



National Integration Center Technical Assistance

Community Resilience Indicator Analysis

County-level Analysis of Commonly Used Indicators from Peer-Reviewed Research: 2019 Update

Resilience Analysis and Planning Tool (RAPT)

Update 2020

Emergency Management Higher Education Symposium
June 2020



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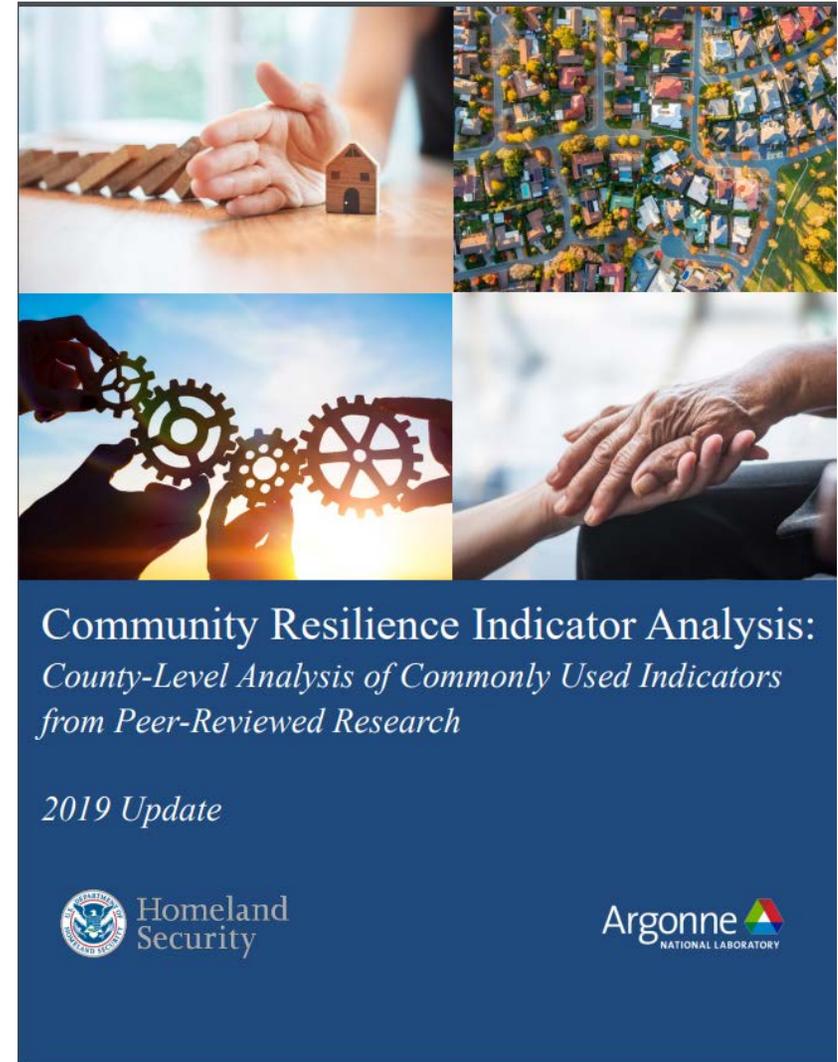
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The National Integration Center (NIC) develops doctrine and tools to lead the whole community implementation of the National Preparedness System (NPS) and the National Incident Management System (NIMS).

Support FEMA Goal 1: Build a Culture of Preparedness

Community Resilience Indicator Analysis:

- Provides a data-driven basis to prioritize locations for technical assistance investment, and
- Informs community resilience, response, recovery planning

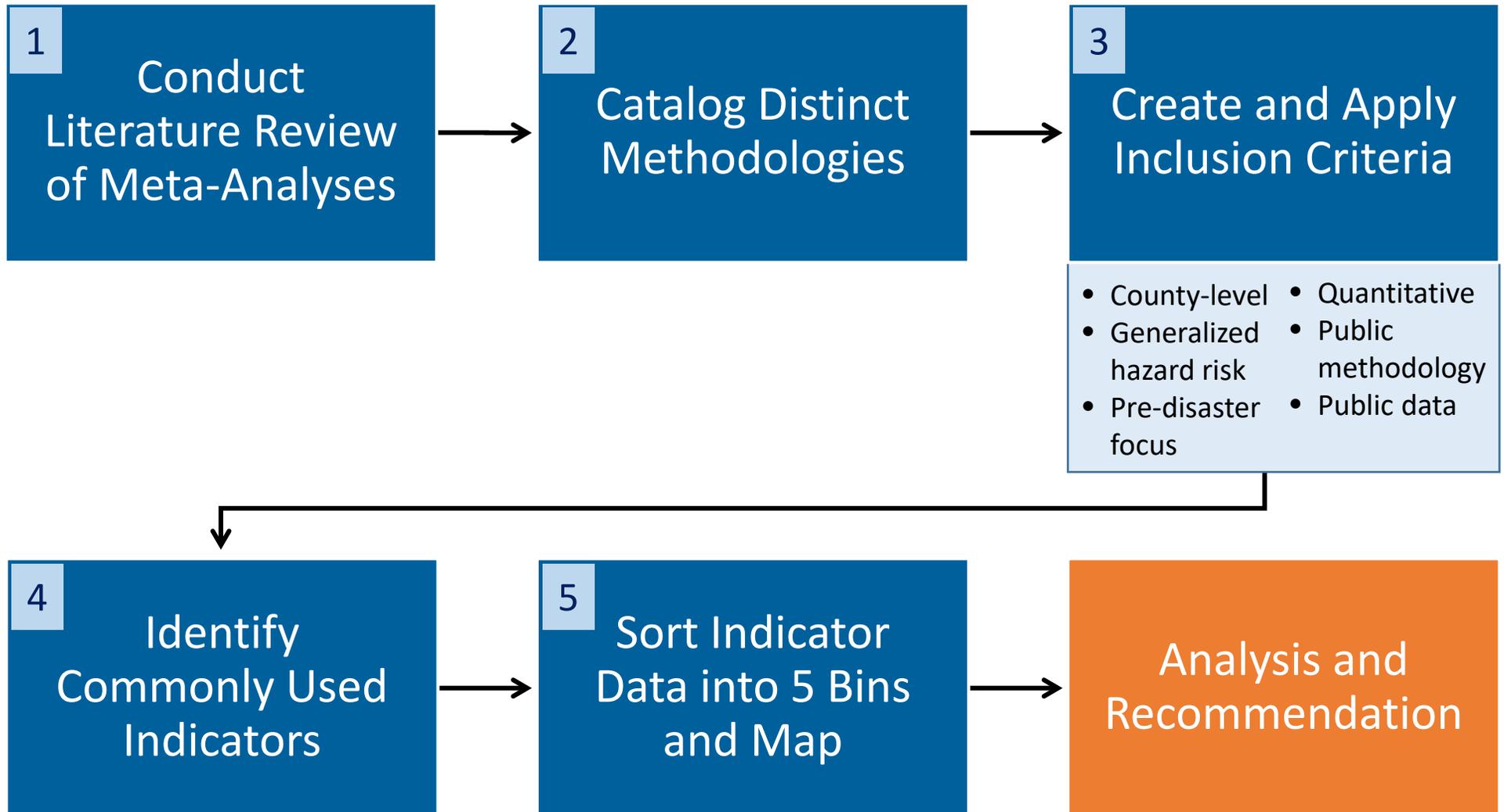


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5-Step Methodology to Identify and Map Commonly Used Indicators of Community Resilience



