



**IDENTIFYING VULNERABLE POPULATIONS
WHO RESIDE IN COMMUNITIES AT HIGH
RISK TO TORNADOS WITHIN THE
CONTIGUOUS USA**

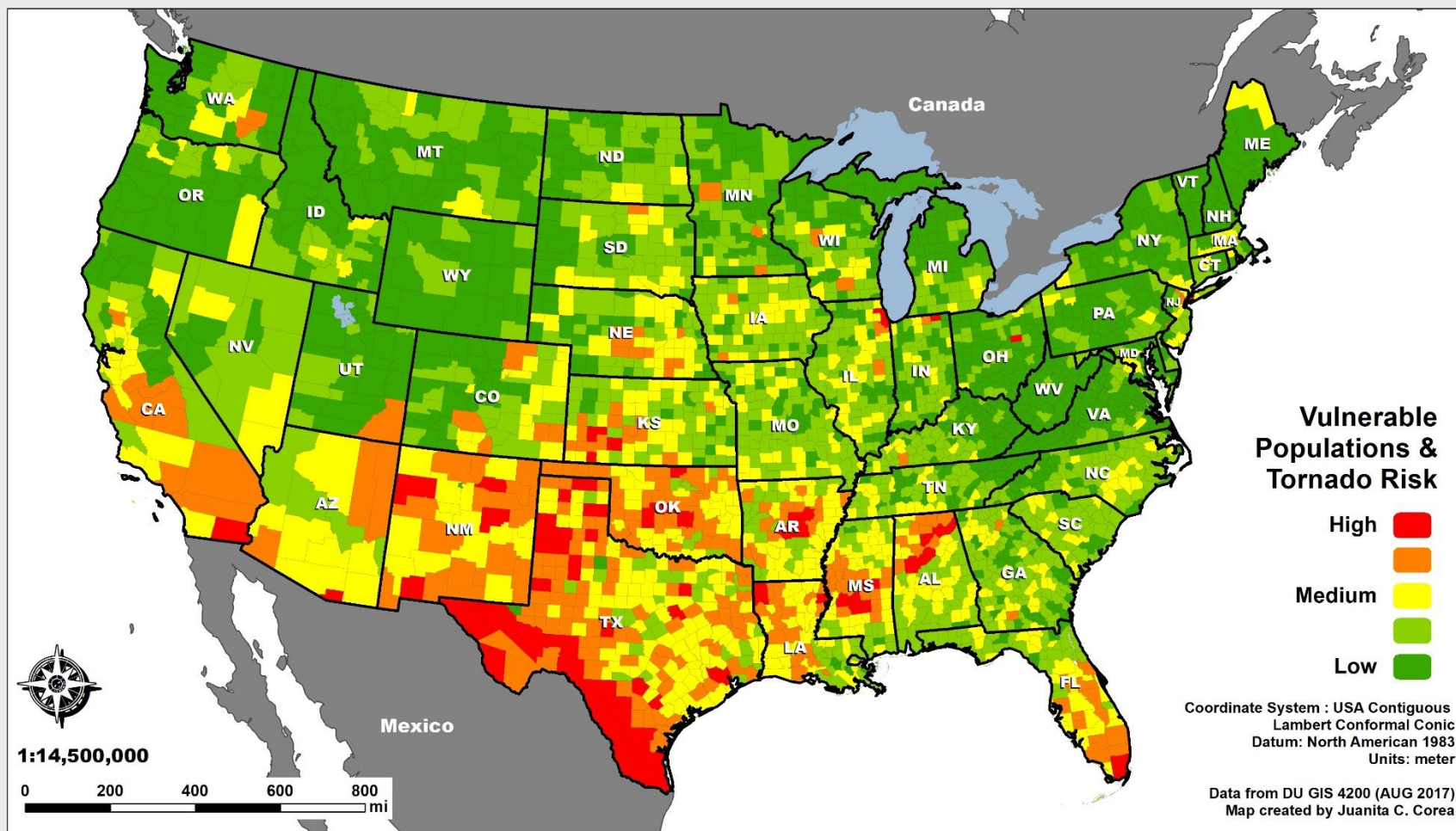
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GEOINT METHODS FOR DEFINING AT-RISK POPULATIONS

Final Vulnerability Score -- Contiguous USA by county

VULNERABLE POPULATIONS AND TORNADO RISK BY COUNTY





GEOINT ANALYSIS OF VULNERABLE POPULATIONS & TORNADOS

In an era of budget constraints, the Federal Emergency Management Agency (FEMA), and other government agencies, must use detailed studies to aid in allocating resources for emergency relief. This report is an example of a GEOINT analysis that uses demographic data and historical tornado data to support disaster-based preparedness, response and recovery planning throughout the contiguous United States.

At risk populations are analyzed using the C-MIST model (Boston Public Health Commission 2017) applied to counties affected by tornados. The C-MIST variables are Communication, Medical, Independence, Supervision and Transportation.

The demographic data is from the US Census Bureau (see the table below). The tornado tracks data (1950 – 2011) is from the National Weather Service Storm Prediction Center (<http://www.spc.noaa.gov/gis/svrgis/>).

