Weighing structural damage and social susceptibility:
A decision-making tool to perform longitudinal studies of geographically large hazards events
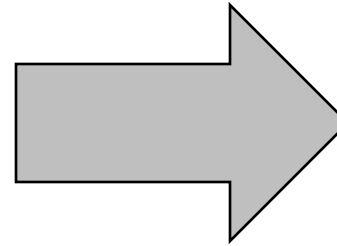
Blythe Johnston

IN-CORE

Resilience

Designing the Social Susceptibility Metric to Predict Specific Outcomes

Factors considered for inclusion in the predictive metric

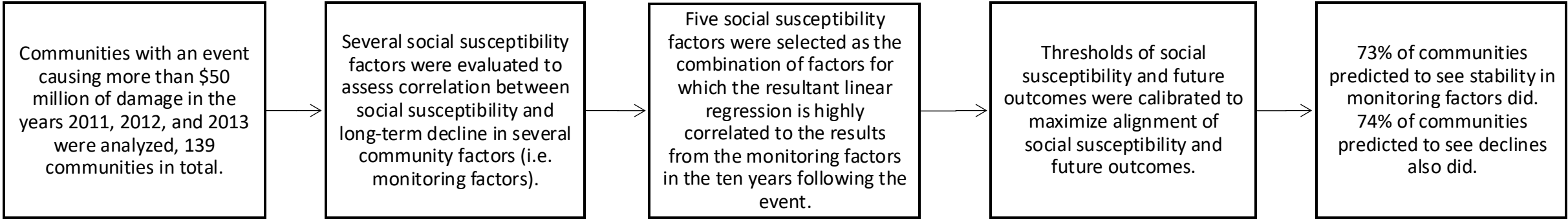1 - Educational Attainment
2 - Median Income
3 - Race
4 - Ethnicity
5 - Rental Tenure
6 - Occupancy Rate
7 - Median Age
8 - Population Density
9 - Rurality
10 - Event Cost
11 – Scaled Value for Event Cost
12 - Community Self-Perception
13 - Racial Affinity Groups
14 - Family Ties
15 - %Less than HS
16 - % Population 65+
17 - %Limited English Households
18 - %Population Below Poverty Line
19 - %Unemployed in Labor Force
20 - %Female Unemployed
21 - %Single Parent Households
22 - Mobile Homes as % of HUs
23 - %owner occupied
24 - % Households w/o vehicle
25 - GINI Index
26 - Number of Healthcare professionals per 1,000 residents
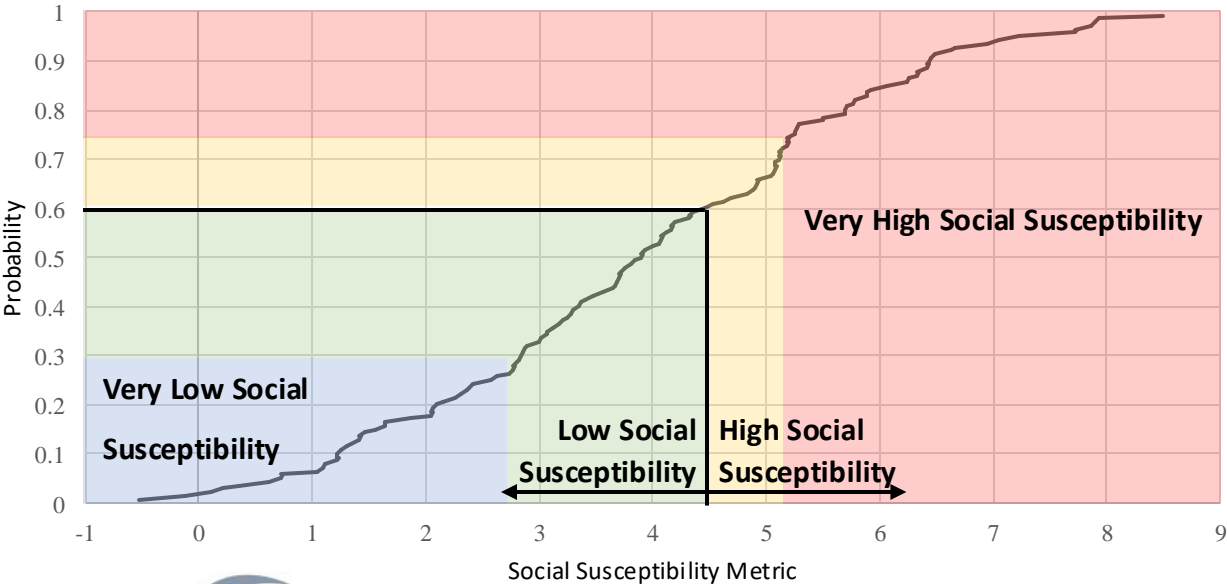
Monitoring factors which the linear fit model was being trained to predict

