Social Vulnerability

Vulnerability Workshop

27 June 2018

University of Geneva

Outline

- Social vulnerability defined
- Social vulnerability indicators
- Social vulnerability measurement
- Social vulnerability models
    A. US-based SoVI model
    B. Australian-based model
- Other related social science research topics and selected models
- Strengths, Weaknesses, Challenges

Social vulnerability defined

- “Socioeconomic and demographic factors that affect the resilience of communities”

  Flannagan et al (2001)

- Meaning of the term in human-environmental systems is common although contested (Adger, 2006)
- The socially vulnerable are:
  - more likely to be adversely affected in disaster
  - more likely to be injured
  - more likely to die
  - less likely to prepare, respond, recover
- Traditionally, social vulnerability was ignored in loss estimates, in favor of inclusion of building & infrastructure loss
  - in US, HAZUS-MH v1.4 began including social vulnerability loss indicators (i.e., shelter requirements and displaced households)

Social vulnerability indicators

- Age (v young <5 yrs, v old >65 yrs)
- Disabled/infirm people
- Income (low)
- Strength of social networks (eg, job/no job)
- Neighborhood characteristics
- Minority status (race/ethnicity)
- Vehicle access
- Housing conditions...

Social vulnerability measurement

- Historically, researchers struggled to find suitable metrics for social vulnerability, as vulnerability is dynamic and linked to bio-physical, social and political processes (Adger 2006).
- Qualitative narratives help inform quantitative estimates

SoVI (Cutter et al, 2003)

- Index synthesizes 27/29 socioeconomic variables from the research lit that contribute to reduction in a community's ability to prepare, respond & recover.
- Assessment at US Census tract level (i.e., sub county)
- Each tract ranked on 14 variables
  - Poverty, vehicle access, crowded housing, etc
- ...then groups into four related themes
- 4 themes
  - Socioeconomic status, Household Composition, Race/Ethnicity/Language and Housing/Transportation
- Each tract receives a separate ranking for each of the four themes and an overall ranking

SoVI variables

Cutter & Emrich (2017)

Variables Used in SoVI® in Tract Level Analyses	
Variable Name	Description
MDGRENT	Median gross rent for for renter-occupied housing units
MEDAGE	Median age
MHSEVAL	Median dollar value of owner-occupied housing units
PERCAP	Per capita income
PPUNIT	Average number of people per household
QAGEDEP	% Population under 5 years or age 65 and over
QASIAN	% Asian population
QBLACK	% African American (Black) population
QCVLUN	% Civilian labor force unemployed
QED12LES	% Population over 25 with less than 12 years of education
QESL	% Population speaking English as a second language with limited English proficiency
QEXTRCT	% Employment in extractive industries (fishing, farming, mining etc.)
QFAM	% Children living in married couple families
QFEMALE	% Female
QFEMLBR	% Female participation in the labor force
QFHH	% Families with female-headed households with no spouse present
QHISP	% Hispanic population
QMOHO	% Population living in mobile homes
QNATAM	% Native American population
QNOAUTO	% Housing units with no car available
QNRRES	% Population living in nursing facilities
QPOVTY	% Persons living in poverty
QRENTER	% Renter-occupied housing units
QRICH200K	% Families earning more than $200,000 per year
QSERV	% Employment in service occupations
QSSBEN	% Households receiving Social Security benefits
QUNOCCHU	% Unocupied housing units