Item	Description	YEAR	Source
AGE275210D	Resident population under 18 years	2010	2010 CENSUS
AGE765210D	Resident population 65 years and over	2010	2010 CENSUS
HEA775207D	All persons under 65 years without health insurance	2007	SAHIE CENSUS
POP815209D	Population 5 years and older who speak other than English at home	2005-2009	5 YR ACS CENSUS
HSG200200D	Occupied housing units	2000	2000 CENSUS
HSG370200D	Occupied housing units with no vehicles available	2010	2000 CENSUS
POP010210D	Resident population	2010	2010 CENSUS
PPQ100210D	Population in group quarters, institutionalized population	2010	2010 CENSUS



USING C-MIST TO DEFINE VULNERABLE POPULATIONS

For this analysis, C-MIST has been modified (for simplicity).

- **Communication** – percentage population who speak other than English at home
- **Medical** – percentage of persons under 65 years old without health insurance
- **Independence** – percentage of population over 65 years old and under 18 years old years old
- **Supervision** – percentage of population institutionalized (prison, nursing, and psychiatric facilities)
- **Transportation** – percentage of households without access to a vehicle

C	Communication
	Individuals who may have limitations that interfere with the receipt of and response to information including those who are deaf or hard of hearing; speak American Sign Language; have limited or no English proficiency; are blind or have low vision; and/or have cognitive or physiological limitations
M	Medical Needs
	Individuals who may require Personal Assistance Services (or personal care assistance) in maintaining their activities of daily living such as eating, dressing, grooming, transferring, and toileting
I	Independence
	Individuals who function independently if they have their assistive devices, such as consumable medical supplies (diapers, formula, bandages, ostomy supplies, etc.), durable medical equipment (wheelchairs, walkers, scooters, etc.), and/or service animals
S	Support, Services, and Self-determination*
	Individuals with behavioral health needs, those who have psychiatric conditions (such as dementia, Alzheimer's disease, Schizophrenia, severe mental illness), pregnant women, nursing mothers, and infants, and children
T	Transportation
	Individuals with transportation needs because of age, disability, temporary injury, poverty, addiction, legal restriction, or those who do not have access to a vehicle



VULNERABLE POPULATIONS & TORNADOS (continued)

The map on page 2 - **VULNERABLE POPULATIONS AND TORNADO RISK BY COUNTY** - shows the final result of this analysis using seven variables. The five C-MIST variables, each as a percent, were summed together to create a risk score. The risk score, normalized by population density to create a population risk score, was added to the tornado risk to create the final **vulnerability score**.

There are 92 high risk, 265 high-medium risk and 635 medium risk counties within the lower 48-states that have vulnerable populations who reside in counties likely to experience tornados.

The majority of at-risk counties are located along the southern US border. Southern California, New Mexico, Texas and southern Florida have high vulnerable populations whereas Oklahoma, Arkansas, Mississippi, Louisiana, and Alabama are within the area known as Tornado Alley. Together they form a swath of counties with vulnerable populations in areas susceptible to tornados.

There are several outlier counties in the northern US: Holmes, OH; Cook, IL, LaGrange, IN; Otter Tail, MN; Clark, WI; Dane, WI; and Champaign, IL. Lack of transportation and lack of independence may cause these areas to have an unusually high vulnerability score despite those counties not being a high tornado risk area.



VULNERABLE POPULATIONS & TORNADOS (continued)

The C-MIST selection criteria for this analysis is based on a simple method that defines at risk populations using a function-based framework while providing a standard approach during disaster-based preparedness, response and recovery planning (Boston Public Health Commission 2017).

Additional variables can be added to increase the accuracy of this method. For example, including the percent of **people with physical disabilities** who are not institutionalized as a separate variable would help to increase the sensitivity of the transportation and supervision variables since these people may need assistance to evacuate during a disaster. The **poverty rate** or **low income population** could be included to improve the transportation variable as this group may need additional support during an evacuation.

Regardless, this method generates a GEOINT product that can be used by FEMA or any local planning agency to aid in preparation for a disaster. The map clearly displays those counties that are at a higher risk to a tornado and have vulnerable populations who may need emergency assistance during a disaster. With this information, agencies can better allocate resources and have trained personnel ready to support people during a tornado.

