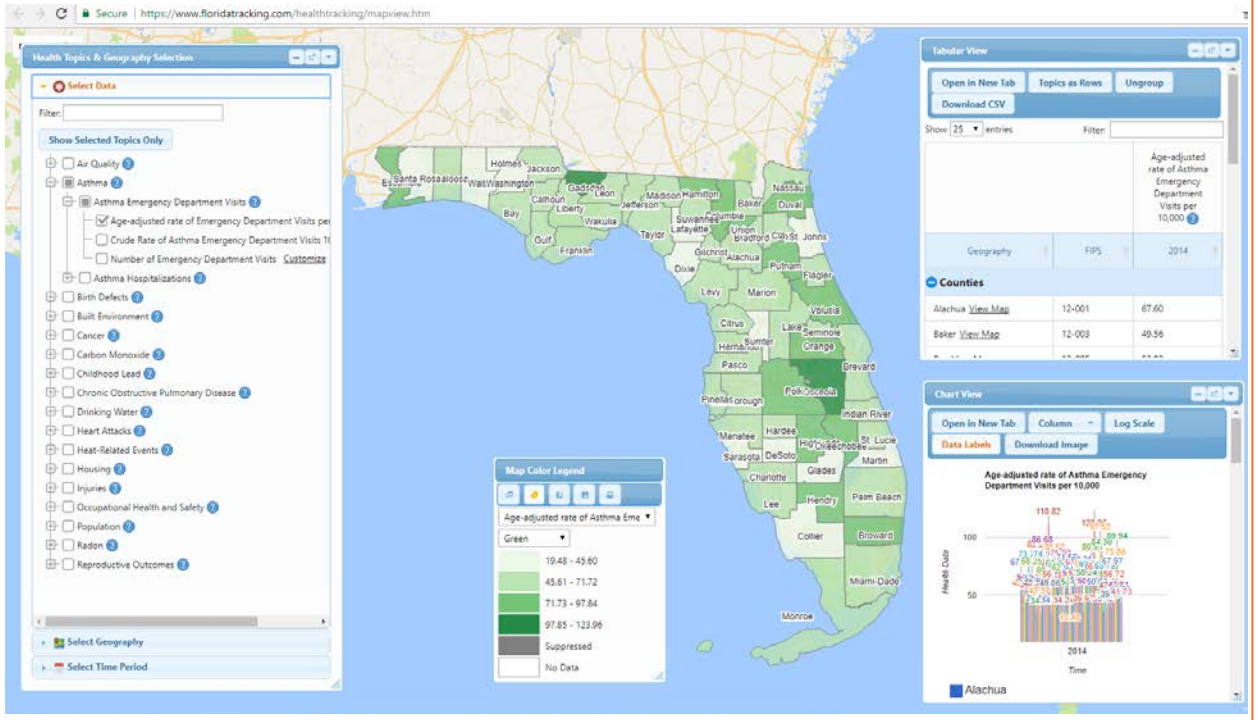
Florida Tracking Program Overview

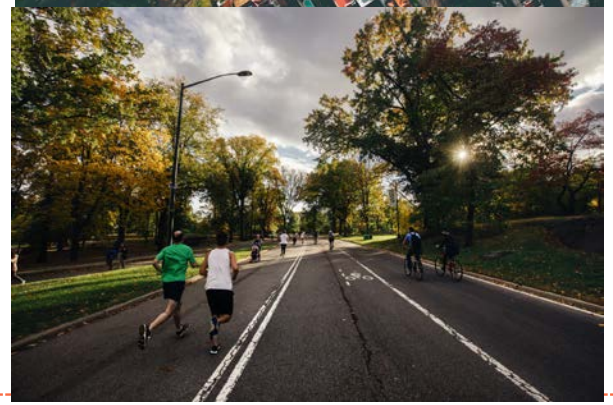
- Environmental Public Health Tracking focuses on surveillance of environmental factors and related health outcomes
- Examples of environmental factors: drinking water contaminants, ozone, particulate matter, community design
- Examples of health outcomes: asthma, birth defects, cancer, cardiovascular disease, heat-related illness, birth outcomes
- Funded through a cooperative agreement with CDC since 2003



FloridaTracking.com

Built Environment and Public Health

- Walkability (sidewalks, pedestrian priority, connectivity)
- Access to food sources (healthy and fast food)
- Proximity to recreational features (e.g., parks, trails, etc.)
  - Used as proxy for physical activity potential
- Exposure to hazards (e.g., busy roadways, pollution)
- Safety (e.g., lighting, crime, dilapidation)



Links to Chronic Disease

- Access to food sources affects dietary choices.
- Physical inactivity can lead to obesity, which increases the risk of chronic disease.
- Zoning and other factors of the built environment can lead to greater exposures (e.g., pollution).