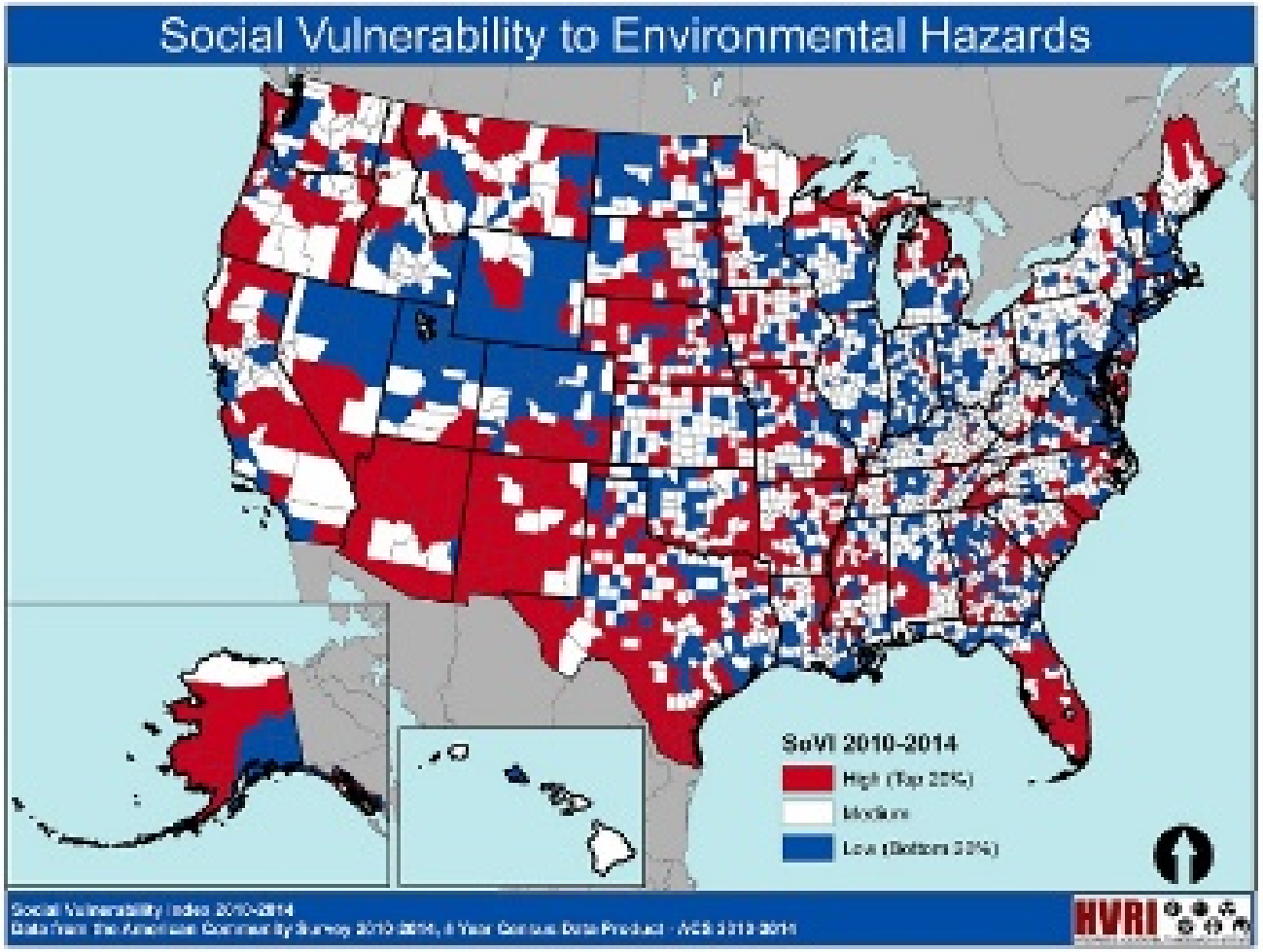
SoVi variable component summary

United States Tract-Level 2010-14 Social Vulnerability Component Summary

Component	*Cardinality*	*Name*	*% Variance Explained*	*Dominant Variables*	*Component Loading*
1	+	Race and Social Status	16.629	QPOVERTY	0.752
				QBLACK	0.750
				QFAM	-0.746
				QFHH	0.702
				QCVLUN	0.700
				QNOAUTO	0.678
				QSERV	0.571
2	-	Wealth	13.689	MHSEVAL	0.900
				QRICH200K	0.823
				PERCAP	0.773
				MDGRENT	0.730
				QASIAN	0.534
3	+	Ethnicity (Hispanic)	12.022	QESL	0.881
				QHISP	0.854
				QED12LES	0.689
				PPUNIT	0.687
4	+	Age (Old)	11.506	QSSBEN	0.896
				QAGEDEP	0.856
				MEDAGE	0.801
5	+	Gender (Female)	7.114	QFEMALE	0.843
				QFEMLBR	0.799
6	+	Special Needs	5.472	PPUNIT	-0.565
				QNRRES	0.534
				QRENTER	0.523
7	+	Race (Native Americans)	4.345	QNATAM	0.896
		Cumulative Variance Explained	**70.776**		

