

EARTH
NETWORKS®

2019

UNITED STATES
LIGHTNING REPORT



ABOUT THIS REPORT

The 2019 Lightning Report was prepared by Earth Networks using the Earth Networks Total Lightning Network (ENTLN). The following report includes in-cloud, cloud-to-ground, and total lightning data from the continental United States and the surrounding water bodies throughout 2019. Counts, densities, currents, rankings, Dangerous Thunderstorm Alerts (DTAs), and Thunder Days in this report are from January 1, 2019 to December 31, 2019.

THE EARTH NETWORKS TOTAL LIGHTNING NETWORK (ENTLN)

The lightning data in this report is derived from the Earth Networks Total Lightning Network (ENTLN), which monitors the combination of in-cloud and cloud-to-ground lightning strikes over 100 countries. With over 1,800 sensors, the ENTLN is the most extensive and technologically advanced total lightning network in the world. ENTLN has been specifically deployed to detect real-time lightning and provide advanced warning for severe weather events that could threaten public safety and operational efficiency.

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112,310,896

TOTAL LIGHTNING STRIKES

TOTAL LIGHTNING

is the combination of cloud-to-ground (CG) and in-cloud (IC) lightning strikes



Cloud-to-ground lightning:

Lightning that happens between opposite charges in a cloud and on the ground

In-cloud lightning:

Lightning that occurs between opposite charges within a thunderstorm cloud

19,020,340

Cloud-to-ground



TOTAL LIGHTNING TYPE PERCENTAGES

17%

83%

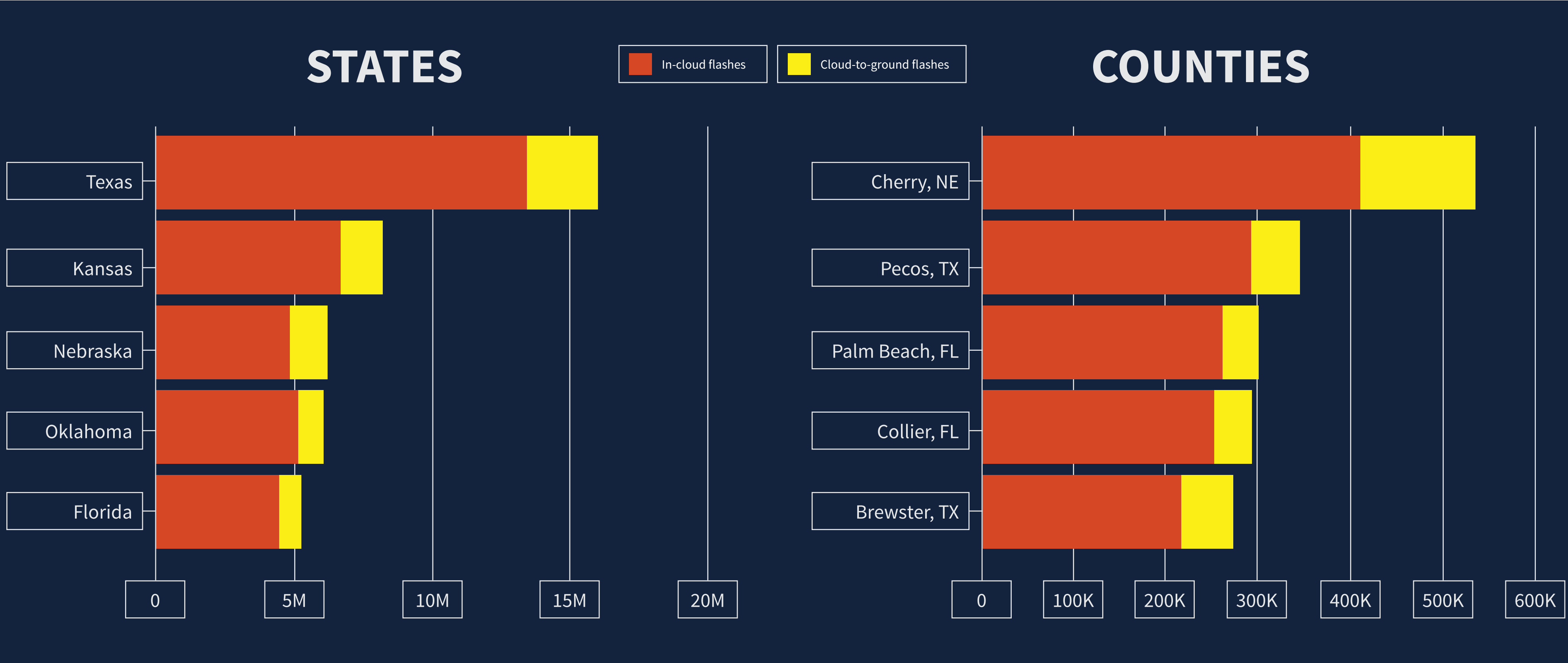


93,290,556

In-cloud

LIGHTNING COUNT RANKINGS

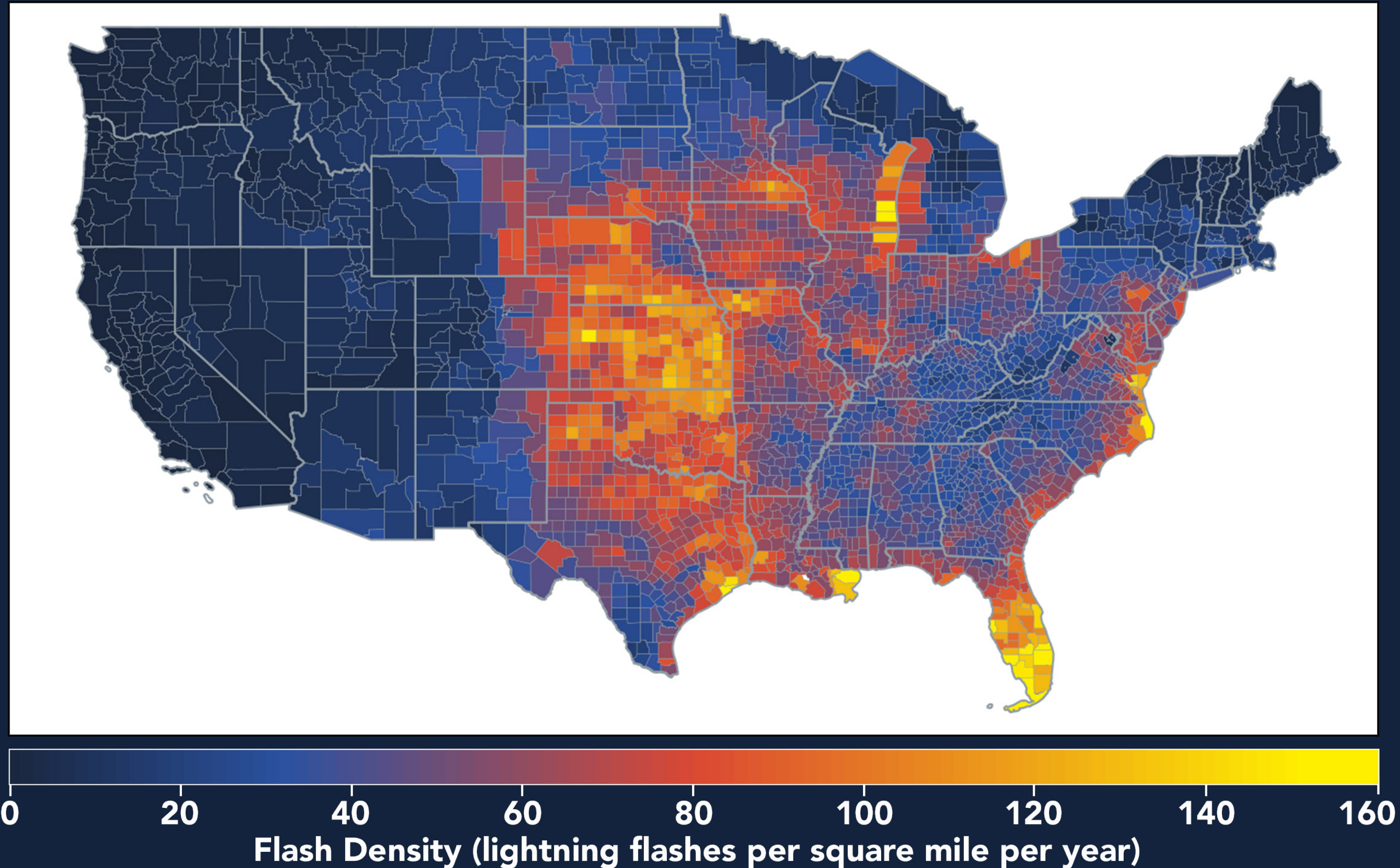
These states and counties saw the highest lightning counts during 2019:



Texas is the USA’s 2019 Lightning King; seeing 16,032,609 total lx strikes and having two counties with the top lightning counts according to our network. This has a lot to do with Texas’ overall size as our second largest state by area at 268,567 square miles. Although it didn’t claim the top spot, Florida, the “Lightning Capital” of the country, squeaked in to round out the top five states with 5,271,987 strikes and two counties in the top five.

A wet year with a lot of thunderstorms and tornadoes in the spring pushed Cherry County, Nebraska to the top of the county count rankings.

TOTAL (CG+IC) FLASH DENSITY MAP



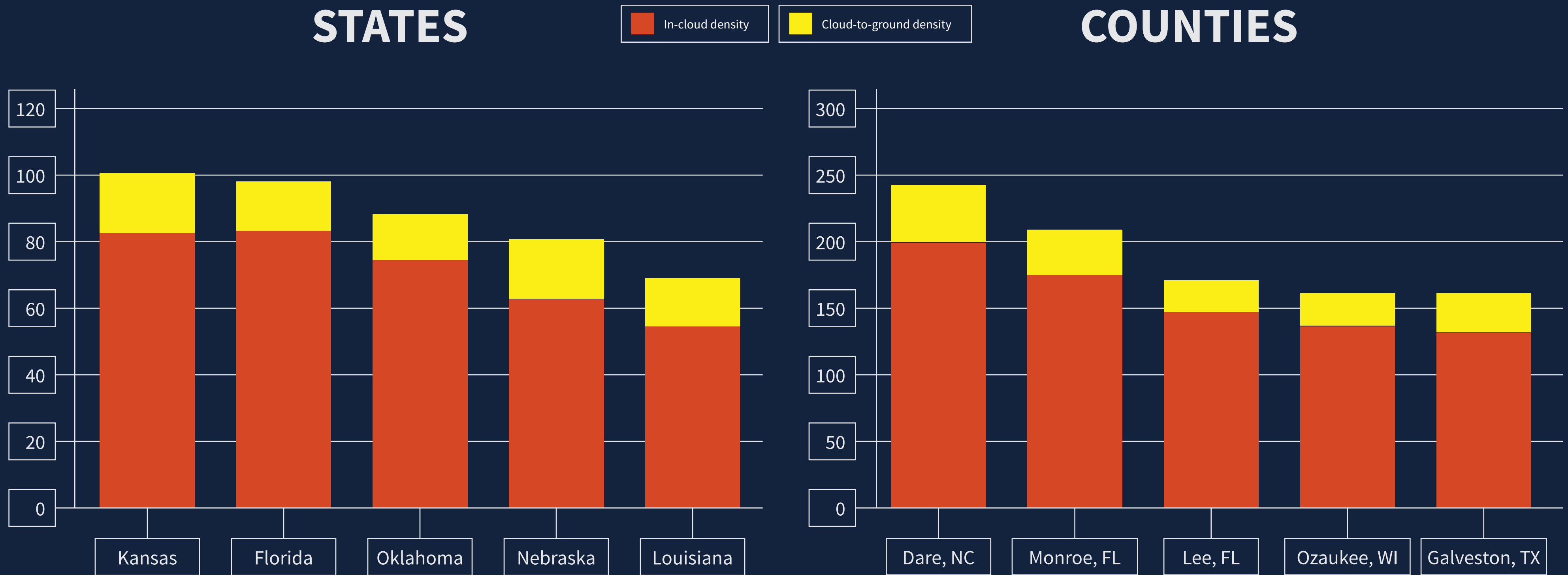
As you can see from the map above, there was no state that escaped lightning activity in 2019.

The yellow “hot spots” on the map above accentuate areas with high concentrations of lightning strikes. You can see maximums in Tornado Alley, along the coast of Lake Michigan, and along the East Coast.

We use lightning density rather than lightning count to compare different-sized areas (like states and counties) fairly.