Limitations of Analysis

- **Open Source Data**: more specific data may be available from proprietary sources; this methodology used open, easily available, no cost datasets
- **Incomplete National Datasets**: U.S. Census primary datasets do not include results for many of the U.S. territories
- **No Assessment of Community Capacity**: this analysis does not include data on a community's capacity to respond to hazards relative to these indicators



Benefits of Analysis

- **Existing Peer-reviewed Research**: peer-review process provides greater validity
- **Commonly Used Indicators**: suggest some research agreement
- **Attention to Individual Indicators**: (vs domains comprised of multiple indicators) may help users pinpoint specific areas for improvement
- **Relative Assessment**: identifies priority areas while acknowledging all communities can take steps to improve resilience
- **Broad Application of Findings**: offers national perspective and local baseline; useful for FEMA programs and SLTT partners



Community Resilience Methodologies

- Baseline Resilience Indicators for Communities (BRIC)
- Community Disaster Resilience Index (CDRI)
- Community Resilience Index (CRI2)
- Disaster Resilience of Place (DROP)
- Resilient Capacity Index (RCI)
- Social Vulnerability Index (SVI)
- The Composite Resilience Index (TCRI)



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Commonly Used Community Resilience Indicators

11 Population-Focused Indicators and Metric Used

Educational Attainment: % population over 25 without high school diploma

Unemployment Rate: % of labor force unemployed

Disability: % of population with a disability

English Language Proficiency: % limited-English-speaking households

Mobility: % of occupied housing units with no vehicles available

Home Ownership: % owner-occupied housing units

Age: % of population 65 years and over

Household Income: median household income

Income Inequality: Gini Index

Health Insurance: % of population with no health insurance coverage (private or public)

Single-parent Households: % of single-parent households



Commonly Used Community Resilience Indicators

9 Community-Focused Indicators and Metric Used

Connection to Civic and Social Organizations: # of organizations per 10,000 people
Hospital Capacity: # of hospitals per 10,000 people
Medical Professional Capacity: # of health diagnosing and treating practitioners per 1,000 people
Affiliation with a Religion: % of population that are religious adherents
Mobile Homes: % of mobile homes
Population Change: % change in residents who have lived in same county for more than 5 years
Public School Capacity: # of public schools per 5,000 population
Hotel/Motel Capacity: # of hotels/motels per 5,000 population
Rental Property Capacity: % vacant rental housing units



Mapping and Analysis

- **Choropleth Maps** provide high-level visual understanding of relative values of census data (county and census tract).
- **Correlation Analysis** provides greater understanding of inter-connectedness between indicators.
- **Aggregate Indicator** shows national relative standard deviation of all 20 indicators combined.
- **Analysis and Recommendations** are included in the report to highlight specific findings by indicator and by region.

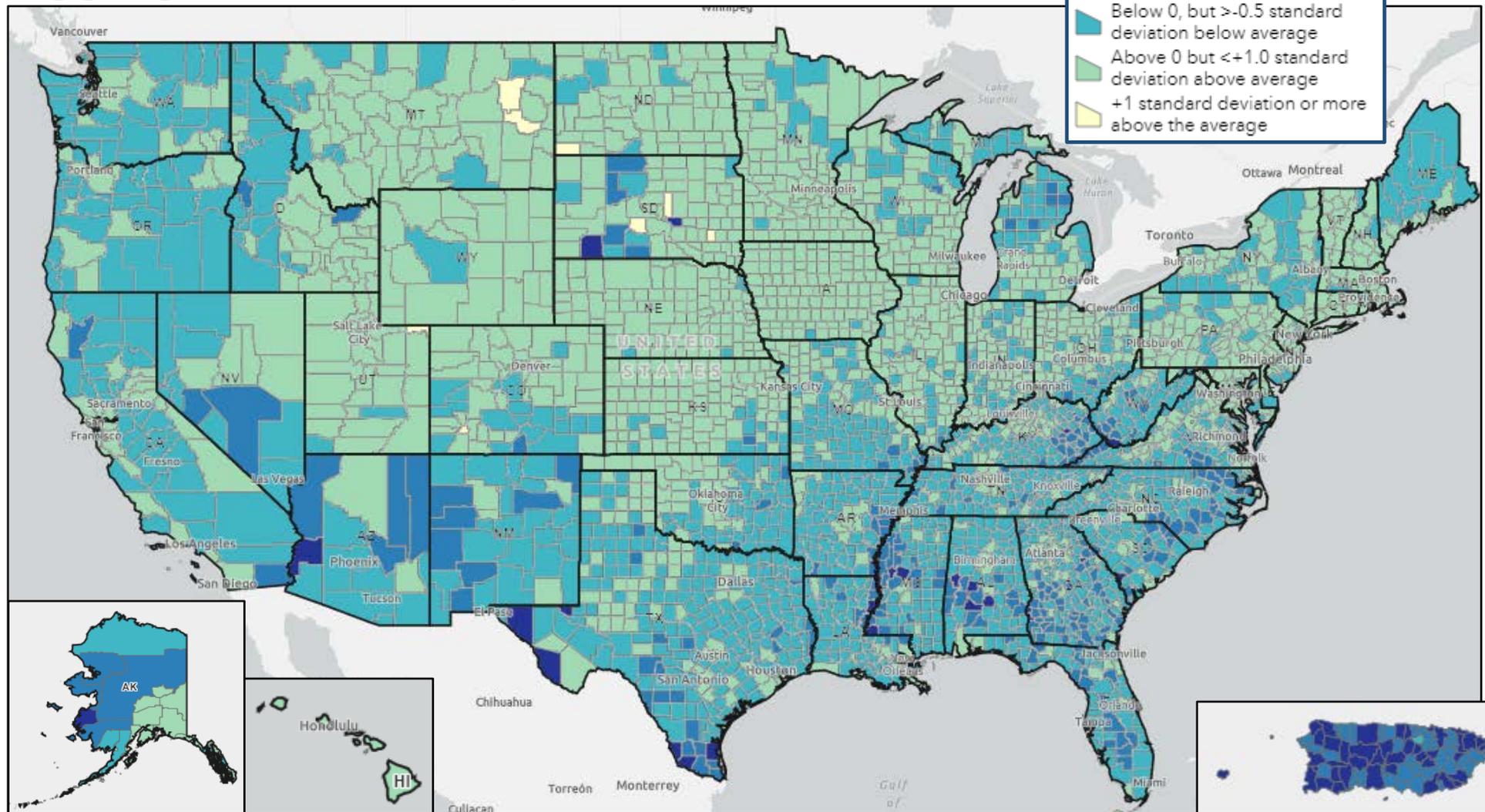
Table 2: Pearson Correlation Coefficients