27 Total Variables, populations < 1 excluded, housing units < 1 excluded

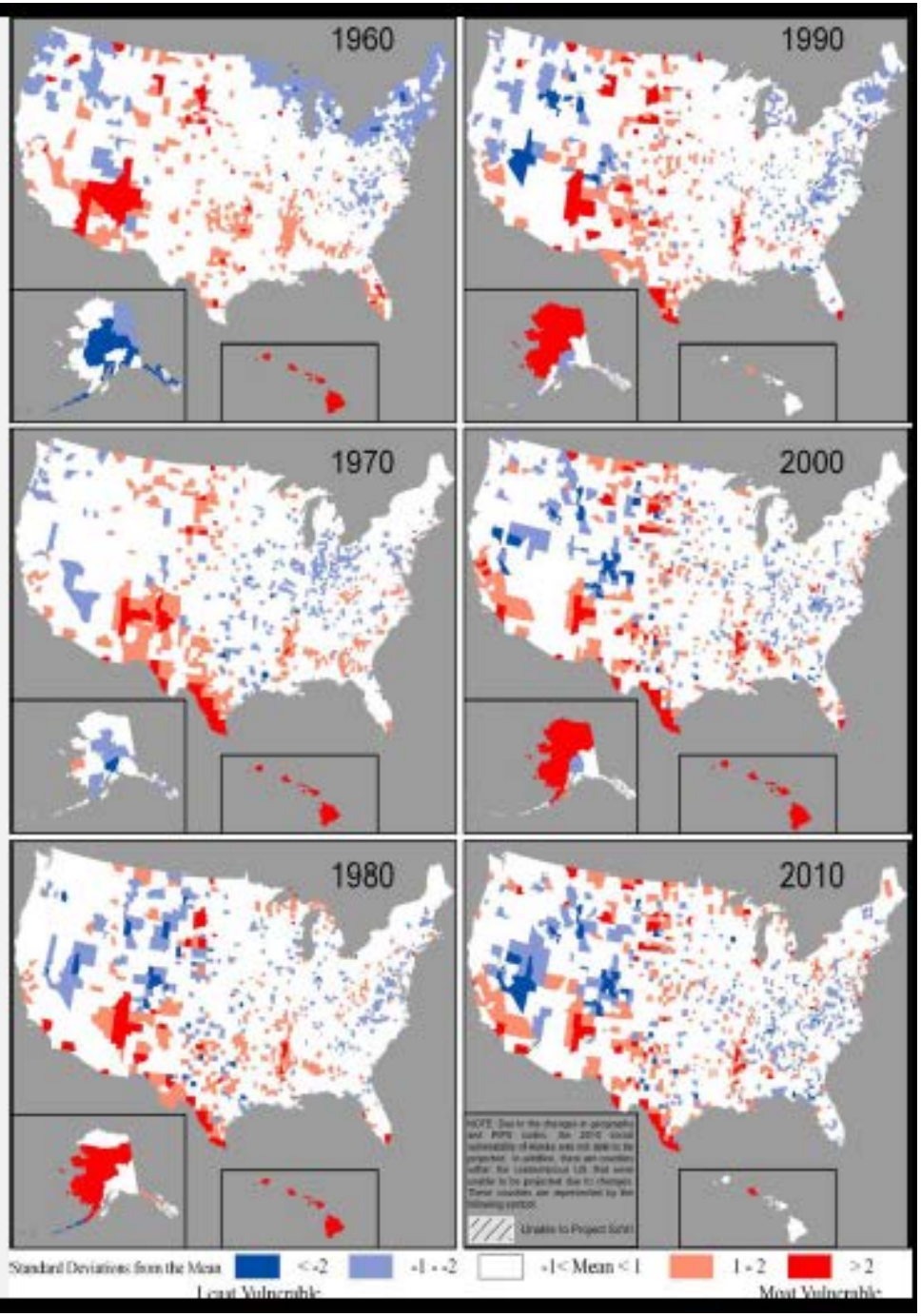
SoVI to Env Hazards map of US



Changes in Social Vulnerability

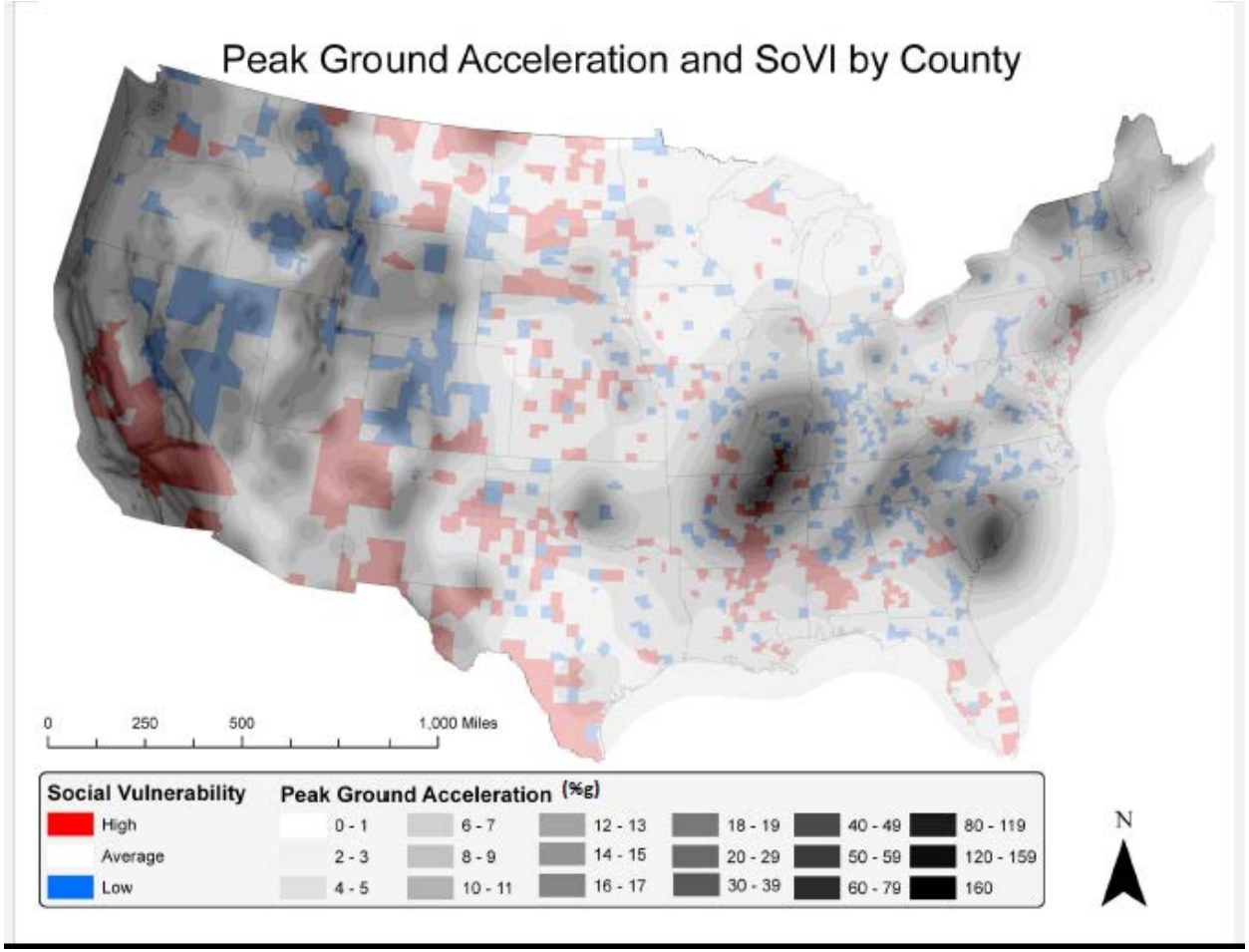
1960–2010