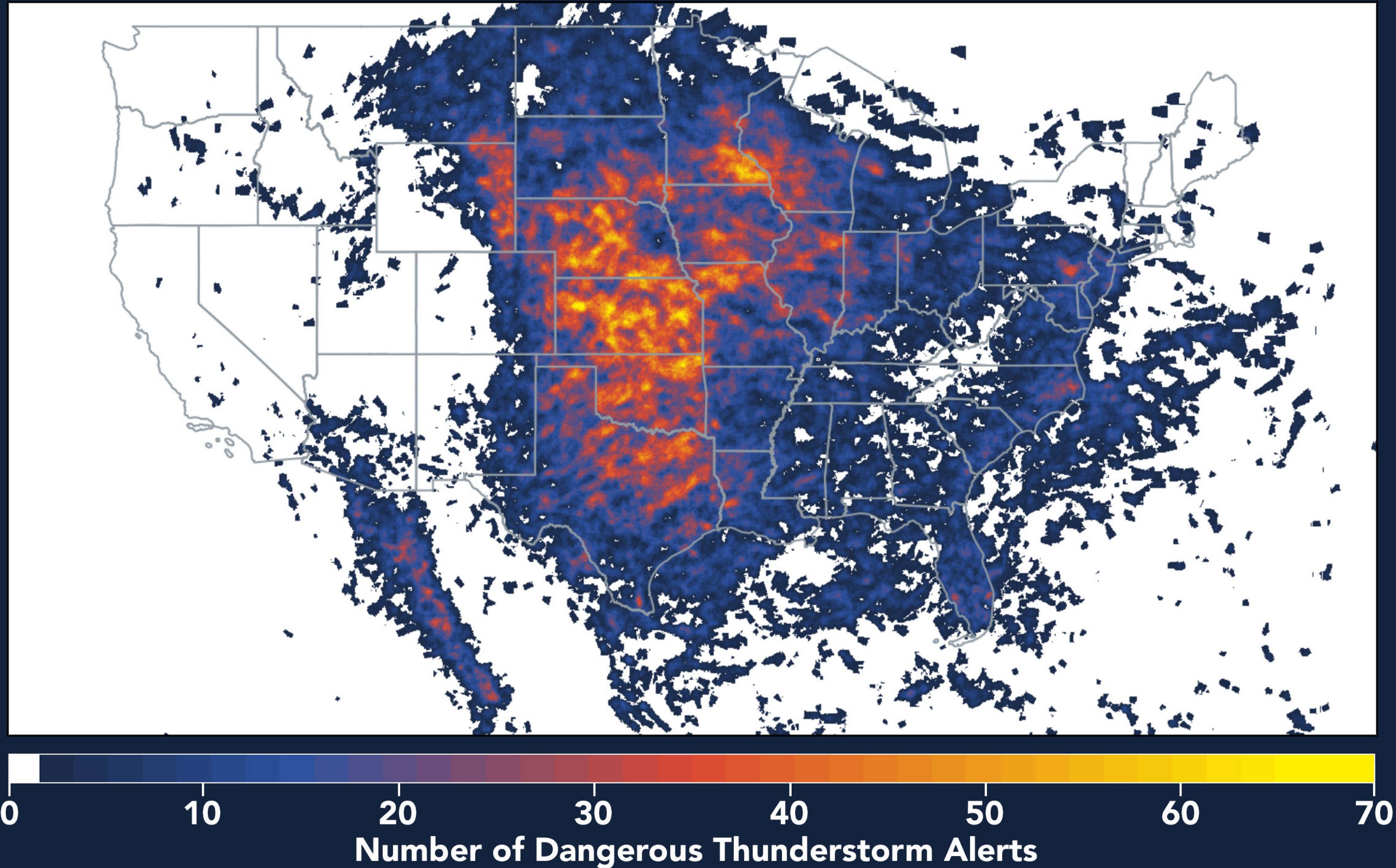
TOTAL FLASH DENSITY RANKINGS

The top states for flash density illustrate an active tornado season in the Midwest and summer thunderstorms on the Gulf Coast.



Even though Texas had the most strikes during 2019, it's the only state from the count list that didn't make the density list. This is most likely due to Texas' large area. Dare County, North Carolina - a narrow coastal county - nabbed the top spot for county lightning density thanks to its peak in sea breeze thunderstorms during the summer months.

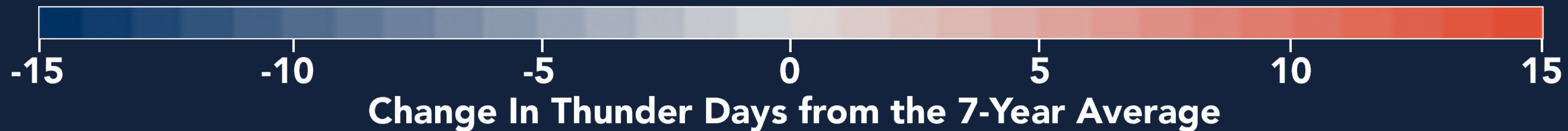
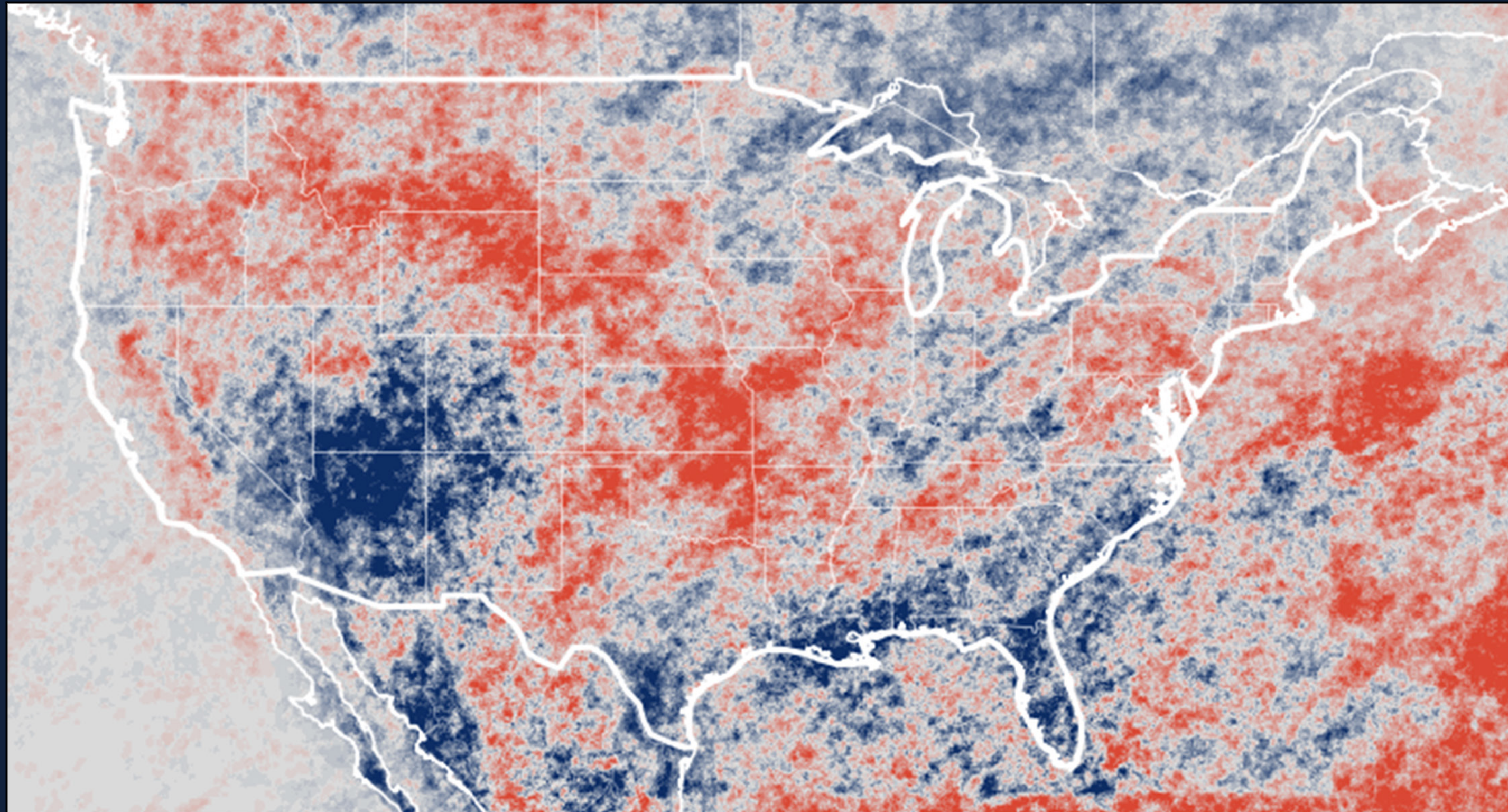
DANGEROUS THUNDERSTORM ALERTS IN THE U.S.