	Age 65 and Older	Lack of HS Diploma	Disability	Limited English Language Proficiency	Lack of Health Insurance	Lack of Vehicle	Unemployment Rate	Household Income	Income Inequality	Home Ownership	Single-Parent Household	Presence of Mobile Homes	Public School Capacity	Medical Professional Capacity	Hospital Capacity	Hotel/Motel Capacity	Rental Property Capacity	Affiliation with a Religion	Connection to Civic and Social Organizations	Population Change
Age 65 and Older	1.00	-0.12	0.41	-0.07	-0.15	-0.16	-0.11	-0.27	0.01*	-0.12	-0.31	0.13	0.23	-0.08	0.26	0.14	0.10	0.03*	0.21	-0.34
Lack of HS Diploma	-0.12	1.00	0.43	0.43	0.46	0.34	0.50	-0.59	0.37	-0.19	0.53	0.45	-0.12	-0.49	-0.01*	-0.11	-0.01*	0.02*	-0.15	-0.19
Disability	0.41	0.43	1.00	0.11	0.09	0.16	0.41	-0.66	0.24	-0.18	0.25	0.48	-0.03*	-0.34	0.04	-0.05	0.04*	-0.08	-0.02*	-0.39
Limited English Language Proficiency	-0.07	0.43	0.11	1.00	-0.04*	0.33	0.52	-0.31	0.28	-0.11	0.38	-0.20	-0.06	-0.14	-0.01*	-0.02*	0.02*	0.02*	-0.05	0.04*
Lack of Health Insurance	-0.15	0.46	0.09	-0.04*	1.00	0.11	0.16	-0.26	0.17	-0.29	0.28	0.37	0.09	-0.41	0.06	0.09	0.12	0.08	-0.08	0.07
Lack of Vehicle	-0.16	0.34	0.16	0.33	0.11	1.00	0.50	-0.30	0.39	-0.32	0.59	-0.05	-0.05	-0.12	-0.09	-0.06	-0.04*	-0.03*	-0.01*	-0.16
Unemployment Rate	-0.11	0.50	0.41	0.52	0.16	0.50	1.00	-0.50	0.41	-0.24	0.66	0.17	-0.16	-0.28	-0.13	-0.09	-0.01*	-0.12	-0.13	-0.13
Household Income	-0.27	-0.59	-0.66	-0.31	-0.26	-0.30	-0.50	1.00	-0.43	0.34	-0.48	-0.42	-0.05	0.42	-0.12	0.02*	-0.07	-0.04*	-0.01*	0.47
Income Inequality	0.01*	0.37	0.24	0.28	0.17	0.39	0.41	-0.43	1.00	-0.34	0.49	0.14	-0.12	-0.04*	-0.06	-0.06	0.04*	0.04*	-0.11	-0.08
Home Ownership	-0.12	-0.19	-0.18	-0.11	-0.29	-0.32	-0.24	0.34	-0.34	1.00	-0.28	-0.11	-0.20	0.30	-0.07	-0.30	-0.29	0.04*	-0.10	0.10
Single-Parent Household	-0.31	0.53	0.25	0.38	0.28	0.59	0.66	-0.48	0.49	-0.28	1.00	0.15	-0.25	-0.21	-0.19	-0.13	-0.05	-0.04*	-0.18	-0.14
Presence of Mobile Homes	0.13	0.45	0.48	-0.20	0.37	-0.05	0.17	-0.42	0.14	-0.11	0.15	1.00	0.01*	-0.39	0.02*	0.00*	0.04*	-0.12	-0.09	-0.17
Public School Capacity	0.23	-0.12	-0.03*	-0.06	0.09	-0.05	-0.16	-0.05	-0.12	-0.20	-0.25	0.01*	1.00	-0.18	0.38	0.33	0.12	0.22	0.27	-0.20
Medical Professional Capacity	-0.08	-0.49	-0.34	-0.14	-0.41	-0.12	-0.28	0.42	-0.04*	0.30	-0.21	-0.39	-0.18	1.00	-0.10	-0.09	-0.11	0.02*	-0.04*	0.19
Hospital Capacity	0.26	-0.01*	0.04*	-0.01*	0.06	-0.09	-0.13	-0.12	-0.06	-0.07	-0.19	0.02*	0.38	-0.10	1.00	0.21	0.08	0.26	0.29	-0.24
Hotel/Motel Capacity	0.14	-0.11	-0.05	-0.02*	0.09	-0.06	-0.09	0.0*	-0.06	-0.30	-0.13	0.00*	0.33	-0.09	0.21	1.00	0.25	0.05	0.24	-0.05
Rental Property Capacity	0.10	-0.01*	0.04*	0.02*	0.12	-0.04*	-0.01*	-0.07	0.04*	-0.29	-0.05	0.04*	0.12	-0.11	0.08	0.25	1.00	0.07	0.07	-0.03*
Affiliation with a Religion	0.03*	0.02*	-0.08	0.02*	0.08	-0.03*	-0.12	-0.04*	0.04*	-0.04*	-0.12	0.22	0.02*	0.26	0.05	0.07	1.00	0.14	-0.15	
Connection to Civic and Social Organizations	0.21	-0.15	-0.02*	-0.05	-0.08	-0.01*	-0.13	-0.01	-0.11	-0.10	-0.18	-0.09	0.27	-0.04*	0.29	0.24	0.07	1.00	0.14	-0.18
Population Change	-0.34	-0.19	-0.39	0.04*	0.07	-0.16	-0.13	0.47	-0.08	0.10	-0.14	-0.17	-0.20	0.19	-0.24	-0.05	-0.03*	-0.15	-0.18	1.00

*not statistically significant
 Positive relationships have green shading
 Negative relationships have blue shading



Aggregate Community Resilience Indicator



Counties in the least resilient bins (darker blues) tend to be in: Central Appalachian counties, Mississippi Delta LA/MS, Alabama, Southeastern US, South Dakota, South Texas, Puerto Rico, the western coast and interior of Alaska



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CRIA Compared with SoVI, SVI, and BRIC

Percent Asian
Percent Black
Percent Hispanic
Percent Native American
Percent Population under 5 years or 65 and over
Percent Children Living in Married Couple Families
Median Age
Percent Households Receiving Social Security Benefits
Percent Poverty
Percent Households Earning over \$200,000 annually
Per Capita Income
Percent Speaking English as a Second Language with Limited English Proficiency

SoVI Index:
2010-2014 County Data
Aggregate Index based on 29
indicators

Susan L. Cutter, et al., 2003, "Social Vulnerability to Environmental Hazards," *Social Science Quarterly*, Volume 84 Issue 2.