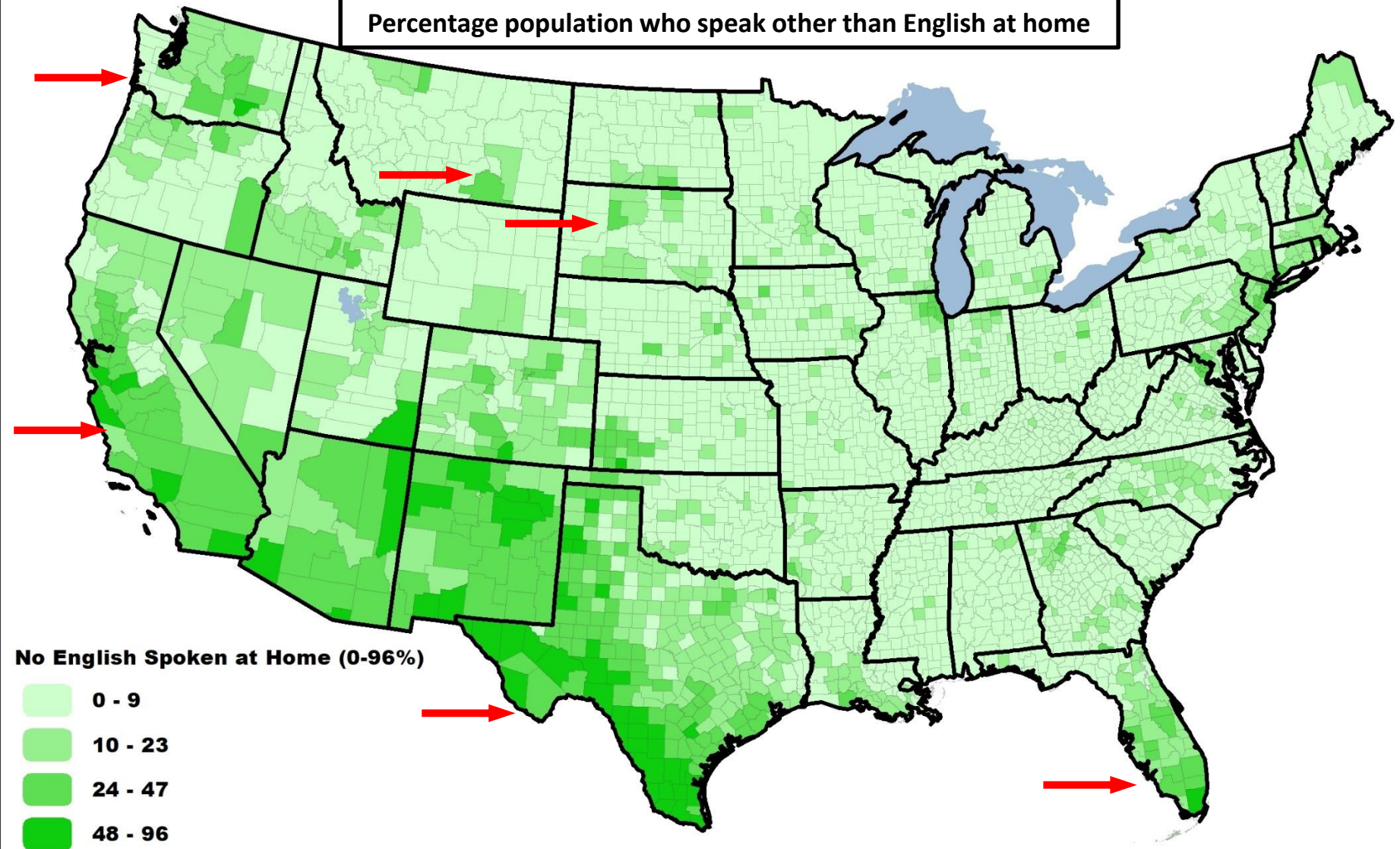
Preparation is critical to success in these events.



COMMUNICATION



Percentage population who speak other than English at home



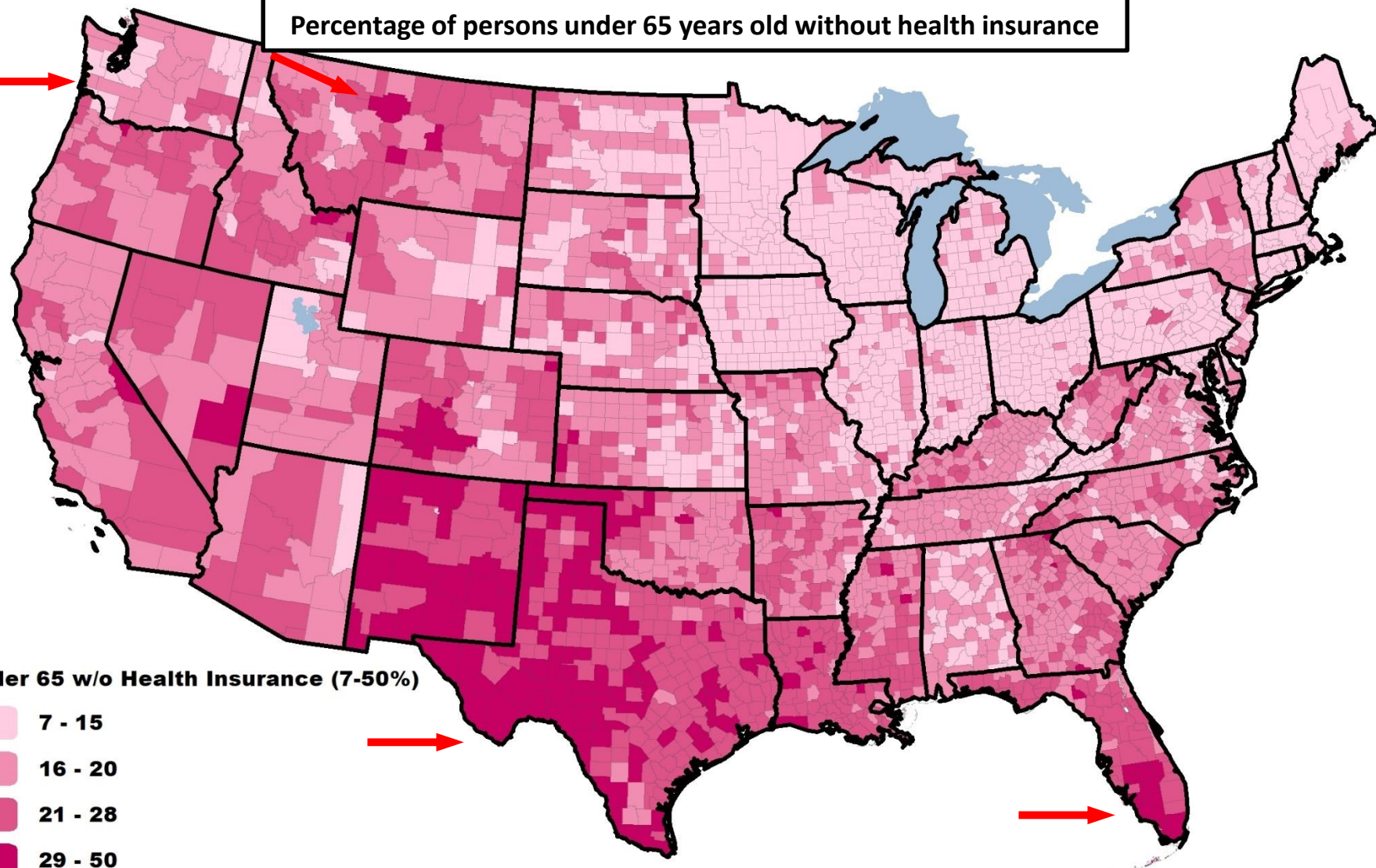
High percentage in counties along US-Mexico border as well as Washington, southern Florida, large metropolitan urban centers, & Native American reservations in Montana, North Dakota and South Dakota.