Median Household Income

Population

Educational Attainment

Number of Households

Number of Housing Units

A Protocol for Community Selection: Assessment of Social Susceptibility

Communities with an event causing more than $50 million of damage in the years 2011, 2012, and 2013 were analyzed, 139 communities in total.	Several social susceptibility factors were evaluated to assess correlation between social susceptibility and long-term decline in several community factors (i.e. monitoring factors).	Five social susceptibility factors were selected as the combination of factors for which the resultant linear regression is highly correlated to the results from the monitoring factors in the ten years following the event.	Thresholds of social susceptibility and future outcomes were calibrated to maximize alignment of social susceptibility and future outcomes.	73% of communities predicted to see stability in monitoring factors did. 74% of communities predicted to see declines also did.

Social Susceptibility Probability for 139 Communities

Social Susceptibility Status	Predicted Outcome Based on Social Susceptibility Only
Very Low	Marked Stability
Low	Stability
High	Decline
Very High	Marked Decline

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NIST CENTER FOR RISK-BASED COMMUNITY RESILIENCE PLANNING
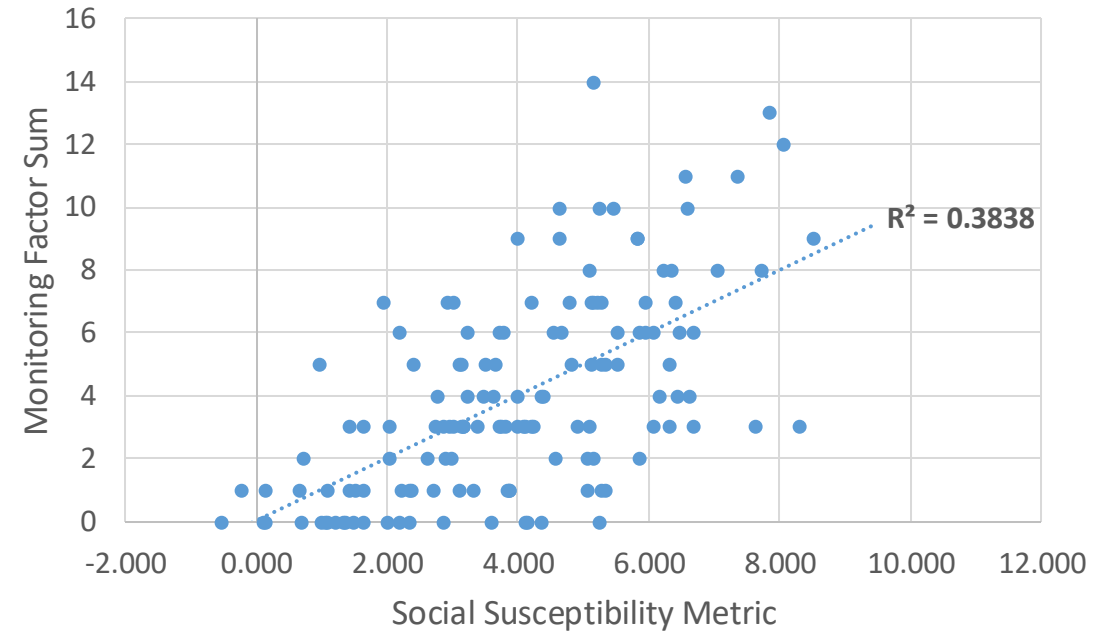
Resilience