Life Expectancy

- Allows us to look at disparities by place
- Influenced by underlying health behaviors, social determinants of health, and other community factors
- Reflects the impact of major illnesses and injuries and their underlying causes, including the social, economic, environmental conditions which influence health

Factors influencing Health Disparities

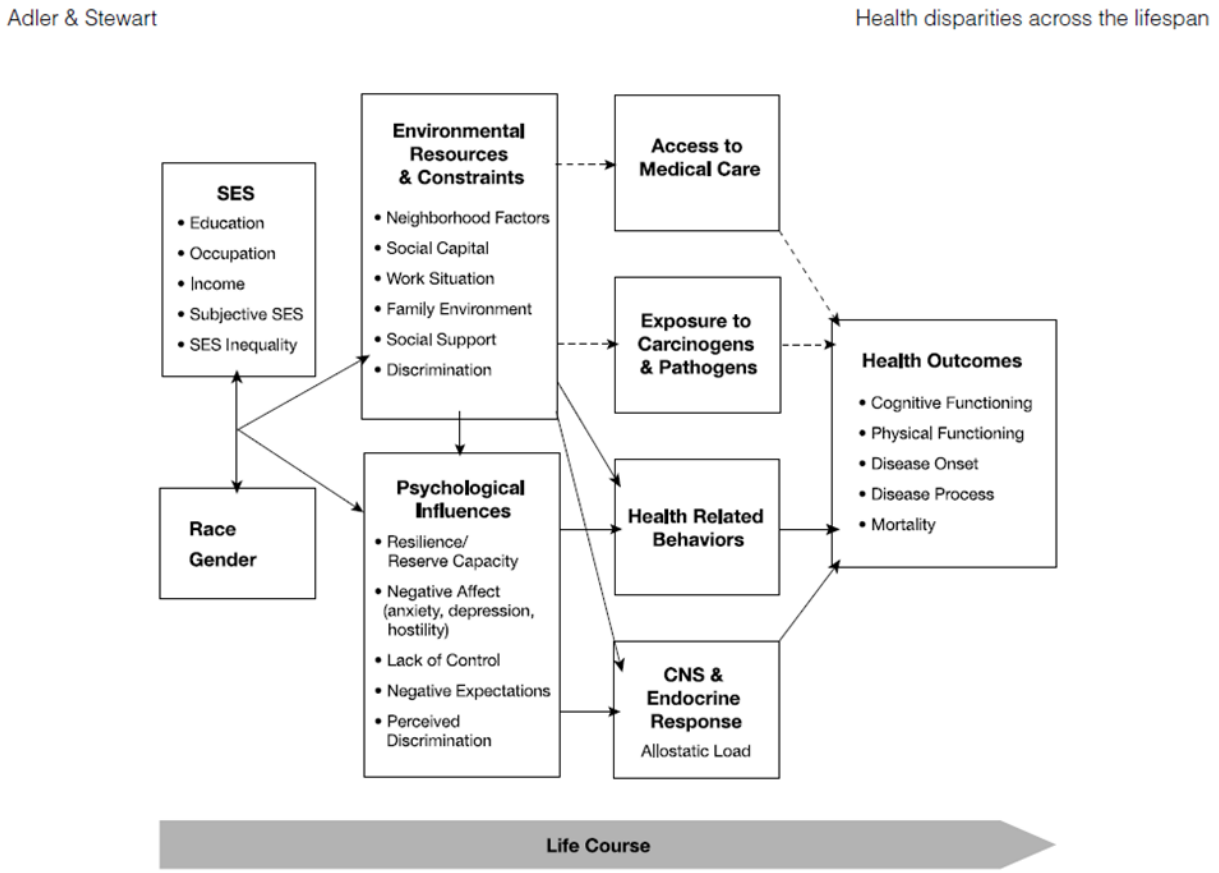


Figure 3. Pathways linking SES and Health. *Note*: The *solid lines* indicate pathways studied by the MacArthur Network on SES & Health; *dashed lines* indicate pathways of importance which the network did not study.