Percent Female	Hospitals Per Capita (County Level ONLY)
Percent Female Headed Households	Percent of population without health insurance (County Level ONLY)
Nursing Home Residents Per Capita	Percent with Less than 12 th Grade Education
	Percent Civilian Unemployment
	People per Unit
	Percent Renters
	Median Housing Value
	Median Gross Rent
	Percent Mobile Homes
	Percent Employment in Extractive Industries
	Percent Employment in Service Industry
	Percent Female Participation in Labor Force
	Percent of Housing Units with No Car
	Percent Unoccupied Housing Units



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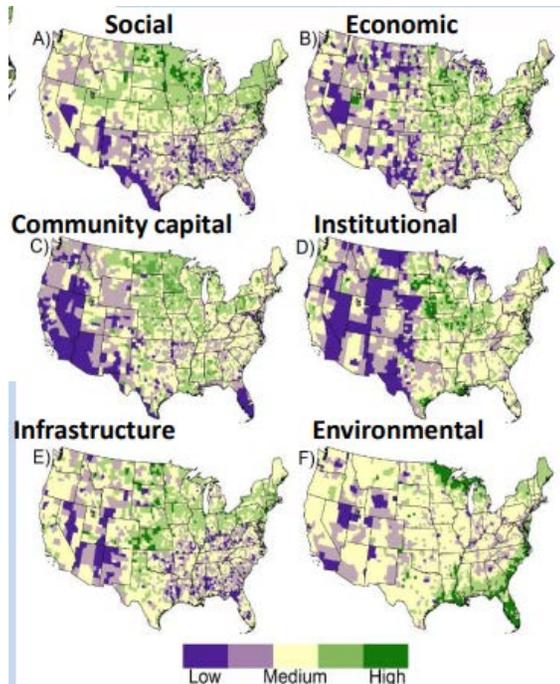
BRIC Index:

2015 County Data

Aggregate and 6 Sub-Indices

(based on 36 indicators):

- Social
- Economic
- Institutional
- Community Capital
- Infrastructure
- Environmental



Susan L. Cutter, Kevin D. Ash, and Christopher T. Emrich, 2014, "The Geographies of Community Disaster Resilience," *Global Environmental Change* 29, 65–77.

CDC SVI Index:

2018 Census-Tract Data

Aggregate and 4 Sub-Indices

(based on 15 indicators):

- Socioeconomic status
- Household Composition
- Race/Ethnicity/Language
- Housing/Transportation

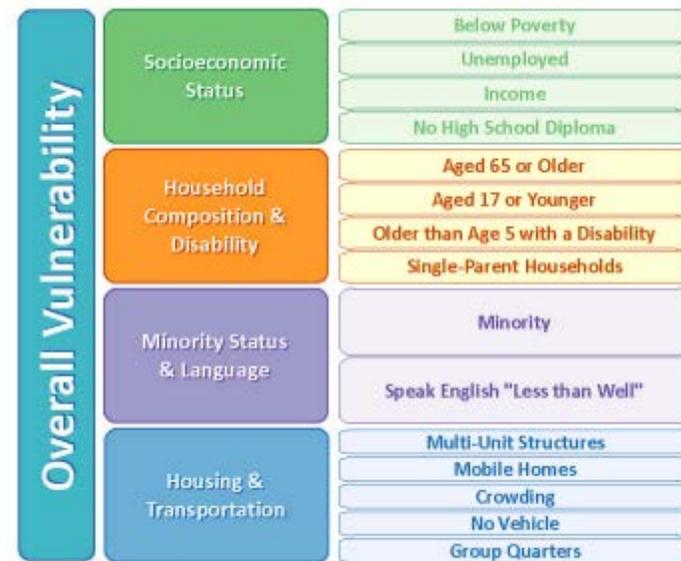


Figure 1. Social Vulnerability Index themes and social factors

Barry E. Flanagan, et al., 2011, "A Social Vulnerability Index for Disaster Management," *Journal of Homeland Security and Emergency Management*.



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Resilience Analysis and Planning Tool (RAPT)

Update 2020



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Resilience Analysis and Planning Tool (RAPT)

- GIS tool to inform strategies for preparedness, response, and recovery.
- Allows **combined analysis** of Population / Community data, Infrastructure data, and Hazard data
- Set of **20 Community Resilience Indicators**:
 - Indicators used in multiple peer-reviewed methodologies
 - Singular datapoint analysis vs composite index
 - 12 of the 20 indicators are available at census tract level
 - Binning process provides useful visualization (county: 5 bins; census tract: 7 bins)
 - Correlation analysis
- Infrastructure data from Homeland Infrastructure Foundation-Level Data (HIFLD) includes **location and characteristics**
- Hazard layers: **historic data, risk data, and real-time severe weather forecasts**
- **Analysis Tools**: Incident Analysis Tool, Select Population Summary, Query
- **Add Data**: Temporarily upload additional GIS layers



