

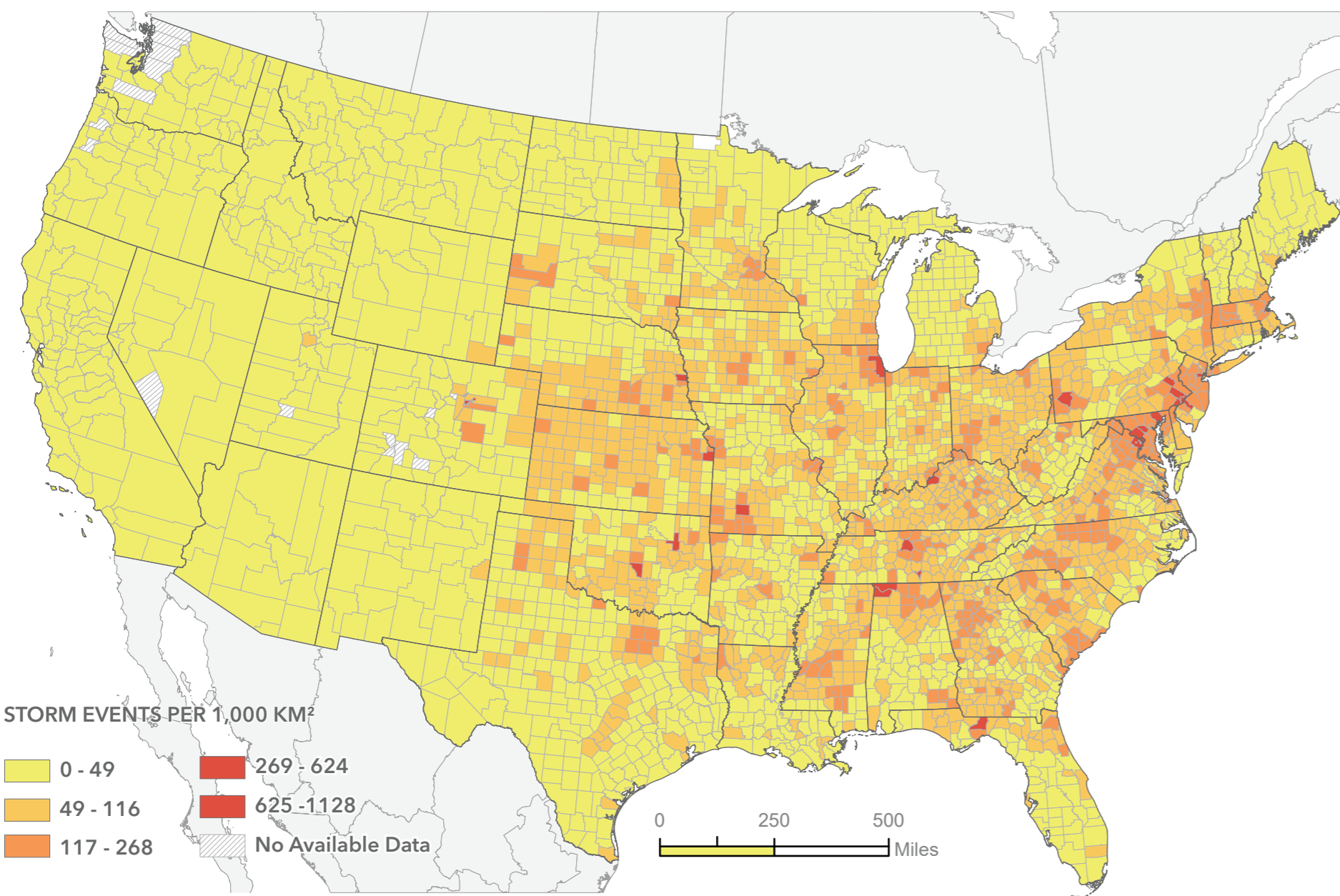
## SEVERE CONVECTIVE STORM EVENT DISTRIBUTION (2014–2023)

This dot density map shows the spatial distribution of severe convective storm events<sup>1</sup> in the contiguous United States, as recorded by the NOAA Storm Events Database between 2014 and 2023. This map enumerates storm events at the county level and omits county administrative boundaries to reduce visual clutter and emphasize broader regional clustering patterns.