MEDICAL



Percentage of persons under 65 years old without health insurance



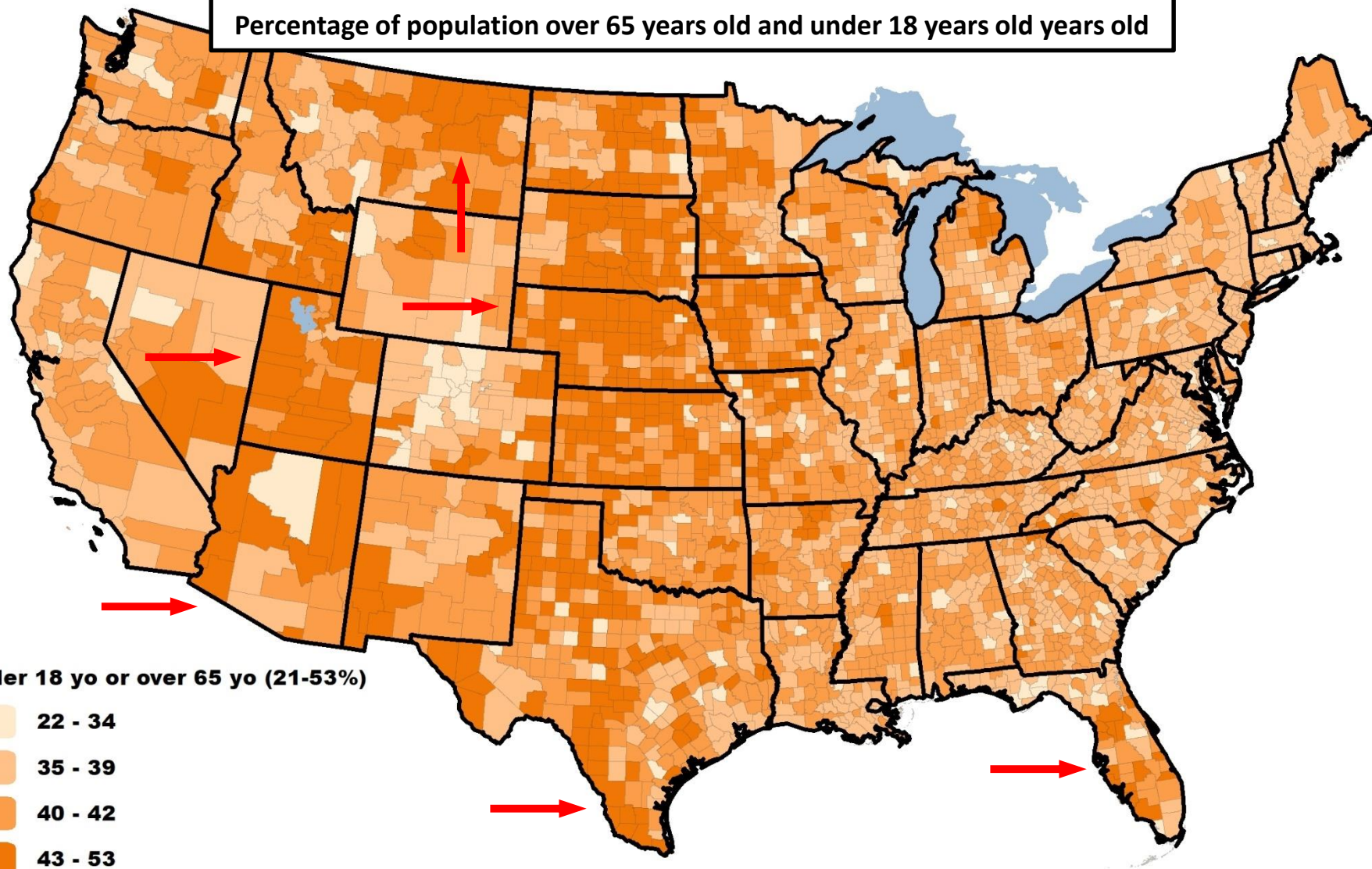
High percentage in counties along US-Mexico border, and Washington, Florida, upstate New York, Montana and Idaho.