RAPT

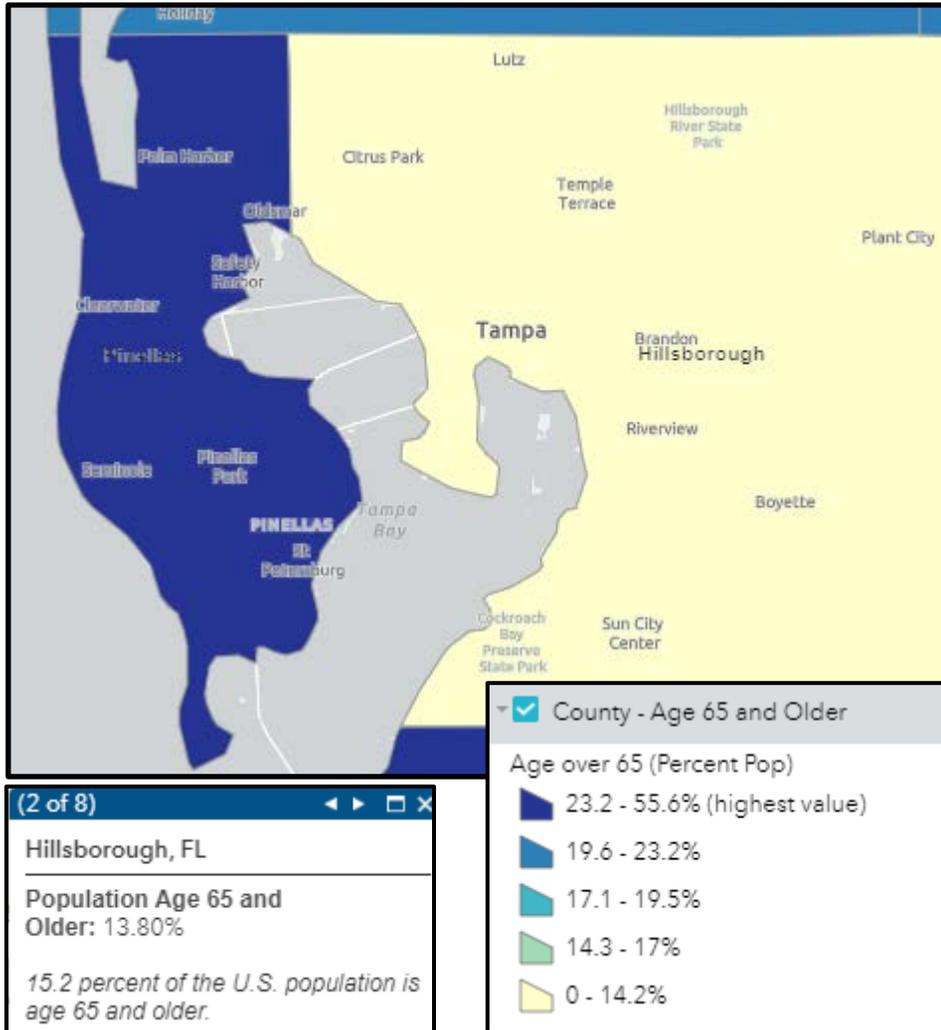
Data Sets

Population-Focused Indicators	Community-Focused Indicators	Infrastructure Data	Hazard Data
CRIA Commonly Used Indicators	CRIA Commonly Used Indicators		Historic / Risk
% Population without Health Insurance*	Connection to Civic/Social Organizations	Nursing Homes	Flood Hazard Zones
% Population Unemployed*	Hospital Capacity	Hospitals	Tornado Paths
% Population without a High School Education*	Medical Professional Capacity	Urgent Care Facilities	Tropical Storms
% Population with a Disability*	Affiliation with a Religion	Public Health Depts.	Seismic Hazards
% Population without Access to a Vehicle*	Presence of Mobile Homes*	Fire Stations	Wildfire
% Population with Home Ownership*	Public School Capacity	Emergency Medical Services (EMS) stations	
% Population over 65*	Population Change	Local Law Enforcement locations	NOAA Layers
% Population Single-Parent Households*	Hotel/Motel Capacity	911 Service Area Boundaries	Current Watches/Warnings
% Population with Limited English Proficiency*	Rental Property Capacity*	Mobile Home Parks	Hurricane Outlook: Atlantic
Median Household Income*		Places of Worship	Severe Weather Outlook
Gini Index: Income Inequality		Public Schools	Excessive Rainfall Outlook
		Private Schools	River Flood Outlook
Other Population Indicators		Colleges and Universities	
At-risk electricity-dependent Medicare beneficiaries		Prison Boundaries	
		Transmission Lines	
		Electric Power Plants	
* Both U.S. Census Bureau county and census tract data; ACS 2014-2018 five-year estimates.		Solid Waste Landfills	
		Wastewater Treatment Plants	
		Pharmacies (RX Open)	