Creating Outcome Tiers for Generating Representative Datasets

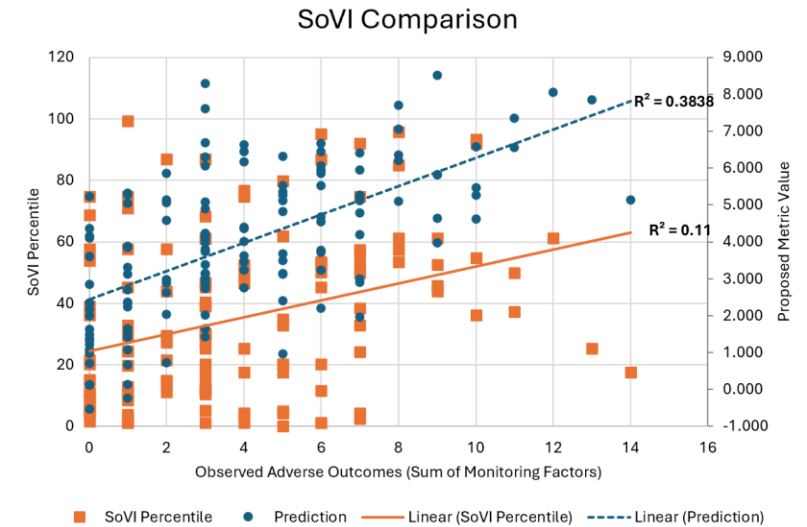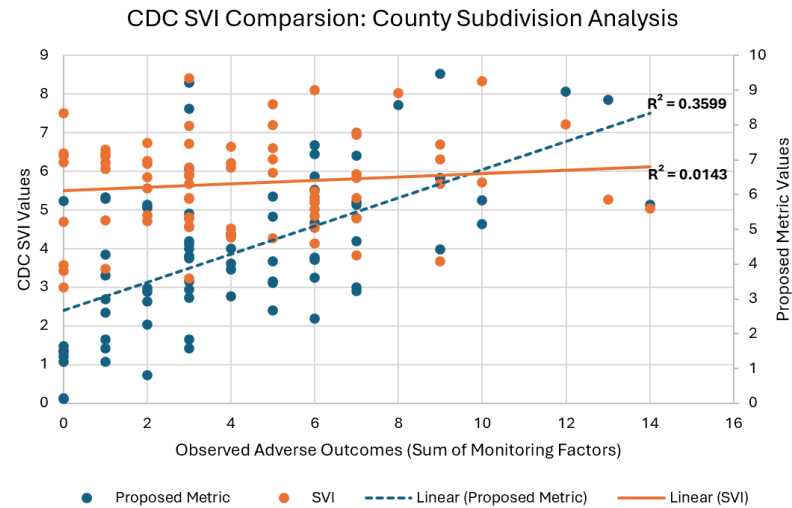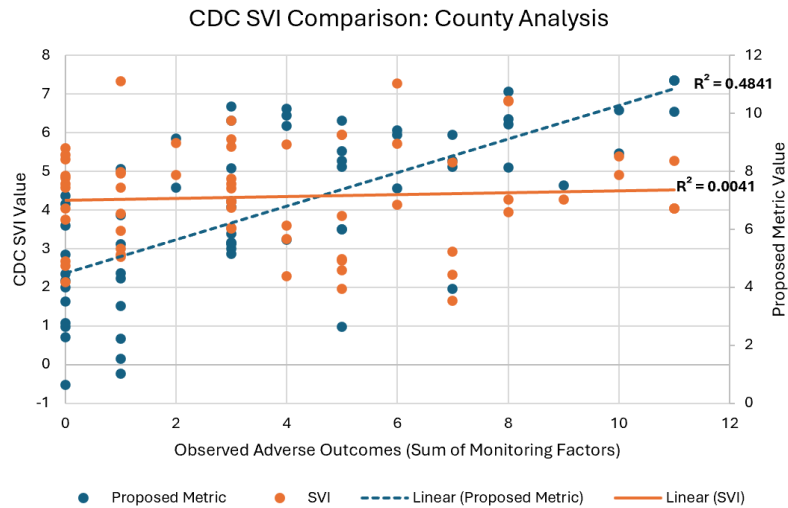| Social Susceptibility Tiers	Outcome Tiers	Score Range		Meaning of Outcome Tiers in the Years Following the Event	
		Predictive Factors	Monitoring Factors	Post-Event Monitoring Factors with Partial Negative Trends (Not Sustained)	Post-Event Monitoring Factors with Sustained Negative Trends
Very Low	Marked Stability	<=2.75	<=1.5	At most 1 factor	None
Low	Stability	<=4.4	<=3.5	At most 3 factors	At most 1 factor
High	Decline	>4.4	>3.5	More than 3 factors possible	More than 1 factor possible
Very High	Marked Decline	>5.15	>5.5	All 5 factors possible	At least 1 factor, More than 2 factors possible