INDEPENDENCE



Percentage of population over 65 years old and under 18 years old years old



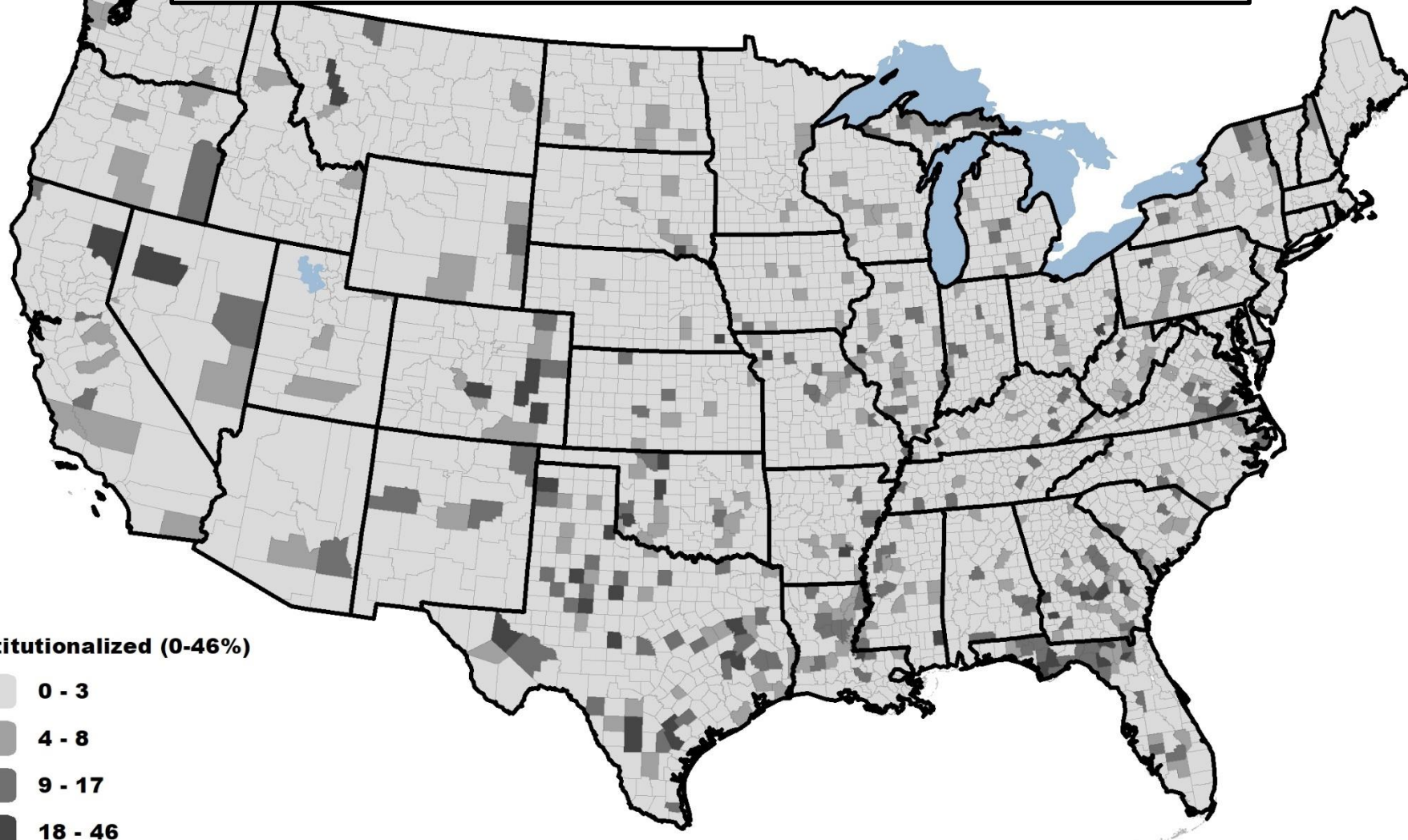
High percentage in Midwestern states, Montana, Utah, Arizona and Florida.



SUPERVISION



Percentage of population institutionalized (prison, nursing, and psychiatric facilities)