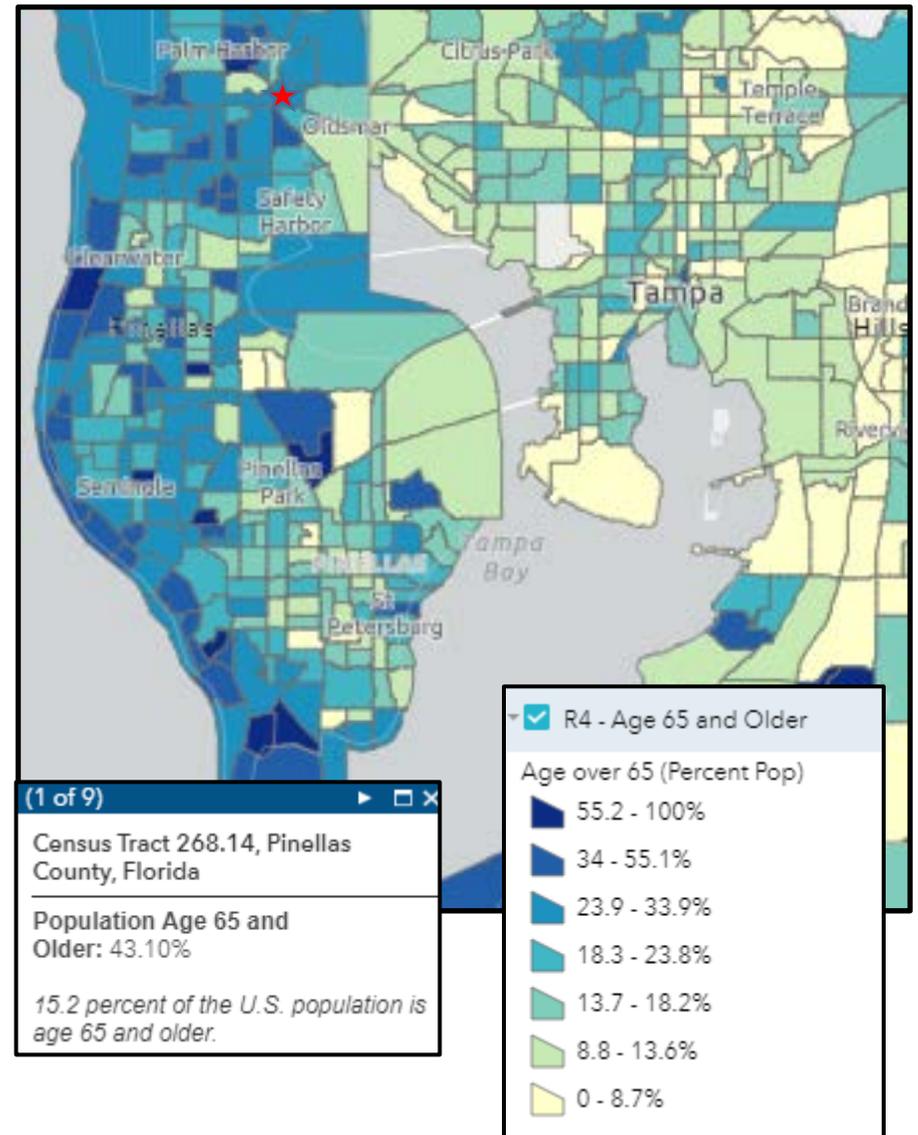


Population Indicator: Age

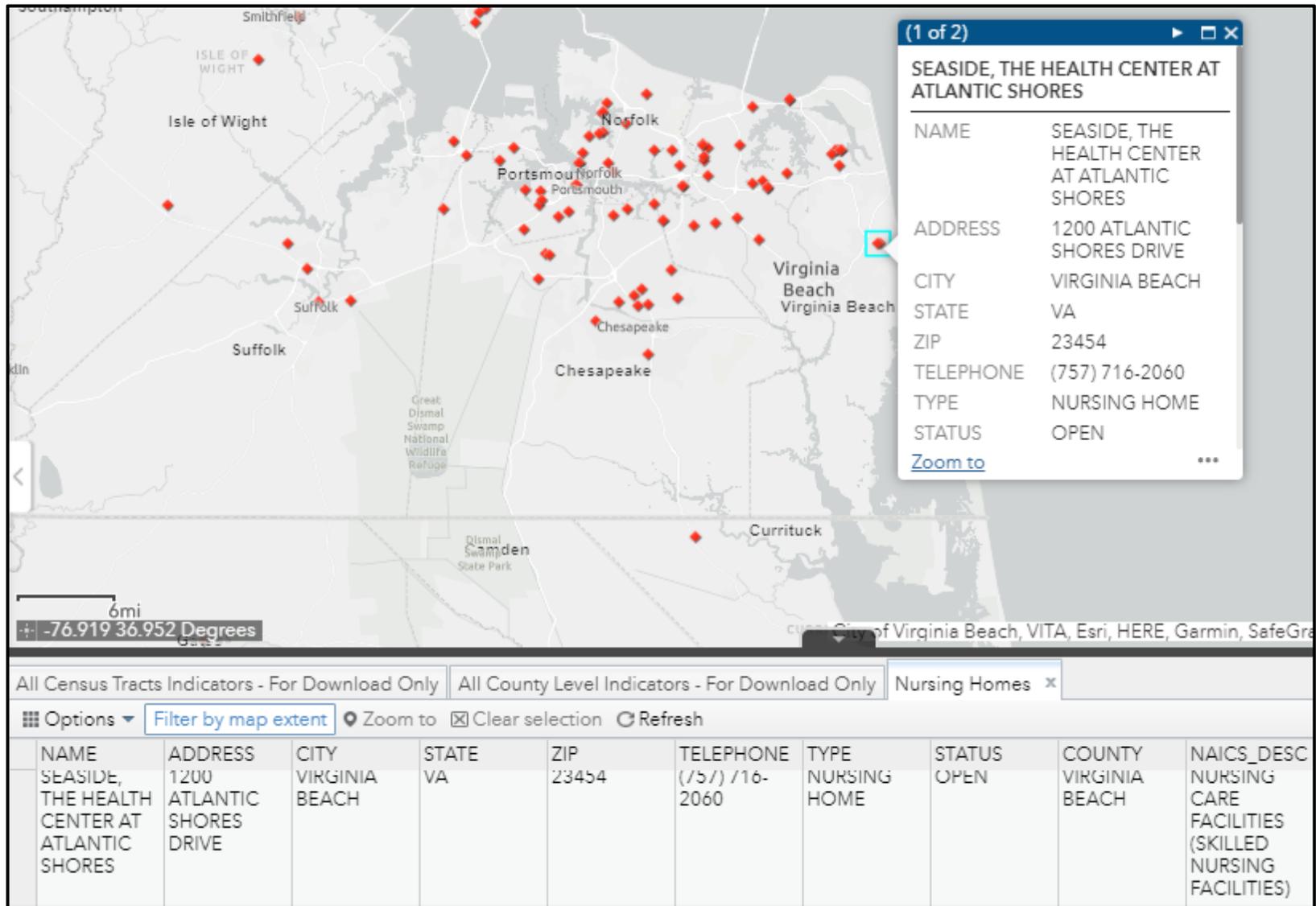
Hillsborough FL with County Data



Hillsborough FL with Census-Tract Data



Infrastructure Data- Nursing Homes



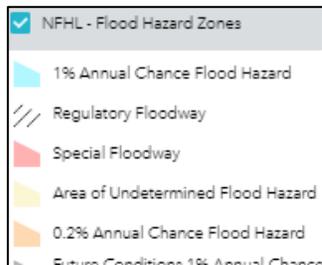
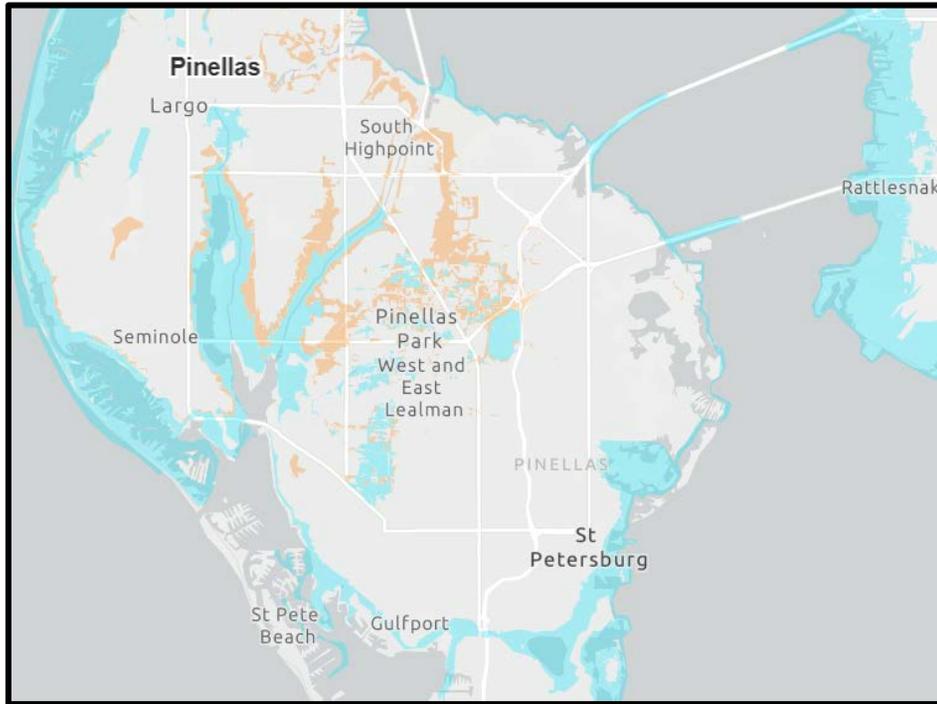
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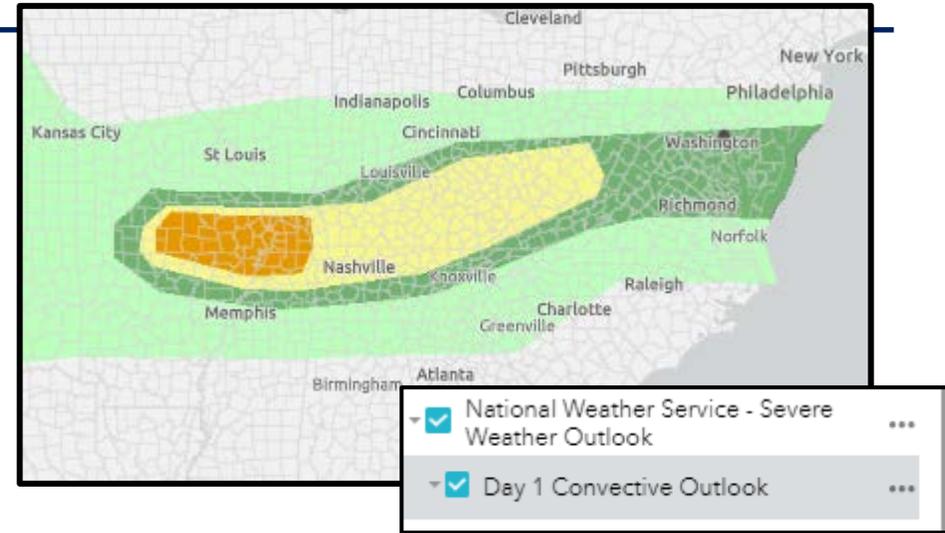
Hazard Data