The Resultant Metric

Factors Selected For Predictive Metric

po - % Population 65+

le - % Limited English Households

sp - % Single Parent Households

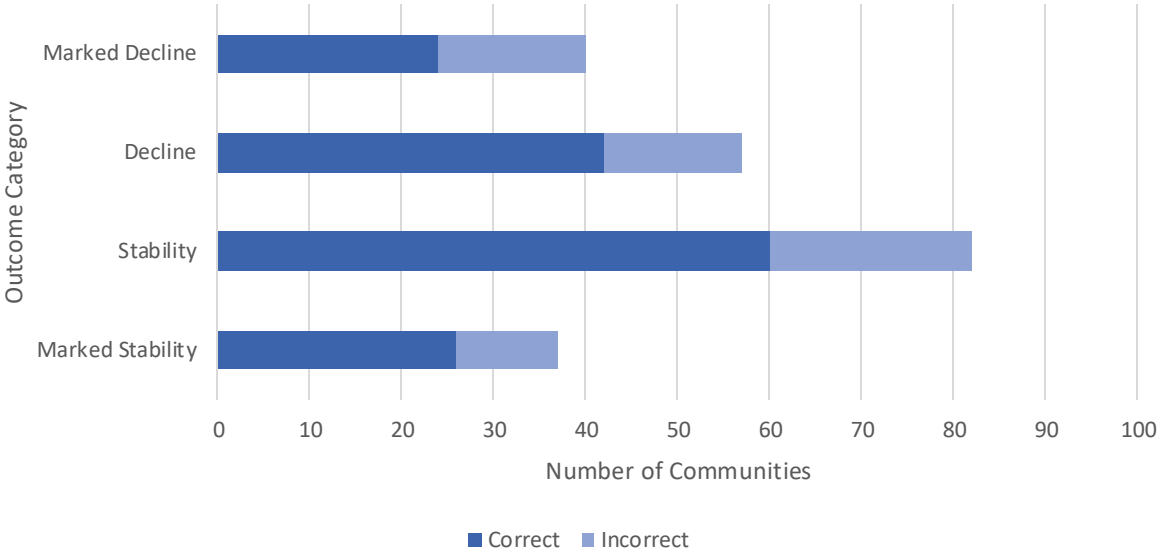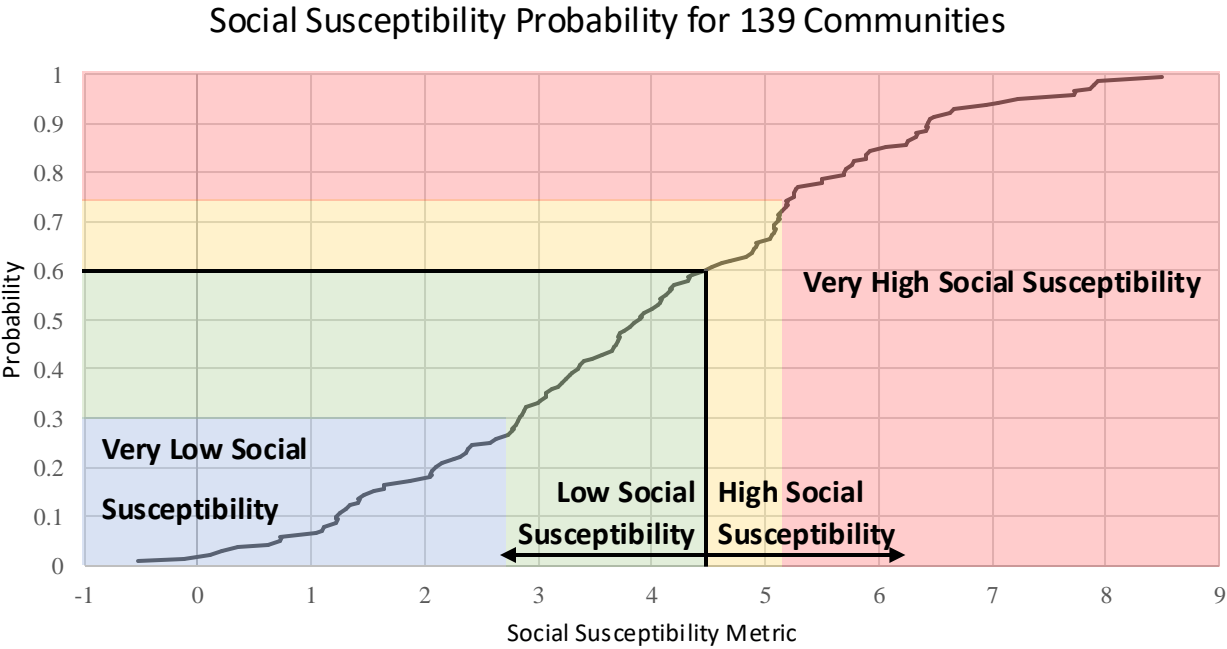hv - % Households w/o vehicle