This map of Dangerous Thunderstorm Alerts (DTAs) highlights the areas that had the most severe storms during 2019. An abnormally active tornado season with over 1,300 tornado reports explains the many DTAs lighting up the center of the country.

Dangerous Thunderstorm Alerts (DTAs), available exclusively to Earth Networks, provide **50% more lead time** to severe storms compared to publicly available alerts.

THUNDER DAYS



There were nine states that experienced over 200 Thunder Days in 2019. They are Texas, Florida, Oklahoma, New Mexico, Louisiana, Colorado, Georgia, Alabama, and Mississippi. It's also interesting to note the areas with less-than-average Thunder Days. The Four Corners area is below average thanks to a less active than normal monsoon season. Another surprisingly low activity area was the Gulf Coast.

Sometimes smaller storms can have a big impact, especially when you aren't expecting them. That's why we calculated Thunder Days, or days we detected lightning over a certain area. The map shows the deviation of Thunder Days from normal. Another way to think about this is the amount of Thunder Days this year compared to the past seven years.

2019 LIGHTNING RECAP:



TORNADO ALLEY

Just how active was Tornado Alley this year?



GULF COAST

How can Florida have some of the highest lightning densities but be below average for Thunder Days?



EAST COAST

Why were these coastal areas active during the second half of the year?

Lightning can tell us more about the weather and climate than most people think. The second half of this report focuses on what the data means, using real case studies to answer questions posed by the data our analysis uncovered.

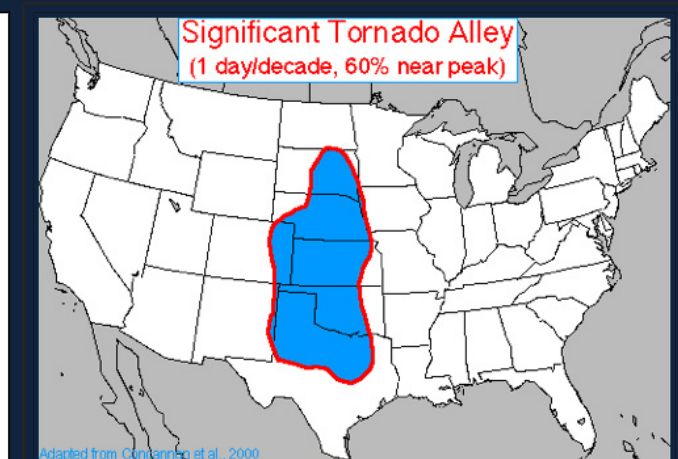
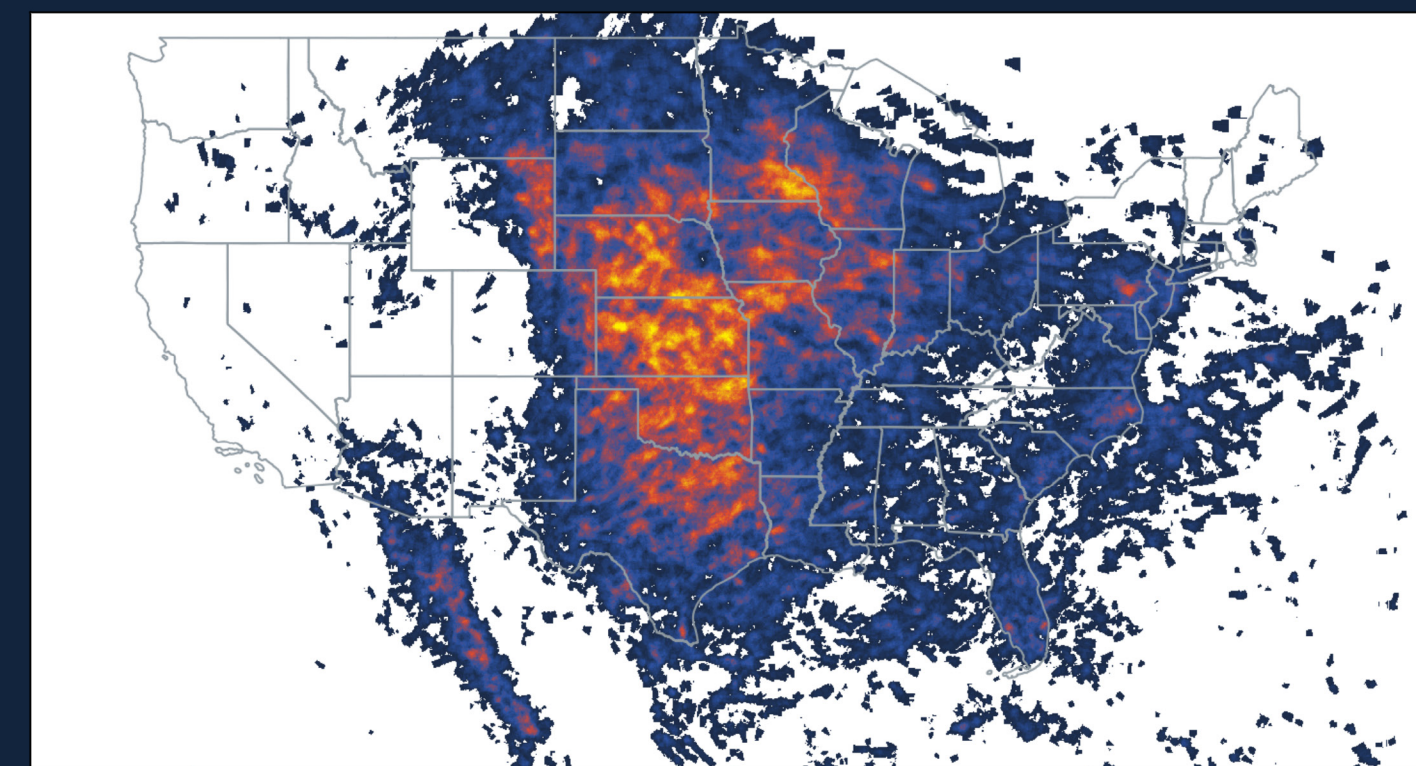
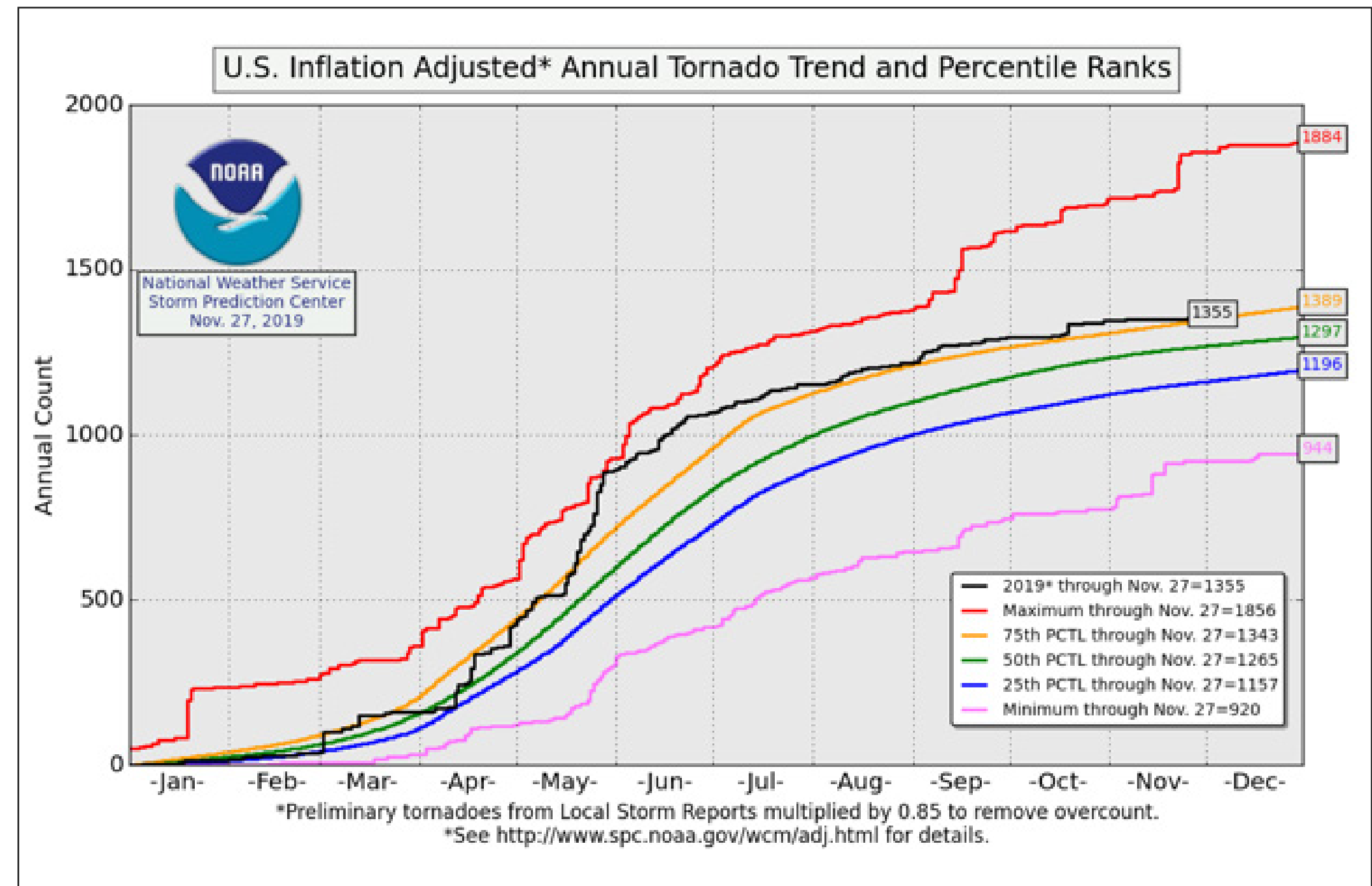