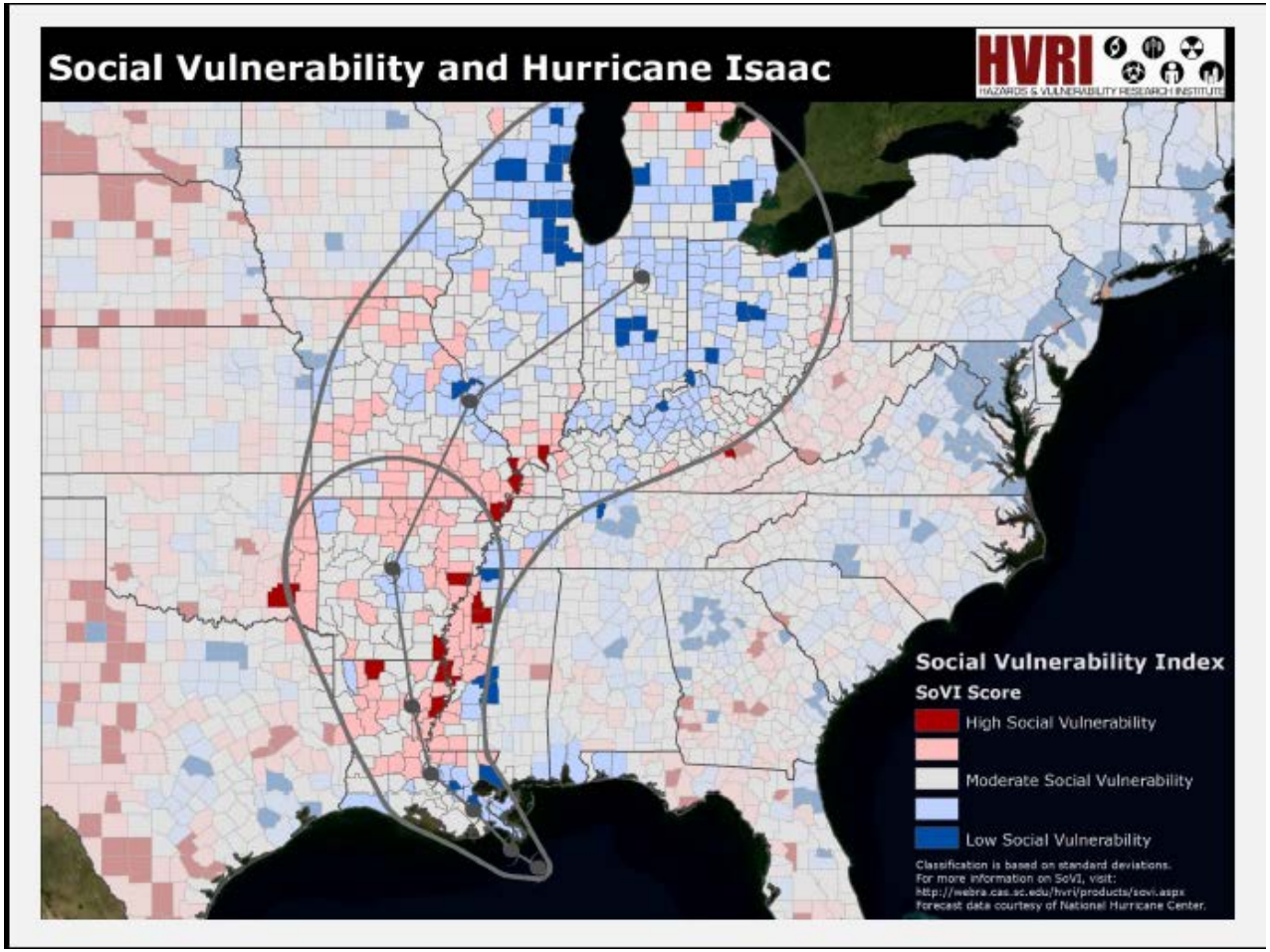
Consistent Factors:
Socioeconomic status
Development density
Age



Cutter, S.L. and C. Finch, 2008. Temporal and spatial changes in social vulnerability to natural hazards. *PNAS* 105 (7): 2301-2306.