Adler, N.E. and Stewart, J. (2010). Health disparities across the lifespan: Meaning, methods, and mechanisms. Ann NY Acad Sci, 1186. pp.5-23. doi: 10.1111/j.1749-6632.2009.05337.x

Life Expectancy Calculations

Life expectancy at birth:

- The number of years a newborn can expect to live if current age specific mortality rates in that population remained the same over time

- This is a common measure used to routinely monitor health inequities across countries

- Given that life expectancy and survivorship is increasing in many places, there is some concern that the gap may be widening between those who experience greater longevity versus those who do not (Murray, C et al, 2006)

Life Expectancy Methods

- Linked residential address provided on the death certificate with 2010 Census Tract areas
- Used 2010 Census Tract Population estimates by gender and race/ethnicity for denominator
- For mapping purposes, only the combined gender/race calculations were used to limit the unstable life expectancy values
- Aggregated five years of mortality data (2009-2013)

Life Expectancy Limitations

- Some tracts have high standard error calculations due to low number of deaths or low populations
- Suppression based on low numbers of deaths and/or population can help correct for this
- Can overcome this by using geographic aggregation to increase the number of deaths or population by area
- Take into consideration mapping special facilities or populations (e.g., prisons, universities, assisted living facilities)

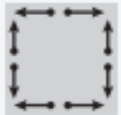
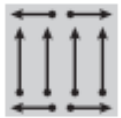
The Social Vulnerability Index (SOVI)

- Created by grouping 28 variables from the US Census into 6 principle components: race and poverty, age, wealth, ethnicity, gender, and retirement communities
- Social vulnerability is driven by the place specific combination of underlying socioeconomic and demographic conditions present at the local level
- It is a quantitative measure of social vulnerability to environmental hazards

Why map these variables?

- It would be expected that both SOVI values and life expectancy should follow a similar geographic pattern due to shared underlying social determinants

- By using the diagonal method of bivariate mapping, we can analyze which census tracts fell out of expected patterns of life expectancy and social vulnerability

Focal Model	Iquiry Syntax & Simple Questions	Focal Areas	Focal Axes	Sample Color Palette
Corners	**Low/High of x** **Low/High of y** **Where are areas of high income and low education?**			
Range	Diverging **range of y within low/high of x** **What is the range of education among high earners?**			
	Qualitative **range of y within category** **What is the range of education within -- categories?**			
Diagonal	**relationship of x and y** **What is the relationship of income and education?**			

Based on Trumbo's Four Principles (1981)

Illustration by Benjamin Thornton, Florida Resources and Environmental Analysis Center

Why use GIS?

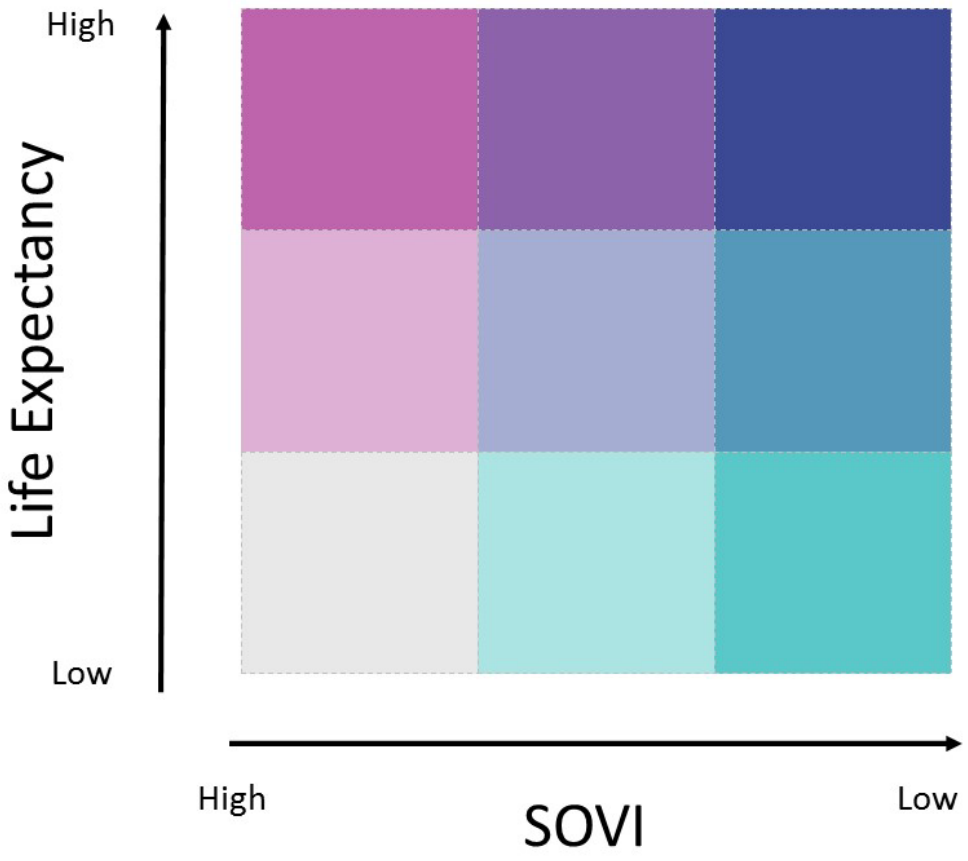
- GIS allows us to see areas where vulnerabilities were low but life expectancies were also low, possibly due to a misuse of resources or a lack of important health resources in the area