TORNADO ALLEY

Above-Average Tornadic Activity

2019 was an active year for tornadoes, with over 1,355 confirmed reports. Just how active? We were in the 75th percentile for tornadoes. This chart (top right) from NOAA's National Weather Service Storm Prediction Center shows 2019's tornado activity as the black line. There was a strong uptick in tornadic activity in May before it flattened out over the second half of the year.

While tornadoes occurred throughout the country, including a particularly bad tornado outbreak in Alabama on March 3rd, many occurred in Tornado Alley. According to our Chief Meteorologist, Mark Hoekzema, Tornado Alley covers the Central United States between the Rockies and the Appalachian Mountains. Some states often associated with Tornado Alley include Nebraska, Kansas, Oklahoma, and Texas. You can see Tornado Alley clearly in our 2019 map of Dangerous Thunderstorm Alerts (bottom right).



0 10 20 30 40 50 60 70
Number of Dangerous Thunderstorm Alerts

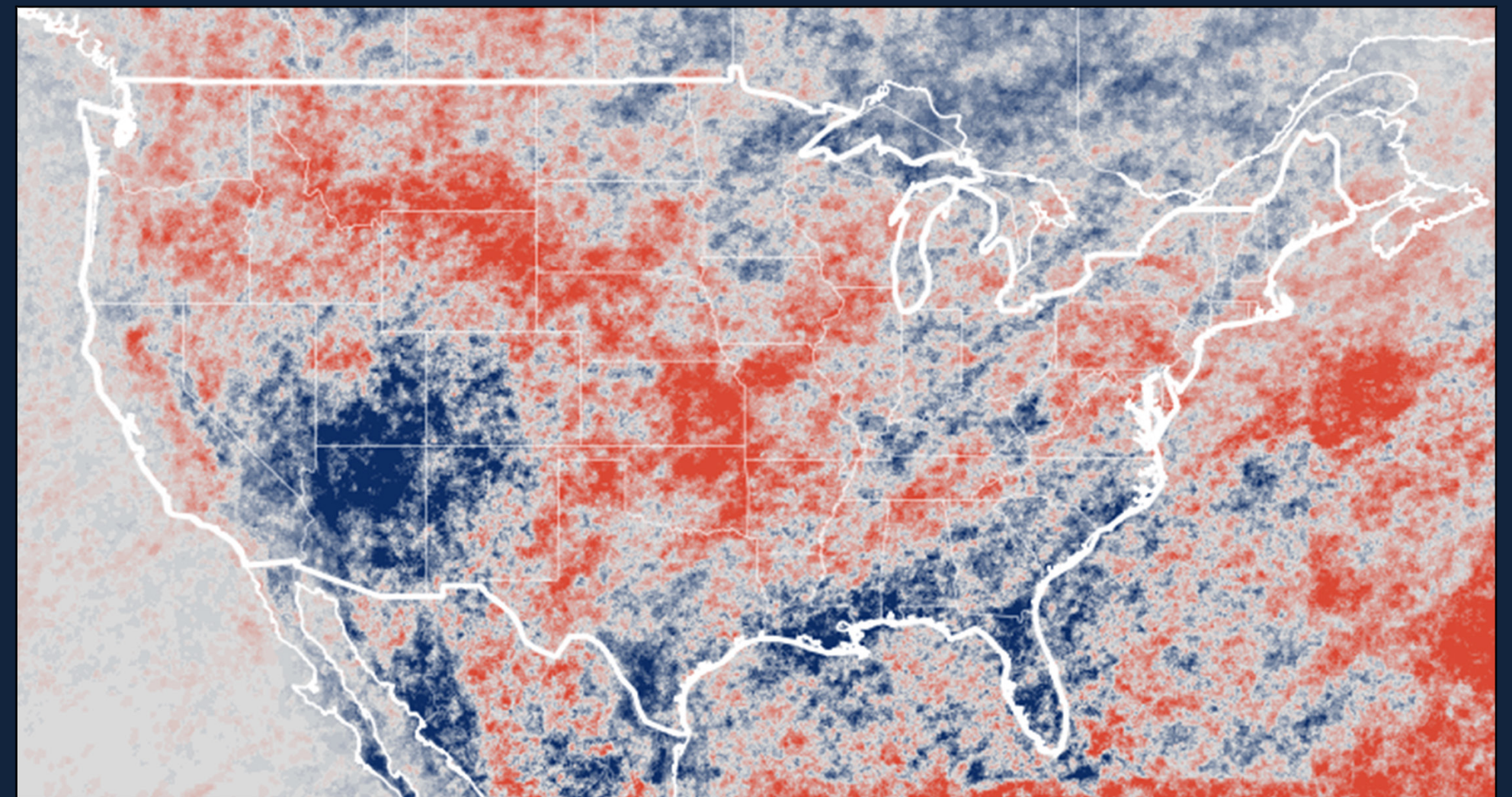


GULF COAST

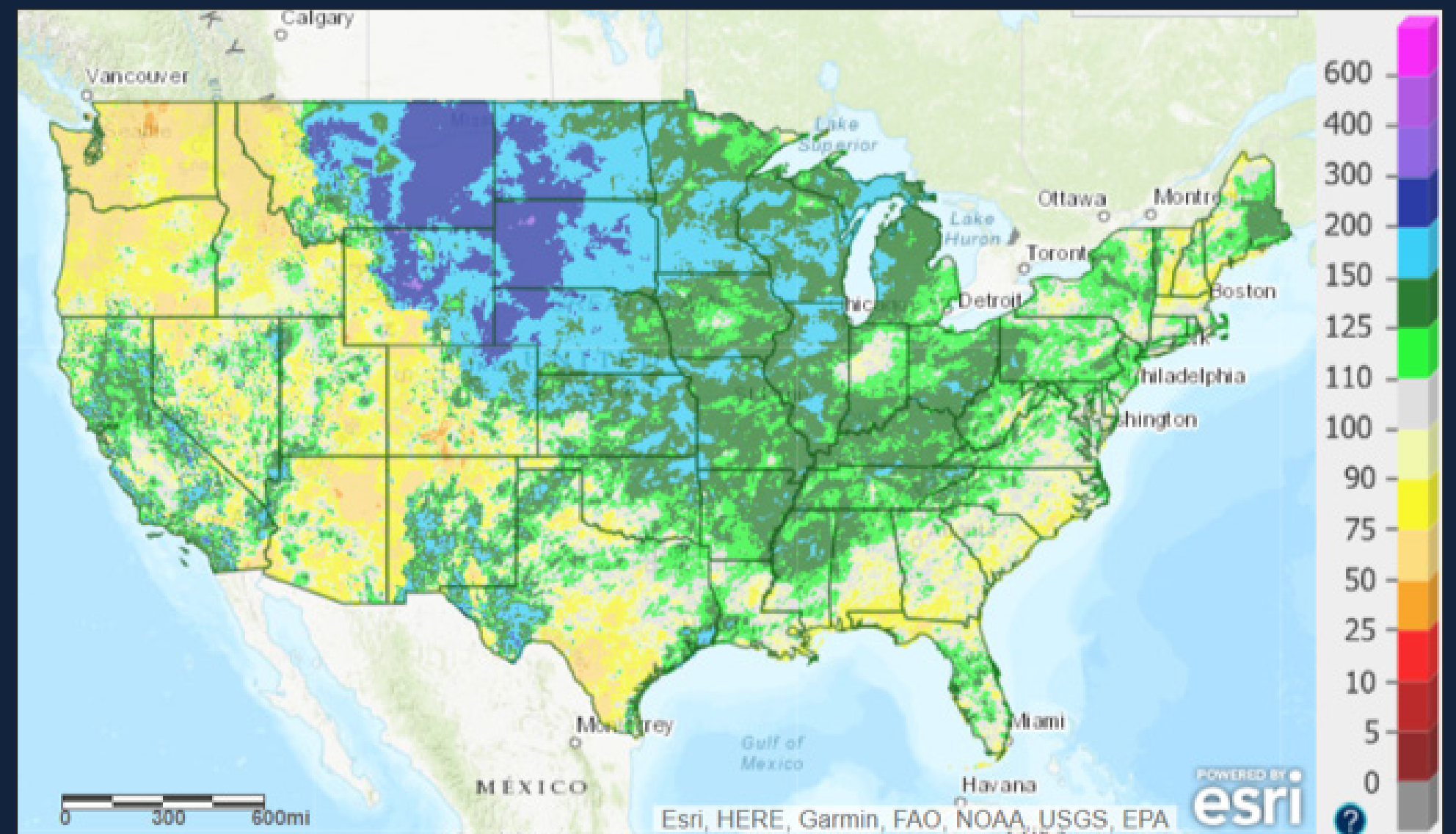
Dry Year & Upper Storm Track Minimized Lightning Activity

While Florida had the second highest lightning density as a state, it and the rest of the Gulf Coast actually saw less lightning activity than normal. If you look at our Thunder Day Anomalies map (top right), you can see the Gulf Coast lit up in dark blue, showing it had 15 less Thunder Days than the 7-year average.

This year, our weather patterns favored a more active storm track in the Midwest and Great Lakes regions, suppressing thunderstorm development and fronts from moving south. This rainfall deviation map from NOAA (bottom right) correlates well with our Thunder Day Anomalies map, showing less rainfall throughout Florida, the Gulf Coast, and the Four Corners region, and more rainfall in the Midwest.