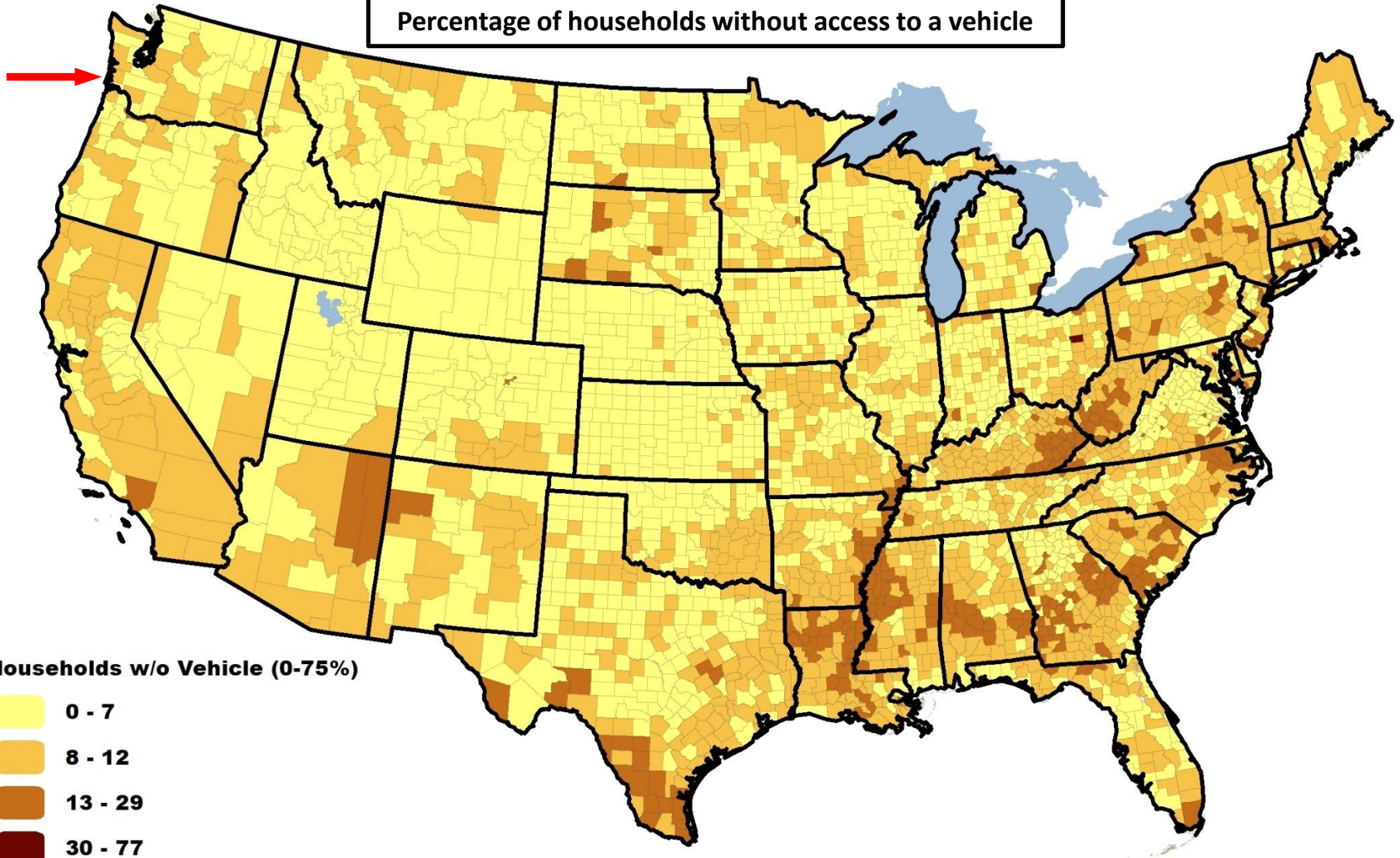
High percentage counties represent those with large prisons or significant numbers of other institutions (nursing homes, or psychiatric facilities).



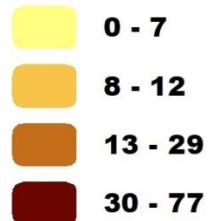
TRANSPORTATION



Percentage of households without access to a vehicle



Households w/o Vehicle (0-75%)



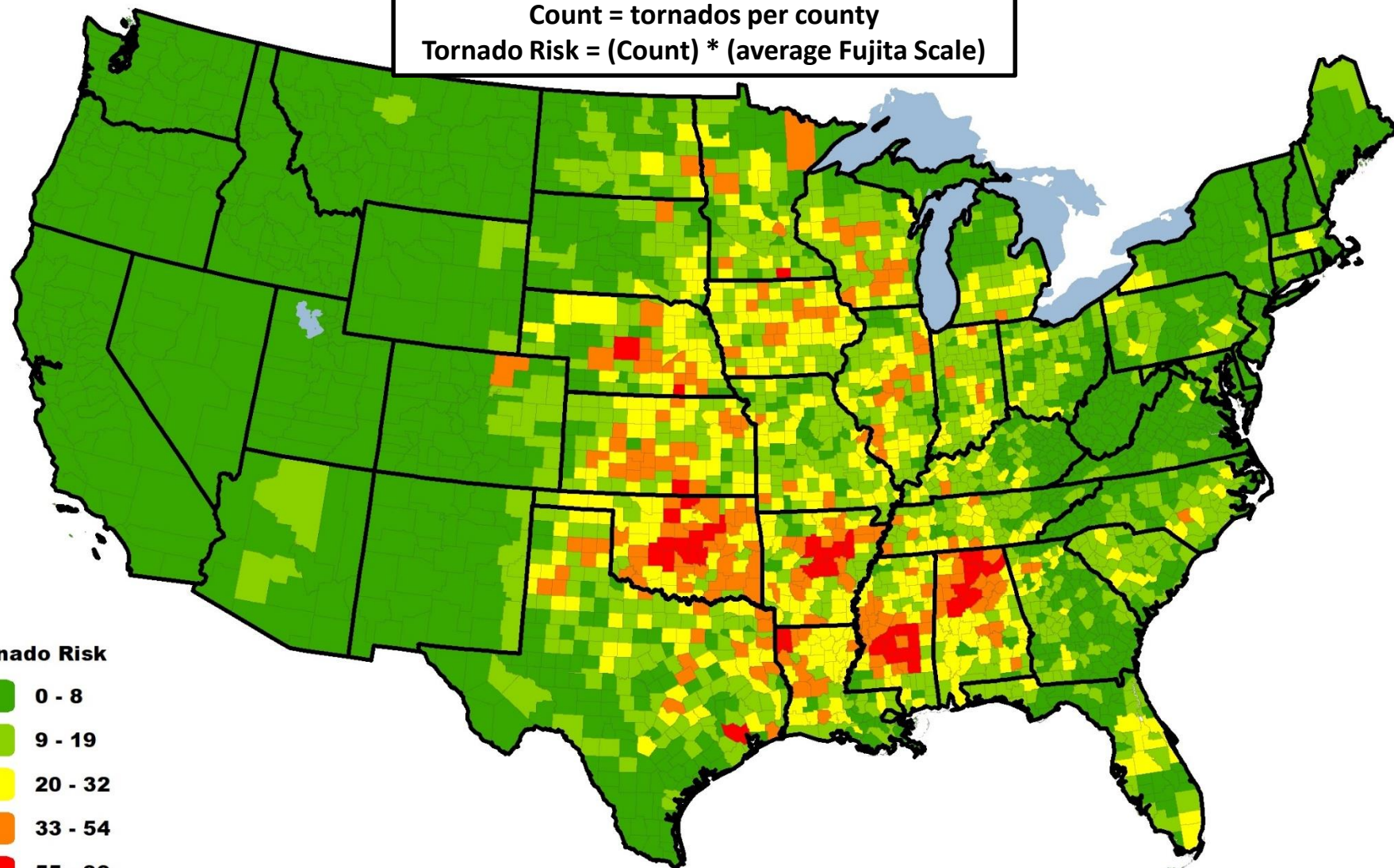
High percentage in southern Texas, Kentucky, West Virginia, and throughout the southern US.