SoVI overlay with hazard maps

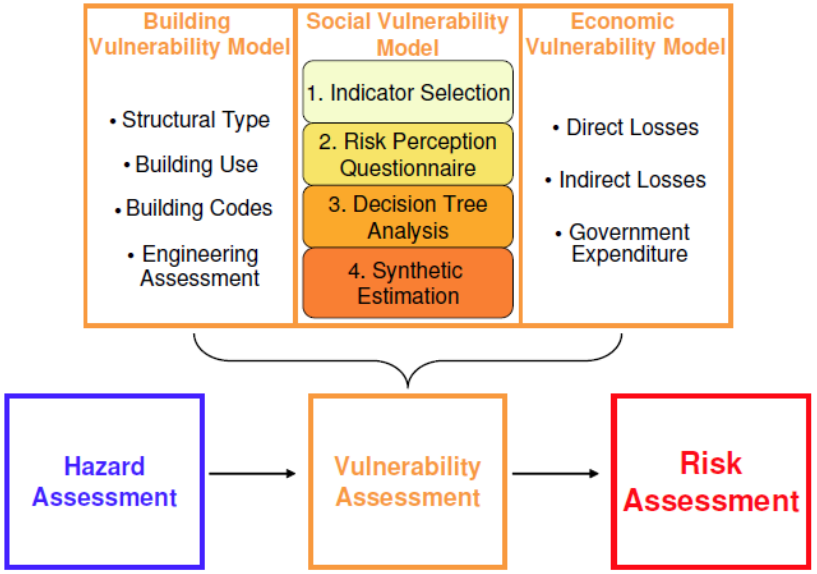



Social Vulnerability and Hurricane Isaac
HVRI
HAZARDS & VULNERABILITY RESEARCH INSTITUTE
Social Vulnerability Index
SoVI Score
High Social Vulnerability
Moderate Social Vulnerability
Low Social Vulnerability
Classification is based on standard deviations.
For more information on SoVI, visit:
http://webra.cas.sc.edu/hvri/products/sovi.aspx
Forecast data courtesy of National Hurricane Center.

Social vulnerability (Aus model)

Four levels:

1. Individual within household (personal)
2. Community (interaction)
3. Regional/geographical (distance from services)
4. Admin/institutional ($ funding)



Dwyer et al (2004/14)

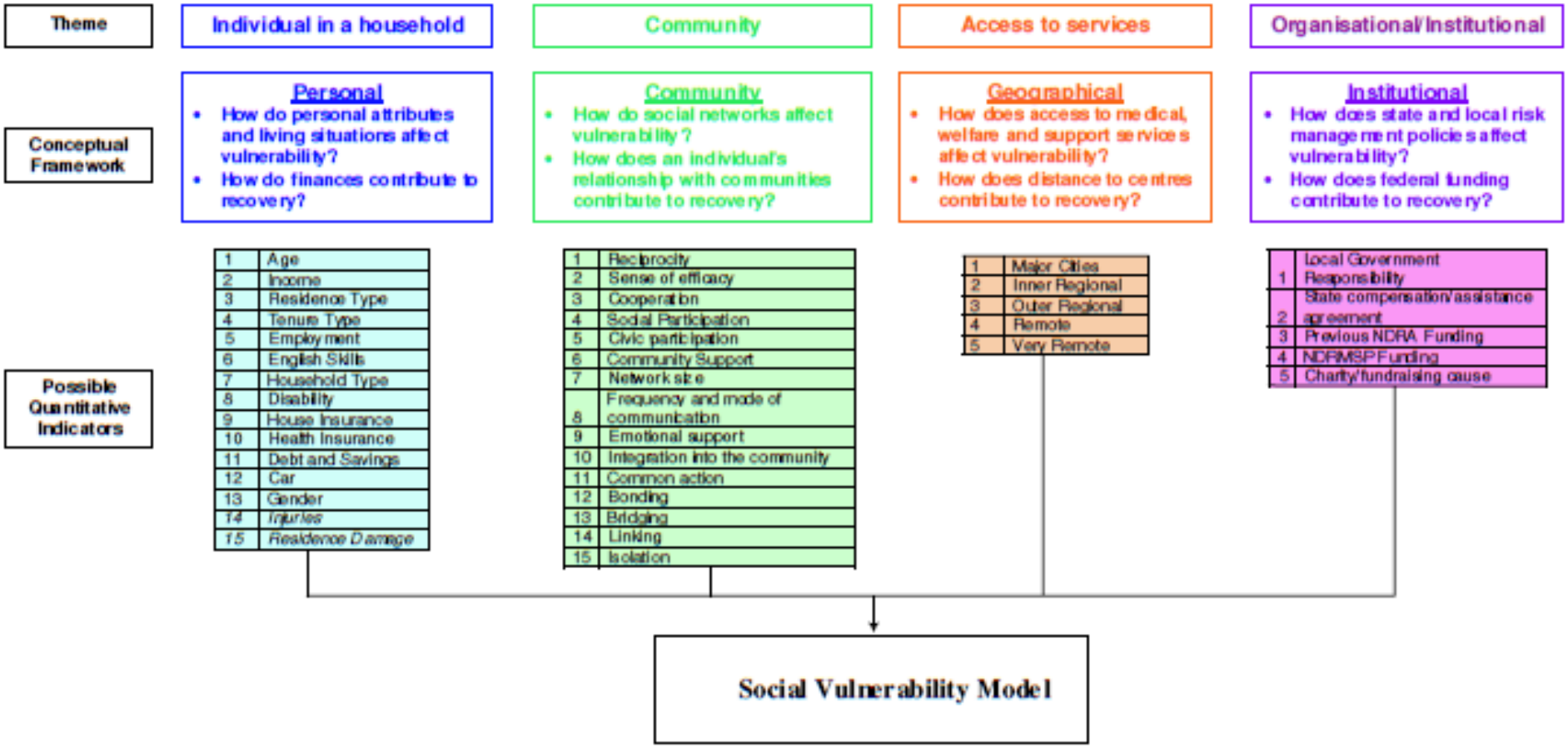


Figure 3: A schematic representation of some of the various factors contributing to social vulnerability. This study will focus on the first level of social vulnerability, which relates to the vulnerability of an individual within a household.