-15 -10 -5 0 5 10 15
Change In Thunder Days from the 7-Year Average





EAST COAST

Coastal Lightning Activity Proves Deadly

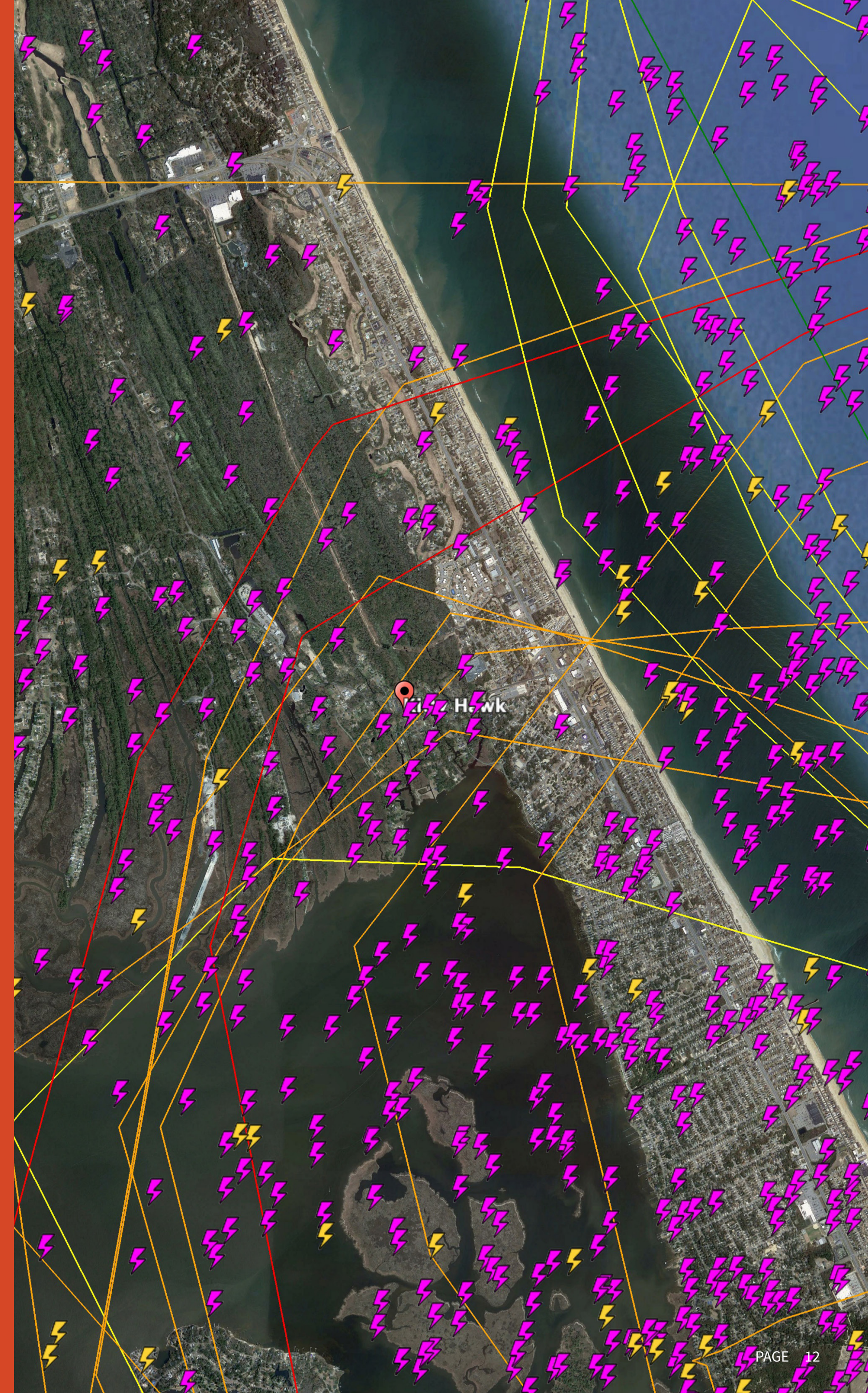
This year we saw plenty of lightning activity along the general Atlantic coast from New York down to Florida, with strong density hot spots in North Carolina and South Carolina. In the summer, sea breeze thunderstorms are common in coastal areas. This is one of the reasons Dare County, North Carolina took the top spot in our lightning density ranking.

Summer thunderstorms along the beach can be dangerous and even deadly. A lightning fatality occurred in Dare County on August 23, 2019 when a bolt from the blue struck and killed a 23-year-old man playing on the beach with his friends.

Our total lightning network detected 3,431 pulses in a two-hour period surrounding Kitty Hawk, NC. We even detected a nearby in-cloud strike just 20 minutes before the fatal accident.

Lightning can strike when skies are blue because it can extend more than 10 miles outward from a storm cloud. That's why it's important to trust more than just your eyesight when it comes to lightning safety.

In 2019 there were 19 lightning fatalities in the United States. According to the National Weather Service, this is one less lightning death than 2018.



2019 was a very active year for the central U.S. both in terms of lightning and severe weather. Kansas, which saw 25% more lightning than normal, took over the top spot in terms of number of flashes per square mile for 2019. In contrast, the below-average lightning trend in Florida continued throughout the second half of the year, experiencing 30% less lightning compared to 2018. It will be interesting to see if this trend continues in 2020, or if 2019 was an exceptional year.