TORNADO RISK



Count = tornados per county
Tornado Risk = (Count) * (average Fujita Scale)



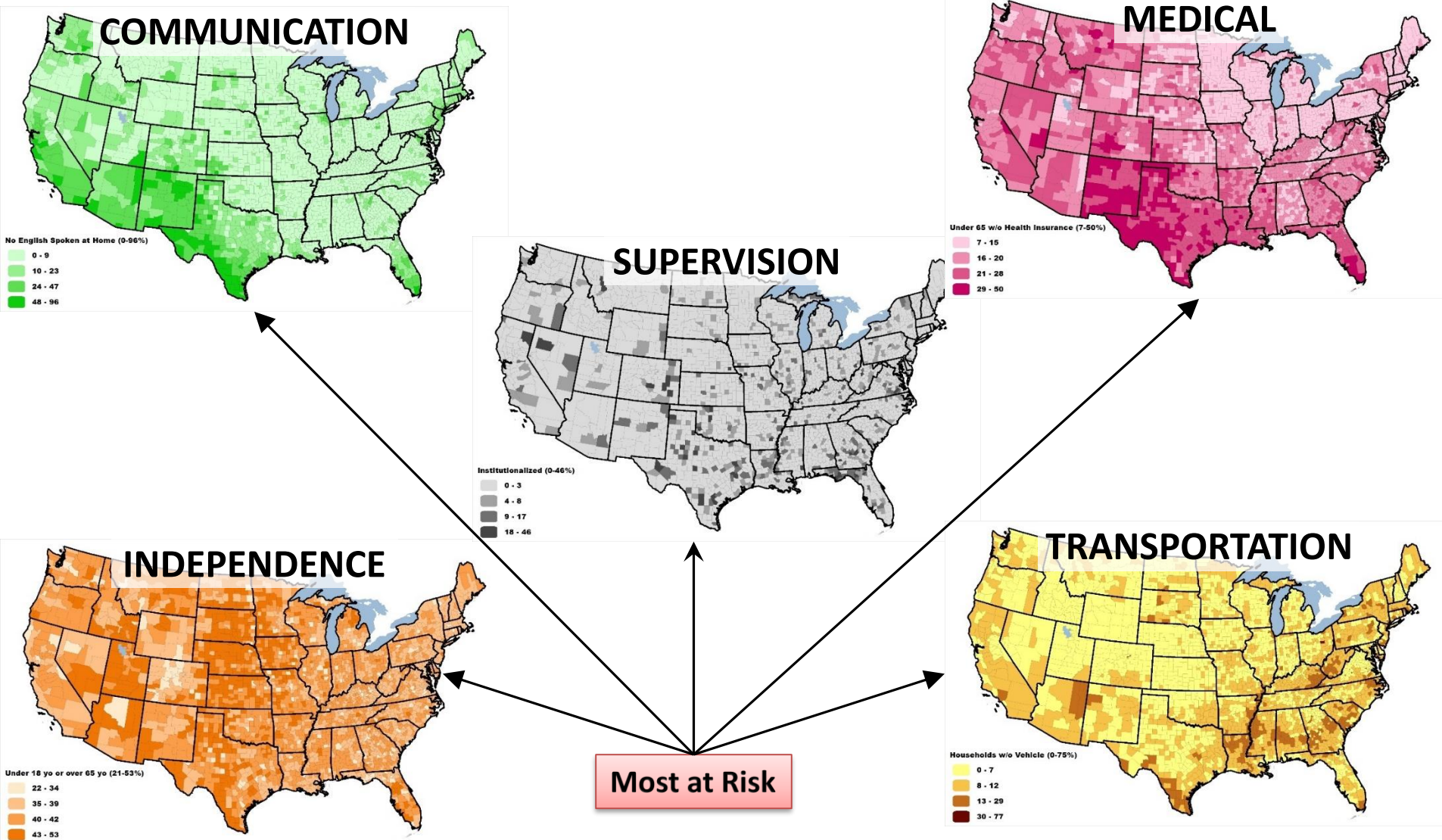
Tornado Risk



High risk in the Midwestern states (Tornado Alley).