Cities Project: 13 indicators

Number	Indicator	References
1	Age	[66, 59, 12, 39, 29]
2	Income	[66, 59, 8]
3	Residence Type	[59, 8]
4	Tenure	[59, 45]
5	Employment	[14]
6	English Skills	[14, 45]
7	Household Type	[39, 29, 14, 45]
8	Disability	[59, 14]
9	House Insurance	[67]
10	Health Insurance	
11	Debt and Savings	
12	Car	[66, 29, 14]
13	Gender	[59, 26, 29]
14	Injuries	[4]
15	Residence Damage	[4]

Other social science

Behavioral models of protective action decision making:

- Classic Persuasion Model (Lazwell 1948)
- Paton (2004)
- Mileti & Sorensen (1990)
- Lindell & Perry (2004)

Mileti and Sorensen

Warning Response Model

Describes warnings as a process or sequence where people have to :

1. hear or perceive (understand, believe, and personalize) a message
2. decide how to respond:
    1. either continue normal routine or
    2. take alternative protective actions & perform them

…people don't passively wait for information, they actively seek it through the *Warning Confirmation Process*

Warning Confirmation Process

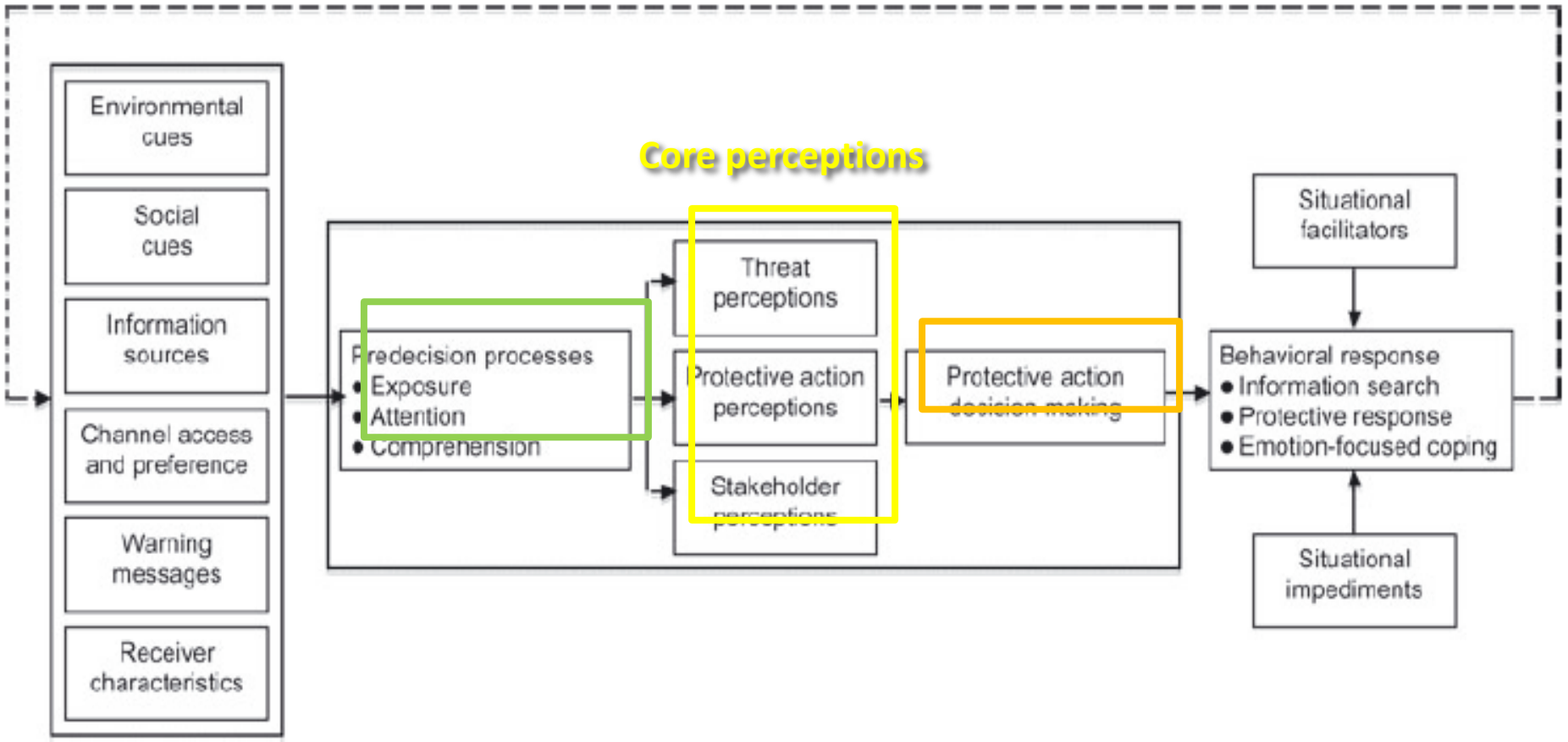
Sequence and human outcomes depend on:

1. *Message Content* Received
   - Hazard, source, timing, guidance
2. *Style of Message* Received
   - specificity, consistency, certainty, clarity, accuracy, sufficiency, and channel
3. *Receiver Characteristics*
   - *Environmental cues, social setting, social ties, social structure, psychological*

Concerns: focuses on immediate aspects of the message rather than long term receiver factors

Lindell & Perry

Protective Action Decision Model (PADM):

