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Megacities: Social vulnerability and resilience building

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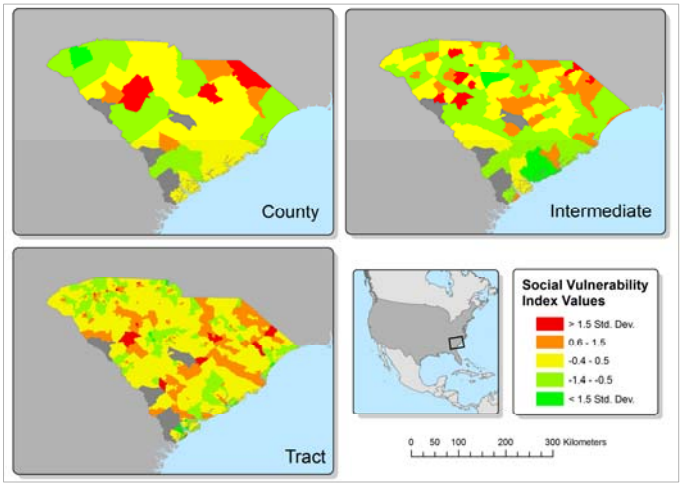
A Sensitivity Analysis of the Social Vulnerability Index

The Social Vulnerability Index (SOVI) is an approach used to characterize social vulnerability based on Principal Component Analysis (PCA) developed by Cutter et al. in 2003 for application at the county level in the United States. The analysis presented here investigates the impact of changing the aggregation level used to represent vulnerability within a study area on the behavior of the SOVI algorithm. Using the variable set employed in the original SOVI as a guide, 25 variables were collected at the U.S. Census Tract level for the state of South Carolina for the year 2000. These variables were aggregated to an arbitrary intermediate level, and to the county level. SOVI values were calculated for each aggregation level using a Varimax rotated PCA, with components selected using the Kaiser Criteria. These components were interpreted and processed, and then summed with equal weights to yield the index values.

Table 2. Numeric properties of indices

Aggregation Scale	Index Variance	Index Range
County Level	4.45	10.38
Intermediate Level	5.09	11.33
Tract Level	6.66	29.25



Results:

PCA is an approach which uses the correlation between variables to identify dominant trends in a dataset. Because decreases in the aggregation level result in decreased correlations between variables, we would expect the PCA to account for less variance as we reduce the level of aggregation. This is the trend we find, shown in Table 1. Additionally, as Table 2 shows, the variance and range of the vulnerability indices increase with decreasing levels of aggregation. Table 1 shows that the subjective interpretations of the main dimensions of vulnerability revealed through the PCA remain relatively stable. Finally, we see in the map to the left that while decreases in aggregation level increases the resolution of our portrayal of vulnerability within a study area, the dominant spatial patterns remain fairly stable as aggregation levels are changed.

Conclusions:

While changes in the level of aggregation result in predictable changes in the numeric properties of the PCA and SOVI values, the dominant dimensions of vulnerability identified, along with the spatial patterns revealed, remain fairly stable within the study area.

Table 1. PCA results

County Level		Intermediate Level		Tract Level	
Var. Exp.	85.0	Var. Exp.	79.3	Var. Exp.	69.1
Interpretation	Var. Exp.	Interpretation	Var. Exp.	Interpretation	Var. Exp.
Wealthy, Urban	29.5	Race and Poverty	22.6	Race and Poverty	17.6
Race and Poverty	21.8	Urban Renters, Race	16.3	Rural/Urban	11.7
Hispanic Immigrants	10.8	Wealth	13.6	Wealth	10.9
Age	9.3	Age	11.3	Elderly	9.6
Gender	7.7	Hispanic Immigrants	8.6	Hispanic Immigrants	8.8
Race	6.1	Gender	6.9	Kids	7.8
				Gendered Labor	6.8