Designing the dot-density map proved challenging. The main difficulty involved determining the optimal dot-size-to-event ratio that accurately represents storm activity while keeping each dot visually distinct. Several trial-and-error sessions ultimately yielded a dot size of 4 points per 15 storm events, which kept the dots individually discernible in less-dense areas and more coalescent in denser regions.

Each dot on the map represents 15 storm events and is randomly placed within the respective county polygon using an automatically generated seed. Because dot placement is stochastic, the symbols illustrate differences in overall storm event occurrence and visual density rather than indicating precise event locations.

Counties with higher overall storm event counts contain proportionally more dots and therefore appear visually denser, while counties with fewer storm events and fewer dots appear correspondingly lighter. The visually densest patterns are along the Central Plains and Midwest, where severe convective storm events are most frequent. Elevated dot concentrations also appear across the Southeast and Mid-Atlantic, where high event totals occur across relatively small geographic units. In contrast, the Western and Southwestern United States exhibit very sparse dot patterns due to larger geographic regions and environmental conditions that are not conducive to severe convective storm development.



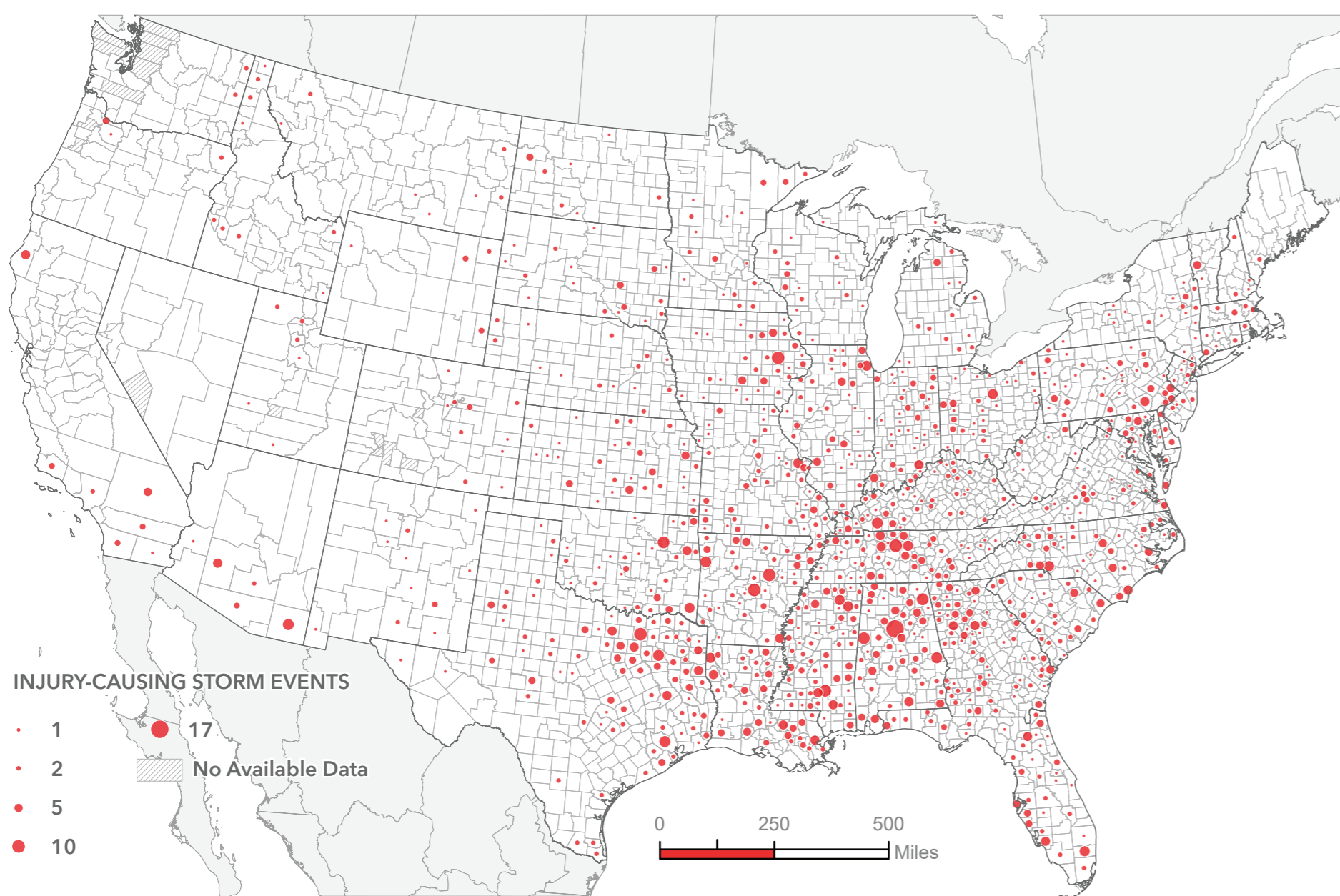
## SEVERE CONVECTIVE STORM EVENTS PER 1,000 KM<sup>2</sup> (2014–2023)