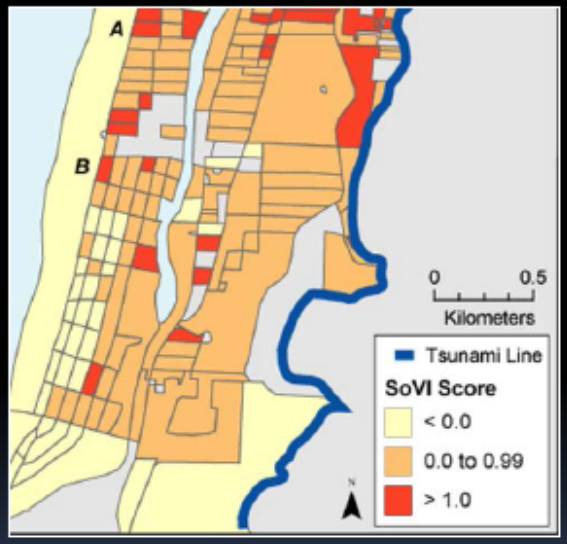


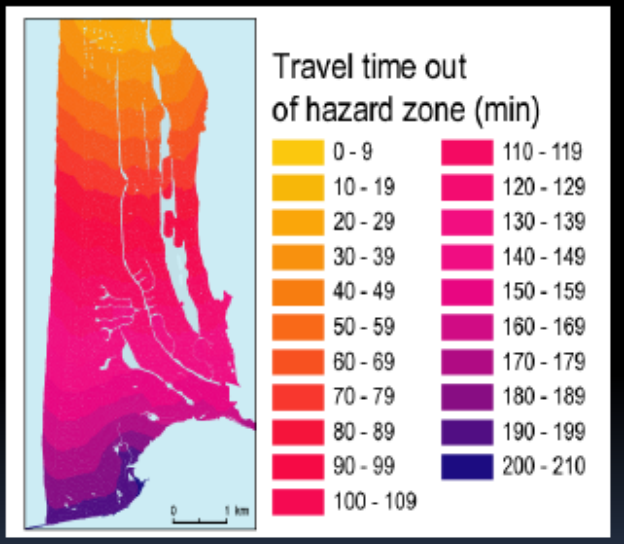
Lindell and Perry (2004, 2012). Protective Action Decision Model

N. Wood. Evacuation modeling

Societal vulnerability to tsunamis

Overview and relationship to national risk analysis





U.S. Department of the Interior
U.S. Geological Survey

Nathan Wood, PhD
USGS Western Geographic Science Center
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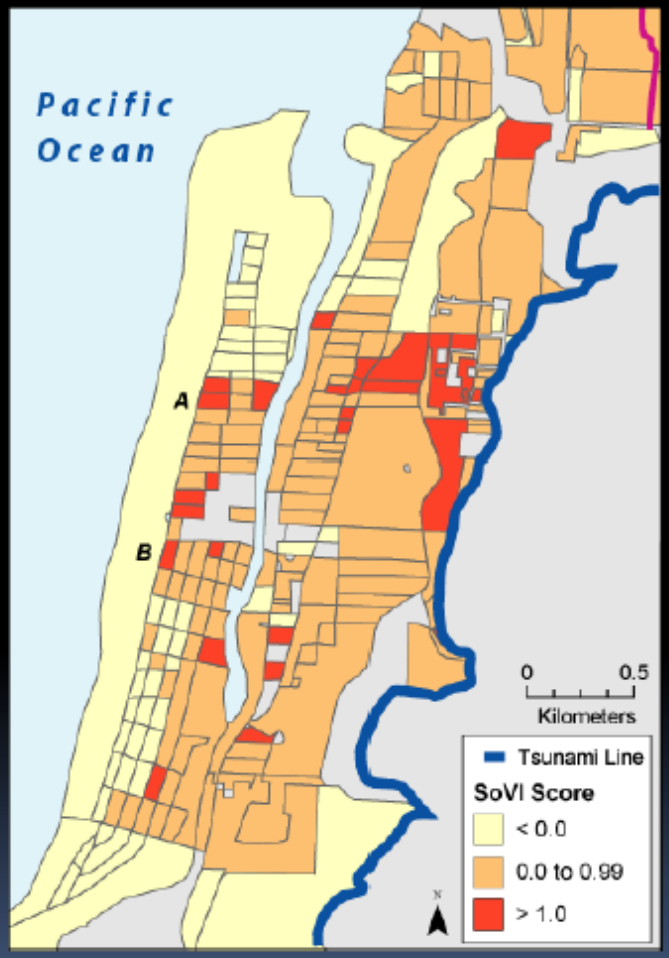
Sensitivity Analysis