- We would also be able to see areas that have high life expectancy but also high social vulnerability, showing a resistance to the impact of socioeconomic factors on life expectancy. These areas would benefit from further research to identify best practices in decreasing health disparities and raising the life expectancy

GIS Analysis

- Joined SOVI data and LE data to 2010 census tract shapefiles
- Created an additional field with values 1-9 based on ranges of SOVI and LE values
- Created bivariate color scheme for each category 1-9
- Both variables were mapped using a three-class standard deviation method.
- The standard deviations preserve the underlying distribution of the data
- The moderate category represents the mean, the elevated (high) category is greater than one-half standard deviation above the mean, and the low category is more than one-half standard deviation below the mean
- This method permits the best balance between interpretation (three classes) and the identification and visualization of extremes (high and low vulnerability that are of the most interest)

Creating the color scheme



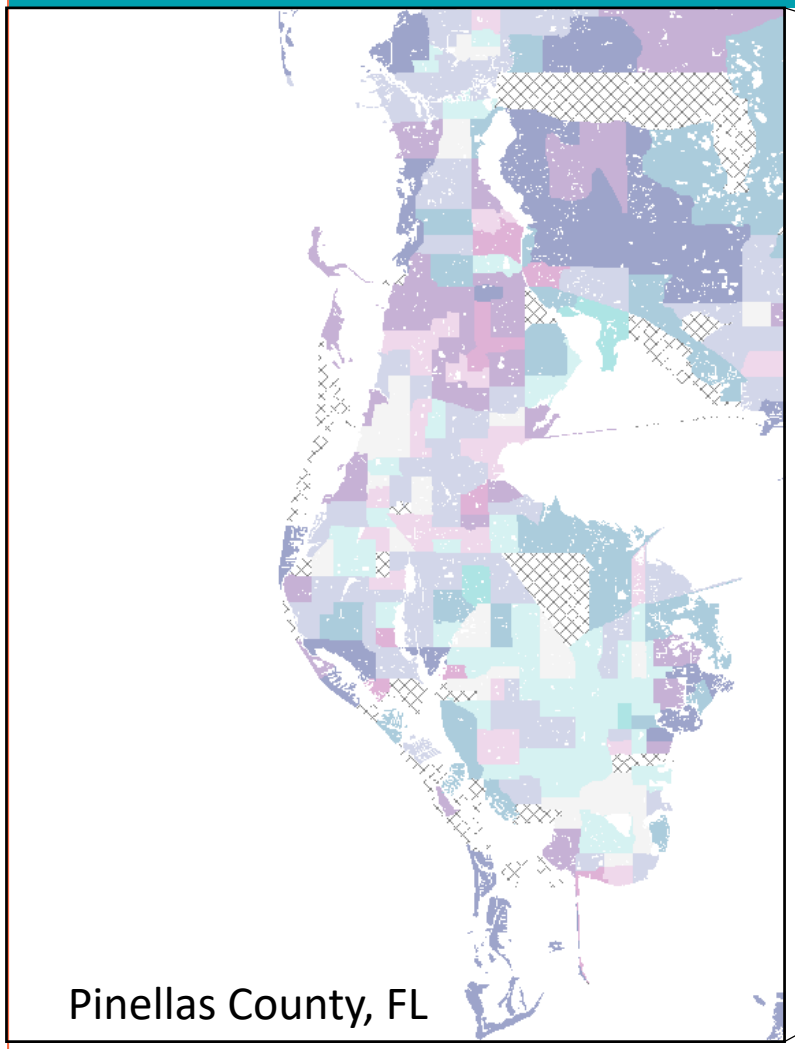
Life Expectancy categories were defined as:

<76.8, 76.9-80.8, >80.9

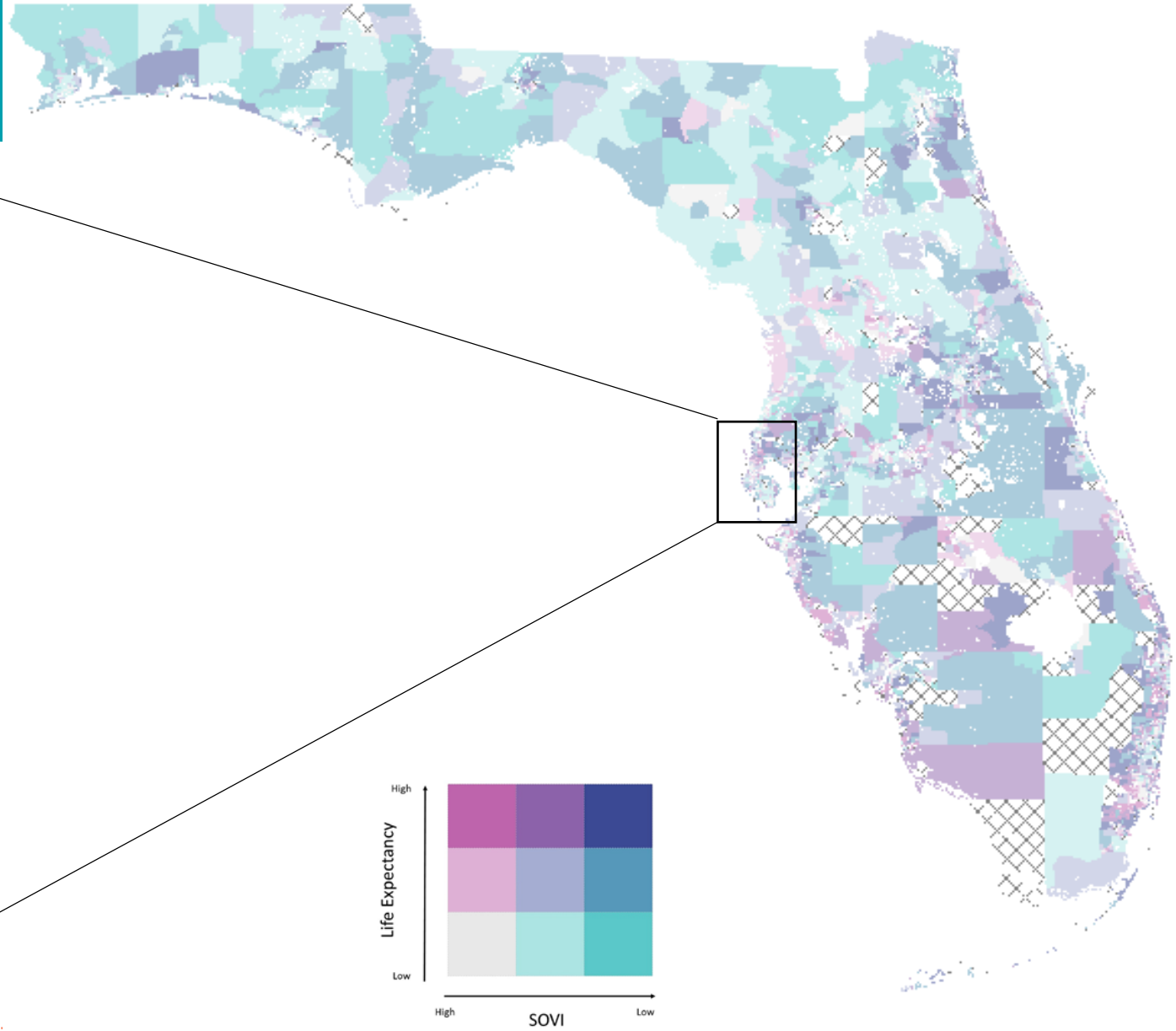
SOVI categories were defined as:

>1.23, 1.22-(-1.24), <-1.25

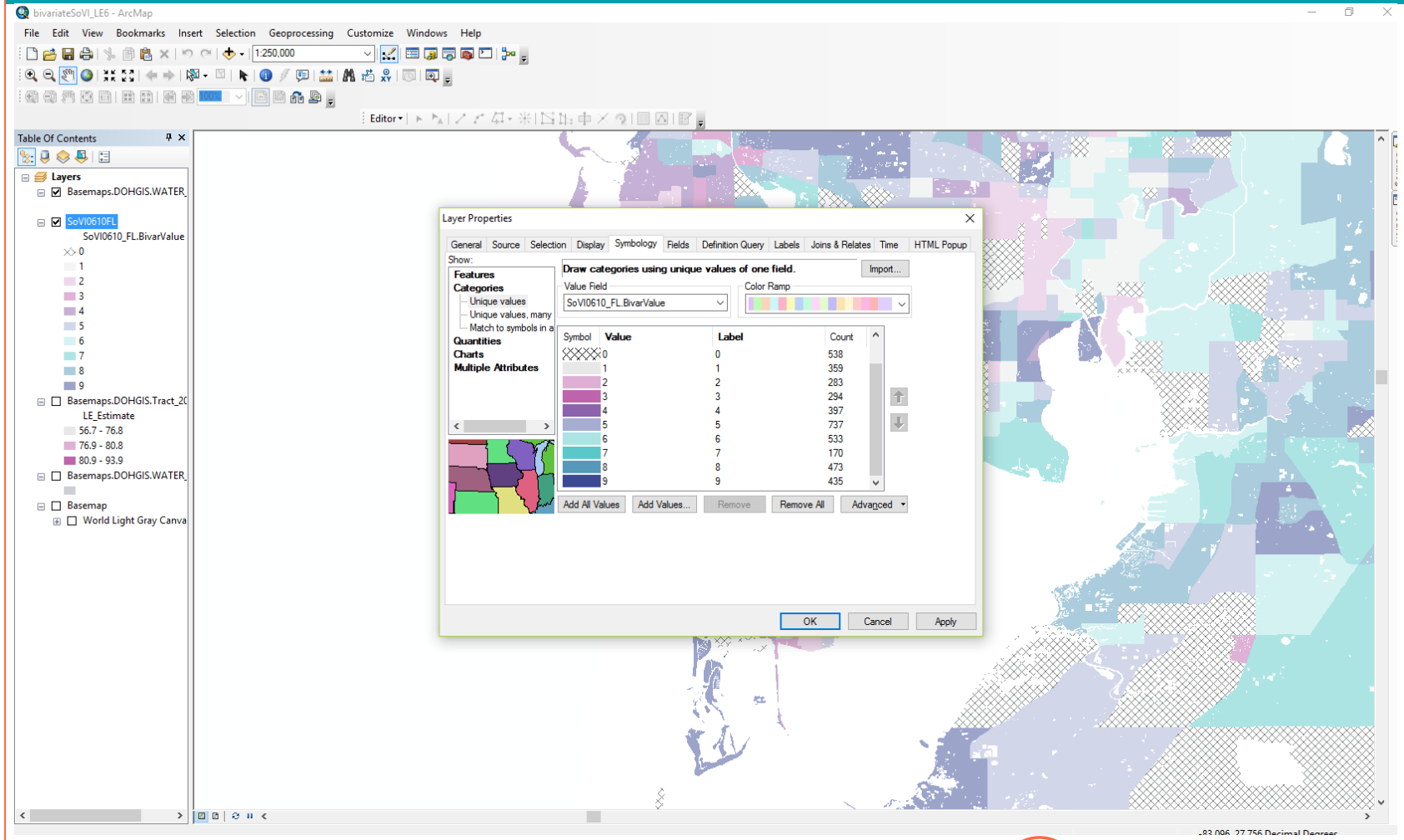
Final Product



Pinellas County, FL



Results



- The majority of census tracts fell into the center category (17.5%)
- About 7% of the census tracts fell into the pink category that would make good studies for “best practices”-they had high vulnerability but also high life expectancy
- 4% of the census tracts fell into the teal category that would be good candidates for further investigation-they has low vulnerability but also low life expectancy

Next Steps

- Share with County Health Department Administrators, Directors and relevant programs, such as the Bureau of Chronic Disease, Office of Minority Health and Health Equity, etc. to target specific areas for interventions
- Move map into ArcGIS Online for easy sharing and zooming
- Look at what policies are in place in the outlier census tracts to determine some “best practices” to share with areas that are underperforming
- Continue discussions on limitations and concerns with sub-county data and solutions

Future Work

Incorporate life expectancy and SOVI (SDoH) measures into existing community profile reports and data visualization tools

- Combine data on environmental hazards, health outcomes, and social vulnerability

Support more local activites

- Community health assessments
- Community health improvement plans
- Health impact assessments

Contact Information

Jessi Joiner

Environmental Epidemiologist

Florida Environmental Public Health Tracking Program

Jessica.Joiner@flhealth.gov

850-558-9662