Flooding



FEMA National Flood Hazard Layer GIS
<https://fema.maps.arcgis.com/home/item.html?id=cbe088e7c8704464aa0fc34eb99e7f30>

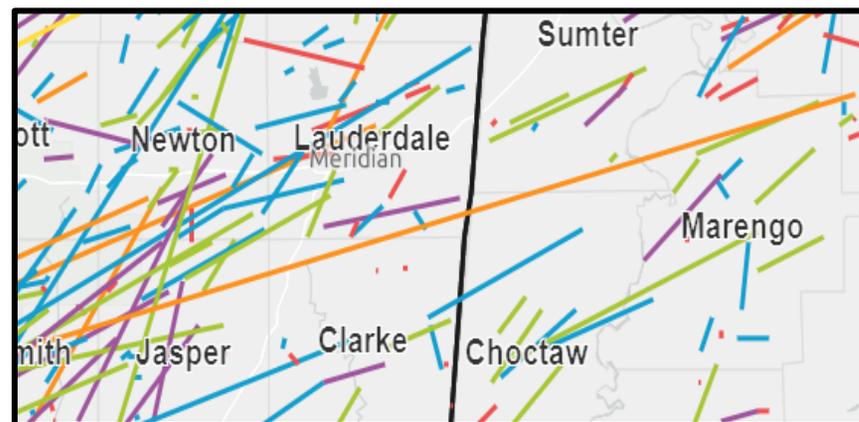
NWS Severe Weather Outlook



- National Weather Service - Severe Weather Outlook
- Day 1 Convective Outlook

<https://fema.maps.arcgis.com/home/item.html?id=cbe088e7c8704464aa0fc34eb99e7f30>