Internal characteristics that inhibit preparedness and response



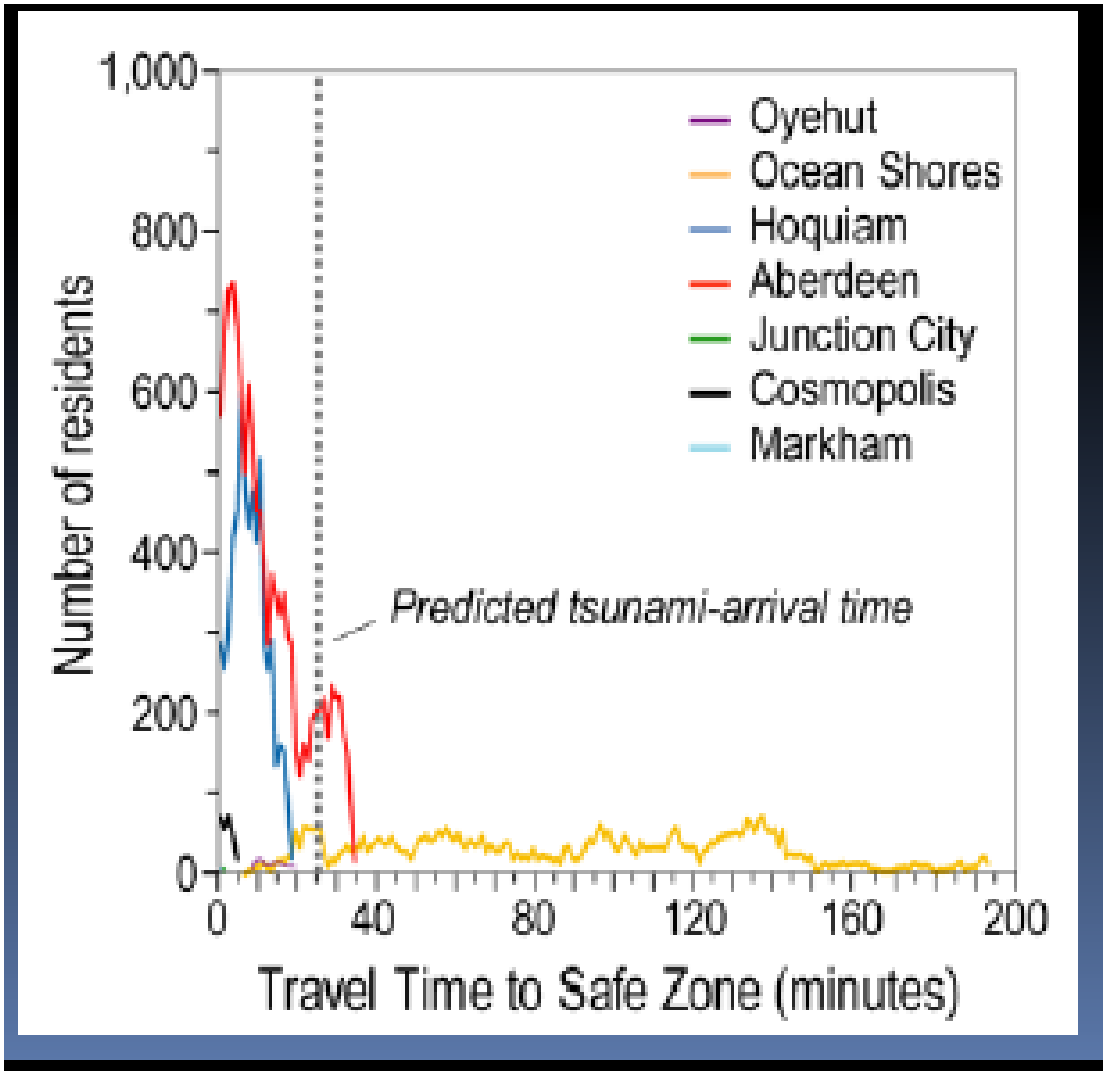
Hot-spots of demographic sensitivity in Seaside, Oregon

(GIS-based factor analysis of demographic attributes of residents)

Demographic characteristics

- Age
- Gender
- Race and ethnicity
- Economic status
- Tenancy
- Ability to speak primary language
- Occupation
- Family structure
- Education
- Dependence on social services

Socially vulnerable to tsunami: pedestrian (foot) evacuation



Strengths, Weaknesses, Challenges

Strengths

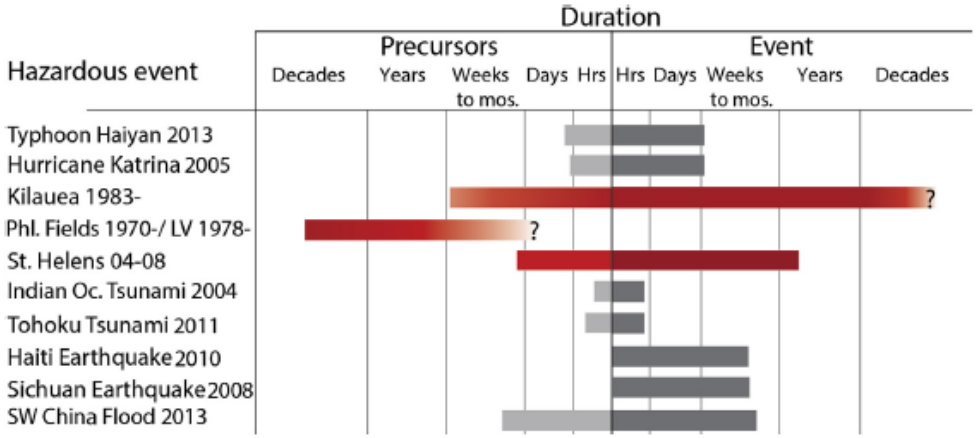
- Qualitative and quantitative data
- Numerous indicators and some census data

Weaknesses

- Uncertainty high
- Inconsistency across indicators or weighting
- High number of volcanic hazards
- High variation in spatial distribution & temporal duration of some volcanic hazards
- Acute vs chronic hazards
- Unrest vs eruption
- Lack of consistent census data
- Census data at tract level too course

Challenges

- Find common indicators across hazards
- common scale for census data
- comparative hazards



Gregg, Houghton & Ewert (2015)