This choropleth map uses data from the NOAA Storm Events Database to display severe convective storm event<sup>1</sup> activity across the contiguous United States from 2014 to 2023, aggregated by county and expressed as events per 1,000 square kilometres. A choropleth map is well-suited to this dataset because it emphasizes regional differences in county-level storm activity, making broad spatial patterns more noticeable and easier to interpret.

Whereas the dot density map showed raw storm event totals aggregated by county, this choropleth map shows where severe convective storm events are most concentrated, normalized by area. Normalization (Events per 1,000 km<sup>2</sup> = (Event count / County area in km<sup>2</sup>) x 1000) of the raw storm data to area is essential in this context. Without it, large counties would appear to have less storm event activity simply because of their size. In contrast, smaller counties would appear disproportionately intense. By normalizing by county area, the map removes size-related bias and more accurately reflects the spatial distribution of severe convective storm events.

Symbolization included applying the Natural Breaks (Jenks) method to create five classes based on data skewness (the majority of counties had relatively low convective storm event activity), and an associated colour ramp from light yellow (lower event frequency) to dark red (higher event frequency). The warm colour progression provides a clear visual hierarchy with strong contrast, allowing areas with higher storm event activity to stand out prominently without implying greater storm severity. A minor design challenge occurred when expression logic inadvertently classified null values into the lowest data class, but was rectified by explicitly filtering and displaying null values.

By normalizing by county area, the map removes size-related bias and more accurately reflects the spatial distribution of severe convective storm events. The following map in the series will explore a more direct measure of human impact by focusing on injury-causing storm events using proportional symbols.