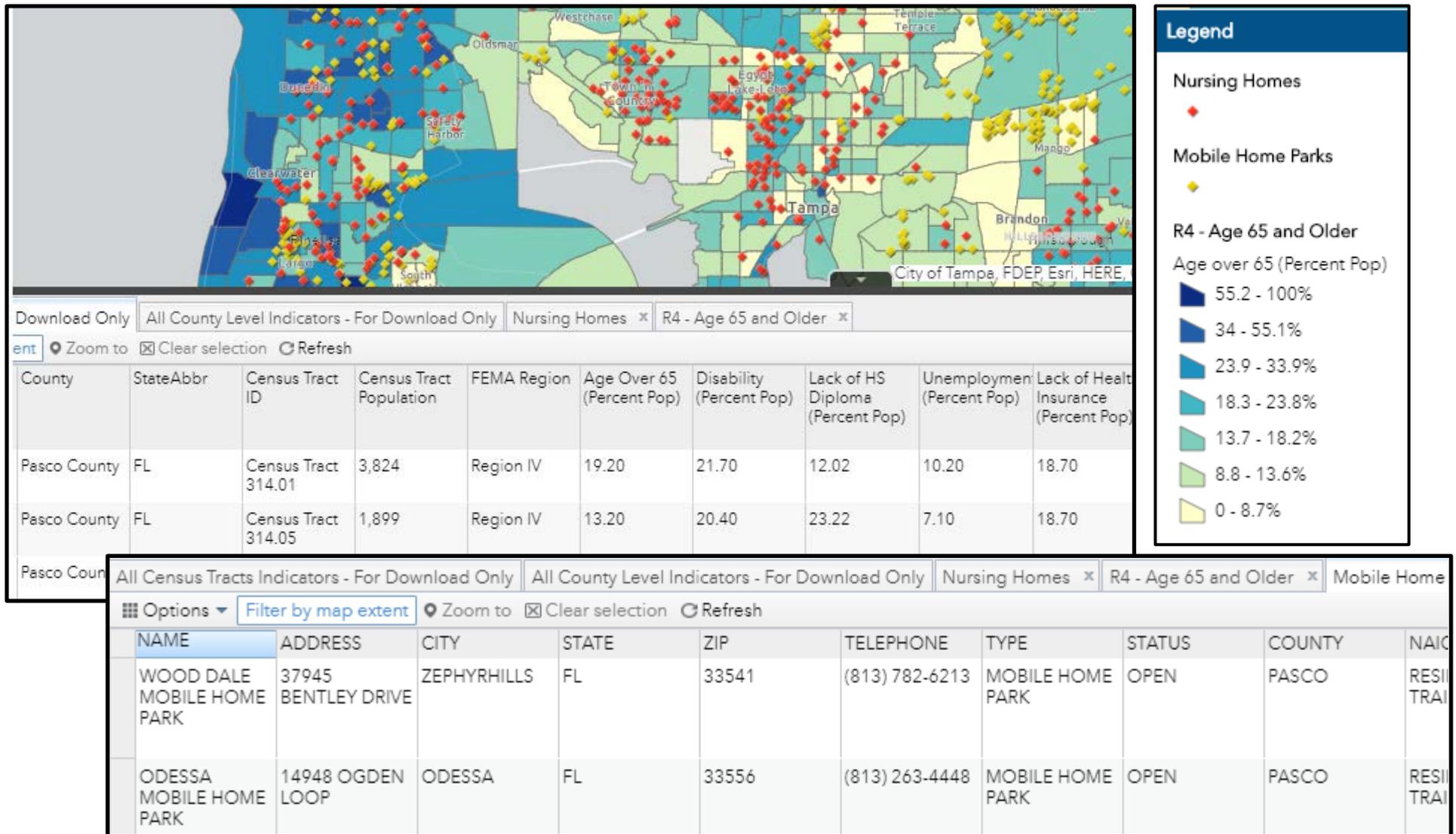
Historic Tornado Tracks



Historic Tornado Tracks	
Tornado Number (Count)	311,079
Year	2011
Month	4
Day	27
Date	2011-04-27
Time	16:42:00
Time Zone	3
State	MS
State FIPS	28
State Number	81
F-Scale	4
Injuries	17
Fatalities	7
Estimated Property Loss	25.81
Length in Miles	122.04
Width in Yards	1,050



Population Indicator (Age) and Infrastructure Layers (Nursing Homes and Mobile Homes)

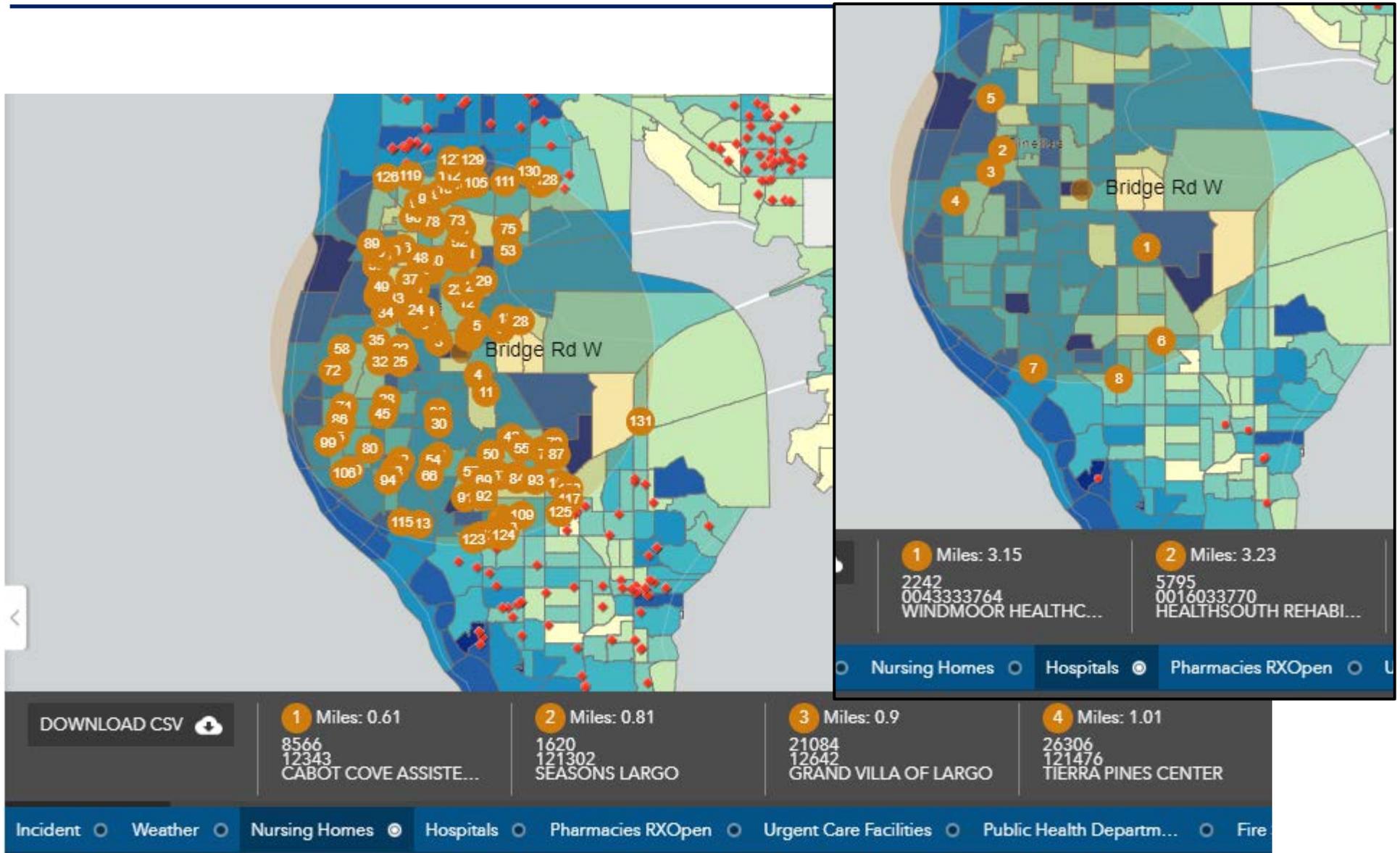


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Incident Analysis Tool: Nursing Homes and Hospitals within 5 Miles of an Incident



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Population – Summary of Selected Indicator Tool

The image displays a map of the United States on the left, color-coded by population density. On the right, two screenshots of a web application interface are shown. The top screenshot shows the 'Selection Area*' menu with a red triangle icon selected, and the 'Choose an Indicator*' dropdown set to 'Age_over_65_Pct'. Below this, the 'Population Indicator Summary' section displays the title 'Population Summary of Selected Indicator', an icon of three people (two standing, one in a wheelchair), and the population count '110,383'. The bottom screenshot shows the 'Selection Area*' menu with a red triangle icon selected, and the 'Choose an Indicator*' dropdown set to 'Disability_Pct'. Below this, the 'Population Indicator Summary' section displays the title 'Population Summary of Selected Indicator', an icon of three people (two standing, one in a wheelchair), and the population count '76,477'. Both screenshots include a 'Run' button and a 'Help' link.



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RAPT Benefits for Higher Education

- **User-friendly** research tool that builds **confidence with GIS** analysis.
- Supports **case study** educational format.
- Basis for **community resilience profiles** highlighting the unique attributes and interplay of population characteristics, infrastructure, and hazards.
- **Multi-level analysis**: regional, state, local, tribal.
- **Support to emergency managers**:
 - Helps inform capability targets for THIRA/SPR, exercises, and EOPs,
 - Provide real-time analysis of severe weather events,
 - Help prioritize recovery strategies.



Questions/Comments?

www.fema.gov/rapt

Email: FEMA-TARequest@fema.dhs.gov



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