– Michael Stock
Principal Lightning Scientist

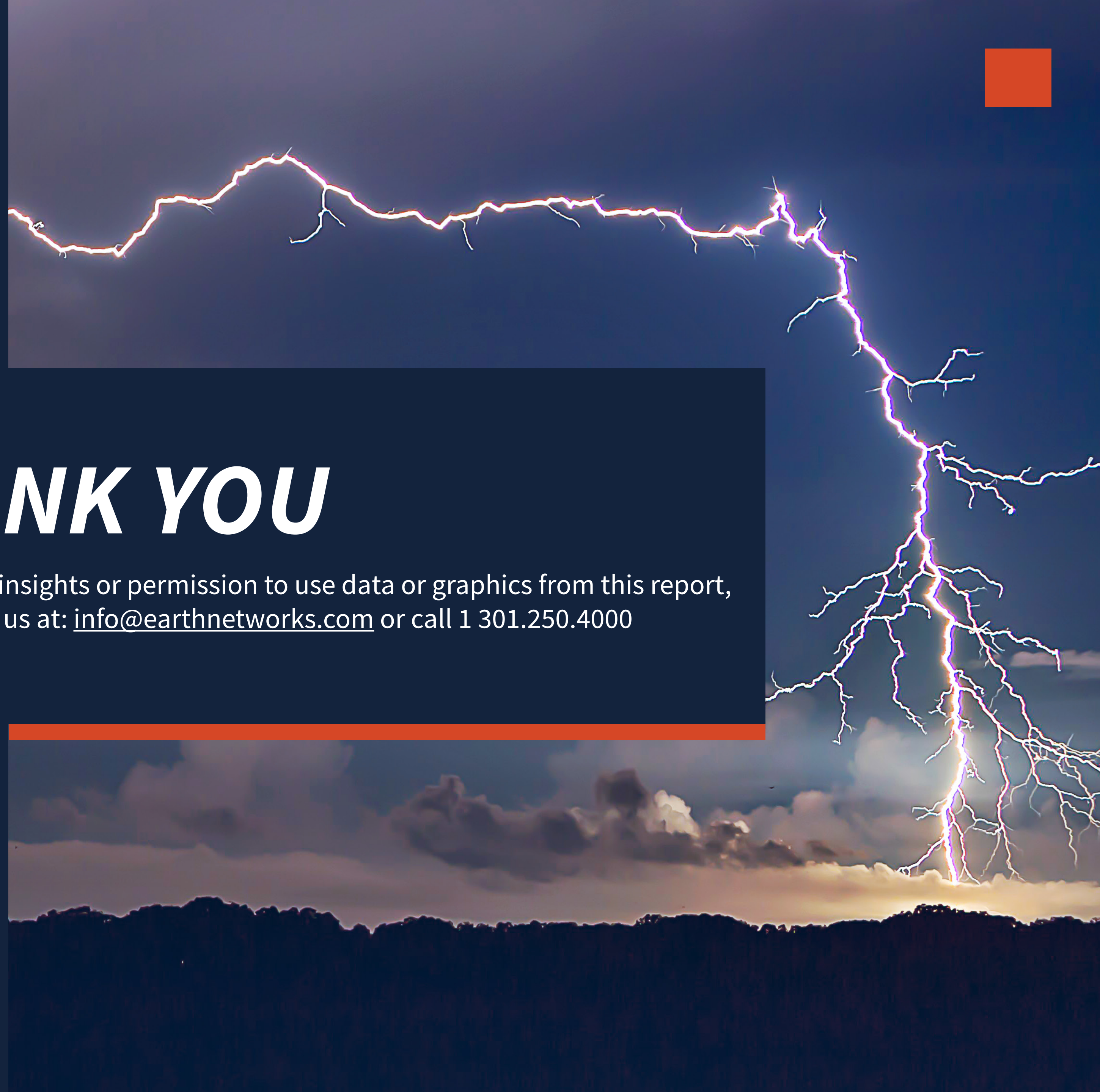


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THANK YOU

For additional insights or permission to use data or graphics from this report,
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APPENDIX

This table ranks the states based on their total lightning count from highest to lowest. Total lightning includes all in-cloud and cloud-to-ground lightning strikes from January 1, 2019 to December 31, 2019.

STATE	TOTAL LIGHTNING STRIKE COUNT
TX	16,032,609
KS	8,200,321
NE	6,166,469
OK	6,039,749
FL	5,271,987
MO	4,612,813
SD	3,706,174
IA	3,603,519
CO	3,499,283
NM	3,436,976
IL	3,214,951
MN	3,148,975
LA	2,986,793
WI	2,833,867
AR	2,749,873
WY	2,561,285
GA	2,509,194
MT	2,216,126
NC	2,204,934
AL	2,185,245
MS	2,113,867
OH	1,997,433
PA	1,878,759
VA	1,875,442
IN	1,865,972
ND	1,819,198
TN	1,620,793
SC	1,501,005
KY	1,493,348
AZ	1,472,234
MI	1,472,050
NY	791,943
WV	743,527
UT	700,721
ID	677,112
MD	554,496
NV	550,676
OR	429,011
NJ	392,212
CA	365,225
WA	183,076
MA	138,347
ME	118,006
DE	113,098
CT	111,136
NH	65,827
VT	60,737
RI	19,551
DC	4,951

APPENDIX

This table ranks the Top 100 U.S. counties with the highest total lightning counts from highest to lowest. Total lightning includes all in-cloud and cloud-to-ground lightning strikes from January 1, 2019 to December 31, 2019.

COUNTY	STATE	TOTAL LIGHTNING STRIKE COUNT
Cherry County	NE	534,436
Pecos County	TX	346,413
PalmBeach County	FL	299,817
Collier County	FL	293,525
Brewster County	TX	272,023
Campbell County	WY	270,158
Union County	NM	263,759
Weld County	CO	251,652
Lincoln County	NE	248,334
Osage County	OK	246,402
Miami-Dade County	FL	243,705
Custer County	NE	234,950
Pima County	AZ	221,011
LasAnimas County	CO	215,923
Lea County	NM	211,861
Sheridan County	NE	206,866
Monroe County	FL	205,844
Polk County	FL	205,057
Chaves County	NM	201,322
Laramie County	WY	198,539
Converse County	WY	194,598
Harris County	TX	193,386
Holt County	NE	191,847
Yuma County	CO	189,798
Goshen County	WY	189,117
KitCarson County	CO	186,239
Baca County	CO	179,599
Colfax County	NM	176,701
SanMiguel County	NM	173,599
Weston County	WY	172,367
Cheyenne County	CO	169,945
Niobrara County	WY	167,900
Platte County	WY	166,877
Butler County	KS	166,729
Socorro County	NM	162,652
Lincoln County	CO	161,940
LeFlore County	OK	161,273
Logan County	KS	161,098
Sumner County	KS	160,384
Hendry County	FL	159,551
Coconino County	AZ	156,785
Crook County	WY	153,717
Quay County	NM	152,934
Washington County	CO	151,275
Eddy County	NM	151,081
Logan County	CO	149,746
Kiowa County	CO	149,304
McCurtain County	OK	148,405
Crockett County	TX	146,116
Meade County	SD	145,993

COUNTY	STATE	TOTAL LIGHTNING STRIKE COUNT
Broward County	FL	145,872
Beaver County	OK	145,578
PowderRiver County	MT	145,494
Apache County	AZ	145,175
Brown County	NE	144,009
BigHorn County	MT	143,803
Brevard County	FL	143,404
Otero County	NM	143,379
Sioux County	NE	143,084
Cimarron County	OK	142,093
Lincoln County	NM	139,639
Marion County	FL	139,028
ValVerde County	TX	137,112
Texas County	OK	136,892
Pennington County	SD	136,834
Cowley County	KS	136,406
Catron County	NM	135,489
Oldham County	TX	134,622
Osceola County	FL	134,037
Hillsborough County	FL	133,715
Lee County	FL	133,205
Presidio County	TX	132,217
Johnson County	WY	131,111
Yavapai County	AZ	129,944
DeafSmith County	TX	128,928
Sedgwick County	KS	126,786
Elko County	NV	126,251
Prowers County	CO	126,207
Brazoria County	TX	125,281
Rosebud County	MT	124,902
Carter County	MT	124,775
Harding County	NM	123,994
Tripp County	SD	122,286
Glades County	FL	120,752
Gove County	KS	119,811
Houston County	TX	119,455
Roosevelt County	NM	119,264
Barber County	KS	118,774
Guadalupe County	NM	118,704
Hartley County	TX	117,019
Greenwood County	KS	116,807
Natrona County	WY	116,741
Elbert County	CO	116,699
Woods County	OK	115,349
Ellis County	KS	114,607
Lyman County	SD	114,291
Highlands County	FL	113,727
Pittsburg County	OK	113,539
Marion County	KS	112,713
Volusia County	FL	112,313