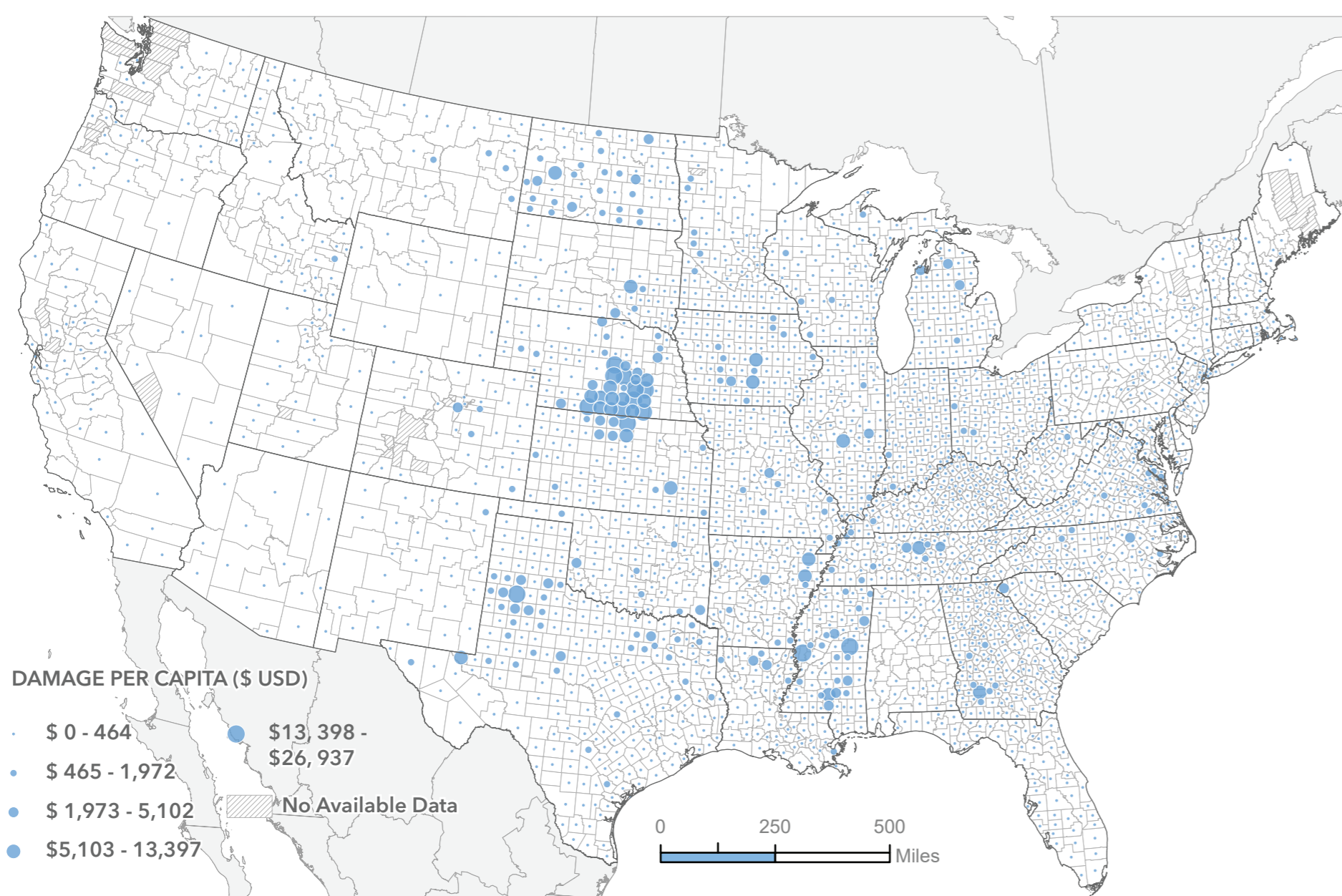
## INJURY-CAUSING SEVERE CONVECTIVE STORM EVENTS (2014–2023)

This proportional-symbols map displays the number of injury-causing severe convective storm events<sup>1</sup> in each county across the contiguous United States between 2014 and 2023. Each symbol represents the count of storm events that resulted in at least one injury, direct or indirect, as recorded in the NOAA Storm Events Database.

Proportional symbols are well-suited to this dataset because the number of injury-causing storm events per county falls within a relatively low range, allowing the symbol size to scale appropriately with the data. The symbols are proportionally scaled by event count, with a minimum size of 4 points to ensure that counties with fewer storm events remain visually discernible. The Flannery scaling method was applied to correct for perceptual bias and ensure that the visual differences between symbols accurately reflect those in the underlying data.

