

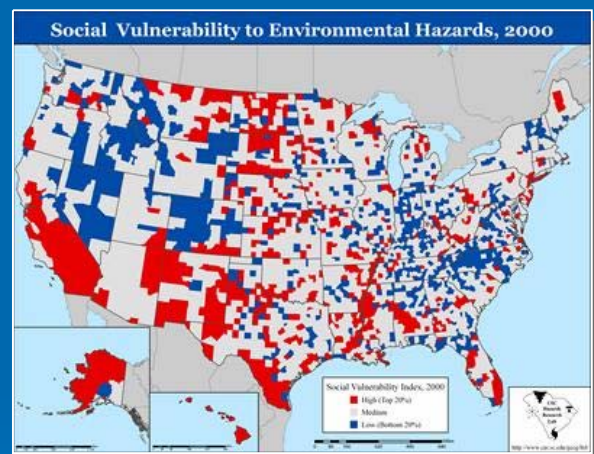
Building Indices of Vulnerability: a Sensitivity Analysis of the Social Vulnerability Index

Mathew C. Schmidlein, Roland Deutsch, Walter W. Piegorsch, Susan L. Cutter

Supported by U.S. National Science Foundation Grant CMS0433158

The Social Vulnerability Index (SOVI)

- Developed by Cutter et al (2003)
- Used to characterize relative levels of social vulnerability for counties in the United States



<http://www.cas.sc.edu/geog/hrl/sovi.html>

SOVI Construction

- Vulnerability indicators identified through literature review
- Indicators used to guide selection of variables used in SOVI construction
- Selected variables used with a Principal Component Analysis (PCA) based approach for index construction

Vulnerability Indicators		
Socio-Economic Status (income, political power, prestige)		Commercial and Industrial Development
Family Structure	Medical Services	Employment Loss
Population Growth	Residential Property	Special Needs Populations
Renters	Occupation	Age
Education	Rural/Urban	Gender
Social Dependence	Race and Ethnicity	Infrastructure and Lifelines

(Cutter et al. 2003)

Research Questions:

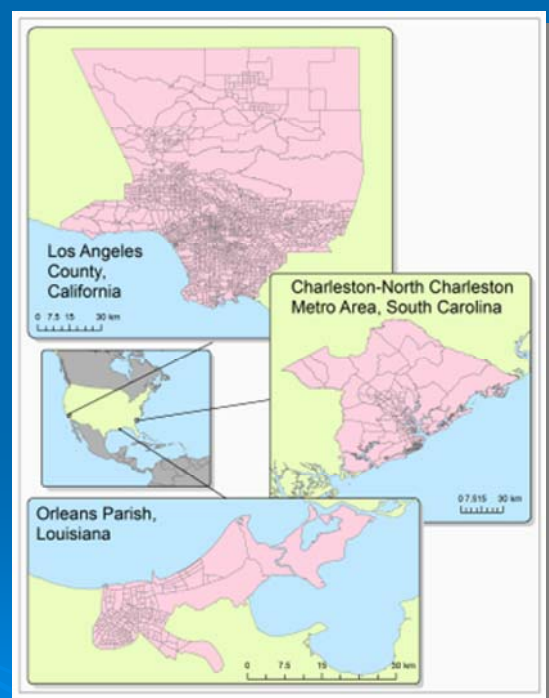
- What is the sensitivity of the SOVI algorithm to changes in some of the subjective decisions made in its construction?
- Does the algorithm behave similarly across multiple geographic contexts?

SOVI algorithm:

1. Standardize variables
2. Perform PCA
3. Select components to be used
4. Rotate initial solution
5. Interpret and process components
6. Combine components
7. Standardize resulting index values

Sensitivity Analysis Approach

- Vary subjective decisions in these three areas
 - 72 separate algorithms identified
- Apply to three study areas at the census tract level
- Assess the impact of changes in each study area, compare results across study areas



Algorithm Changes

➤ Component Selection:

- Kaiser Criterion
- Percent Variance Explained
- Horn's Parallel Analysis
- Expert Choice

➤ PCA Rotation:

- Unrotated
- Varimax Rotation
- Quartimax Rotation
- Promax rotation (k = 2,3,4)

➤ Component Combination:

- Equal weights
- First component only
- Weights based on component variance explained

Impacts of these changes analyzed in each study area using a linear statistical approach (factorial analysis; tract held constant)

Results

➤ Charleston:

- Selection
 - Horn vs. Kaiser
 - Some difference between Kaiser and Variance Explained
- Combination
 - Weighted sum different

➤ Los Angeles:

- Rotation
 - Unrotated different
 - Promax k=3 different
- Combination
 - Weighted sum different
 - Some difference between first factor and sum

➤ Orleans:

- Selection:
 - Kaiser vs. Variance Explained
 - Some difference between Variance Explained and Horn
- Rotation:
 - Unrotated vs. Promax k=3
 - Promax k=3 vs. Promax k=4
- Combination
 - Weighted sum different

Conclusions

- Algorithm is sensitive to changes in construction
- Sensitivity is different across study areas
- In general:
 - Variance weighted component combination leads to substantially different index values in each area
- Knowing the sensitivity of index allows us to evaluate our confidence in its results
- Future work should address reliability of component interpretations, index accuracy

Factorial Analysis

- Linear statistical approach similar to ANOVA
- 3 factors used, plus one blocking factor:
 - Component Selection
 - PCA Rotation
 - Component Combination
 - Blocking Factor: tract ID

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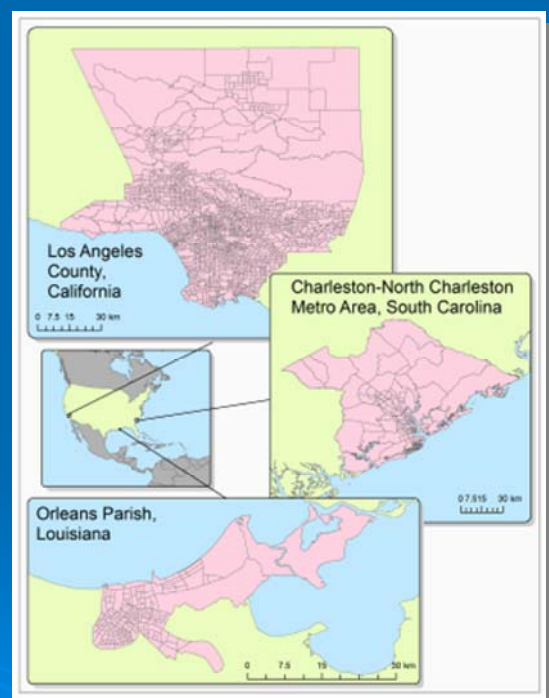
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