MAPPING AT RISK POPULATIONS USING C-MIST



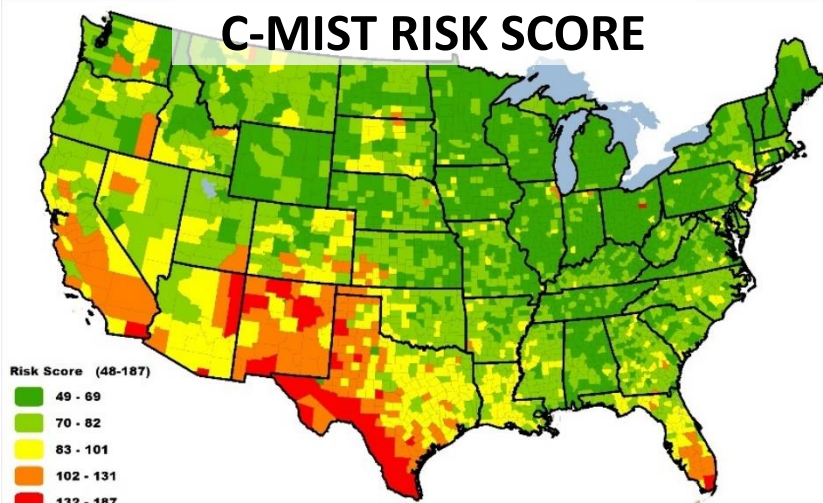
These five variables are then summed together to create “Risk Score”



COMBINING AT-RISK POPULATIONS



C-MIST RISK SCORE

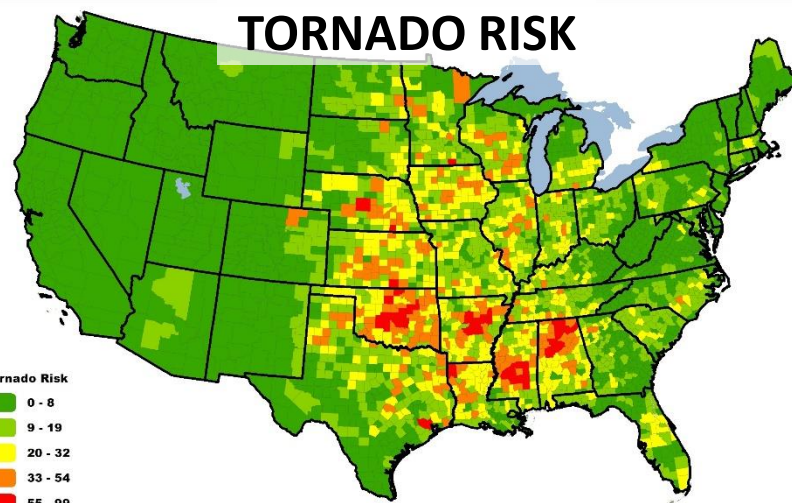


Risk Score (48-187)

- 49 - 69
- 70 - 82
- 83 - 101
- 102 - 131
- 132 - 187

Normalize C-MIST risk score by population density to create population risk (only a small difference)

TORNADO RISK

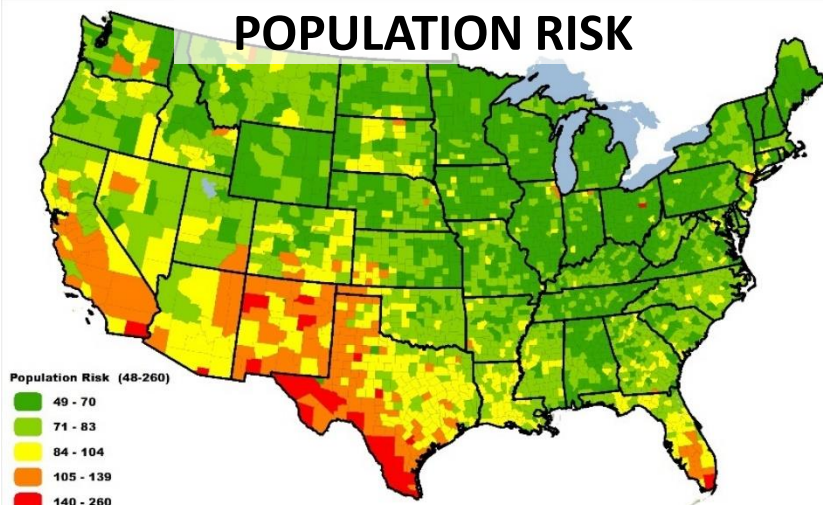


Tornado Risk

- 0 - 8
- 9 - 19
- 20 - 32
- 33 - 54
- 55 - 99

Tornado Risk + Population Risk = Vulnerable Populations to Tornadoes by County (page 6)

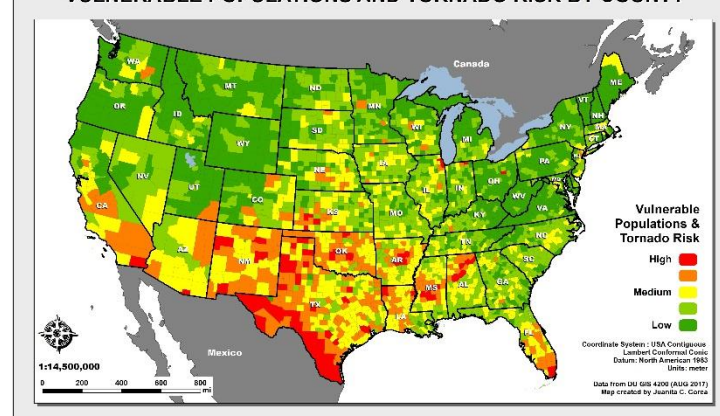
POPULATION RISK



Population Risk (48-260)

- 49 - 70
- 71 - 83
- 84 - 104
- 105 - 139
- 140 - 260

VULNERABLE POPULATIONS AND TORNADO RISK BY COUNTY



Sum Population Risk and Tornado Risk to create final vulnerability score