The symbology's scalability preserves meaningful differences, making counties that experience more injury-causing storm events stand out immediately. Symbol overlap was a challenge when developing this map, particularly in areas with many small counties; however, applying transparency and a background-matching halo to the symbology largely mitigates this issue. Additionally, ArcGIS did not fully capture the full range of proportional scaling during automatic legend generation; therefore, I manually adjusted the legend in Illustrator to include a reference symbol for the maximum observed value of 17 events, ensuring the map accurately reflects the full data range.

By visualizing the frequency of injury-causing events rather than total injuries or population-normalized alternatives, this map emphasizes where hazardous storm conditions have resulted in human impacts, offering insight into the spatial patterns of storm-related risk across the United States and revealing concentrations in regions where severe convective storm events are typical; the following map now shifts focus to the financial burden by analyzing total property damage per capita.



## TOTAL REPORTED PROPERTY DAMAGE FROM SEVERE CONVECTIVE STORM EVENTS PER CAPITA (2014–2023)

The final map in this convective storm series continues the trend of human impact mapping by illustrating the reported total property damage (USD) per capita caused by severe convective storm events<sup>1</sup> for each county in the contiguous United States between 2014 and 2023. Damage totals, derived from the NOAA Storm Events Database, were mapped using graduated symbology and normalized by 2020 decennial census population data (Total damage / County population) to show the average property loss per resident, allowing comparison between counties of different population sizes.

Graduated symbology works well for this dataset because the normalized values display a broad distribution (\$0–26,937 per capita) that, when paired with Natural Breaks (Jenks) as a classification method, separates the data into coherent classes that effectively highlight counties with high per-capita losses while avoiding misrepresentation of counties with lower losses.

Similar to the proportional-symbols map, the main design challenge involved effectively displaying clusters of small, adjacent counties with disproportionately high per-capita losses, where dense concentrations of higher class values risked overcrowding surrounding values. Applying a 20% partial transparency and a background-matching halo mitigated this issue and helped maintain clear visual separation between neighbouring counties.

This per-capita property damage map reveals a far more concentrated pattern than the other maps in this series. While injury-causing storm events and overall storm event frequency are broadly distributed across the central and southeastern United States, total damage per capita from storm events is disproportionately high in some smaller Great Plains counties, where normalizing by a small population base inflates the relative impact of severe events.

# SEVERE CONVECTIVE STORM ACTIVITY IN THE UNITED STATES (2014–2023)



### BASEMAP & REFERENCE DATA

- US STATES & COUNTY POLYGONS: TIGER/LINE SHAPEFILES, UNITED STATES CENSUS BUREAU
- US VECTOR FLAG FILE CREATED BY DBENBENN, ZSCOUT370, JACOBOLUS, INDOLENCES, AND TECHNION, WIKIPEDIA.
- US POPULATION DATA: IPUMS NHGIS, 2020 U.S. CENSUS.
- NOAA STORM EVENTS DETAILS & LOCATIONS FILES (2014–2023), NOAA STORM DATABASE.
- CANADA 2021 CENSUS BOUNDARY FILES - STATISTICS CANADA
- MEXICO SHAPE FILES - GEOBOUNDARIES.ORG (INSTITUTO NACIONAL DE ESTADÍSTICA Y GEOGRAFÍA (INEGI))

### <sup>1</sup>SEVERE CONVECTIVE STORM EVENTS

- EVENTS REPRESENT INDIVIDUAL REPORTED OCCURRENCES (TORNADO, HAIL, OR SEVERE THUNDERSTORM WIND) RECORDED IN THE NOAA STORM EVENTS DATABASE. MULTIPLE EVENTS MAY BE ASSOCIATED WITH A SINGLE STORM SYSTEM.

### PROJECTION

- NAD83 CONTIGUOUS USA ALBERS (EQUAL AREA)

### DISCLAIMER

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