gn - GINI Index

$$SSM = 1.3714 + 4.6717po - 1.9664le + 2.2459sp + 2.3505hv - 1.8548gn$$

How This Resultant Metric Compares

Binning: Creating Outcome Tiers

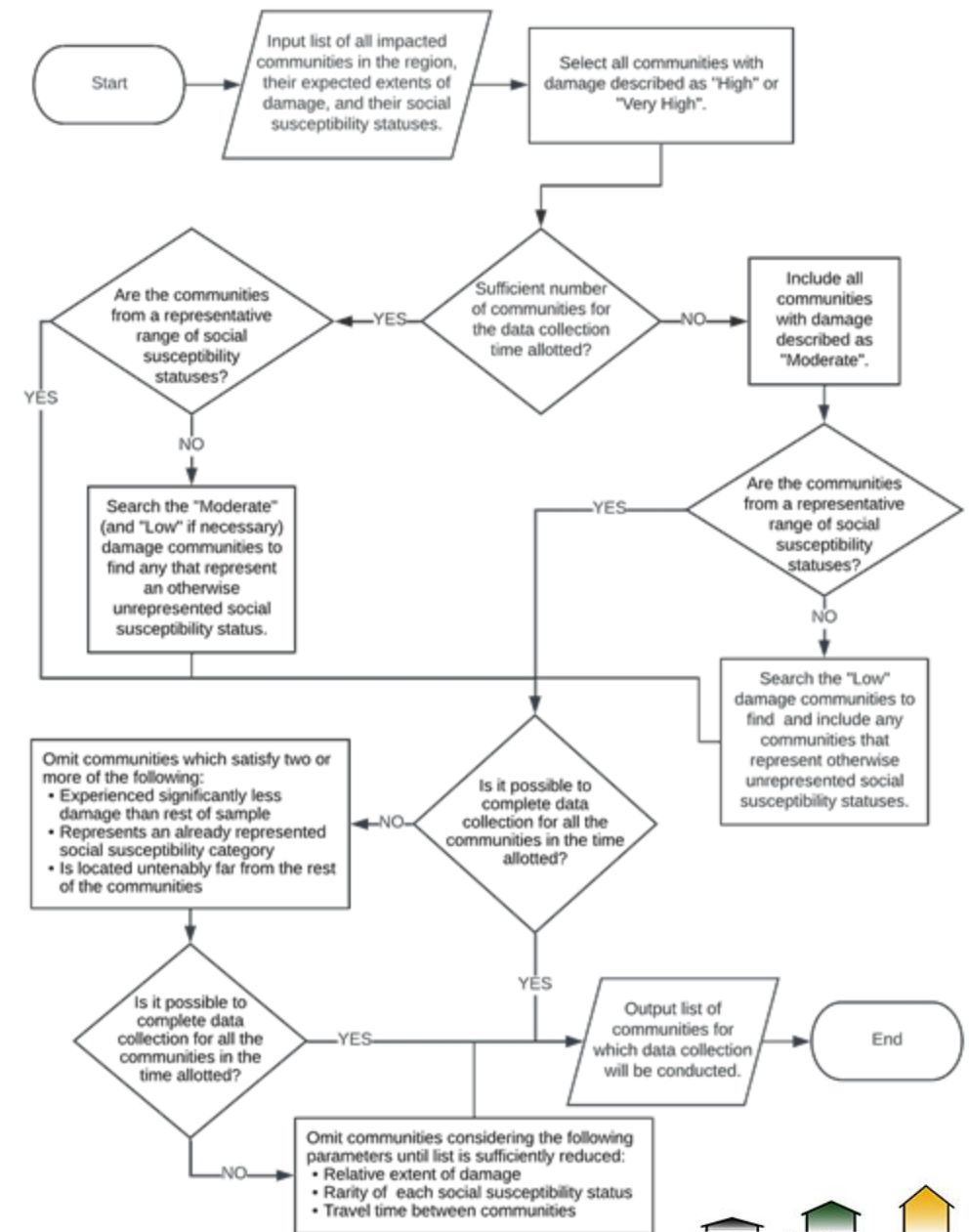Social Susceptibility Probability for 139 Communities

73% of communities predicted to see stability in monitoring factors did.
74% of communities predicted to see declines also did.

Development of a Companion Decision-Making Tool

This tool helps select communities based on:

- Representativeness of social susceptibility outcome tier

- Extent of damage expected or preliminarily documented

- Efficient use of resources available

Limitations and Next Steps

The metric may benefit from further disaggregation of outcomes so that the mechanisms behind recovery can be investigated.

The outcomes outlined here are summary statistics for the community, so concerns regarding equity and dispersion patterns of outcomes remain an area of investigation. This is part of the reason why the metric is not termed a vulnerability or resilience metric.

This metric has been developed for a specific application. Implementation in other applications would need greater investigation to determine appropriateness.

The field study that initially implemented this work will conclude this December, and the data from this field study is actively being processed to determine building recovery patterns to further validate this metric.