



2020

UNITED STATES LIGHTNING REPORT



ABOUT THIS REPORT

The 2020 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 2020.

Counts, densities, rankings, Dangerous Thunderstorm Alerts (DTAs), and Thunder Days in this report are from January 1, 2020 to December 31, 2020.

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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REPORT TERMINOLOGY

To help you better understand the insights from this lightning report, we've included definitions of our frequently used report terminology below.

Lightning Pulse: This report measures lightning pulses. A pulse is a surge of electric current in lightning usually accompanied by a burst of light. Pulses are classified as In-cloud (IC) or Cloud-to-Ground (CG).

Lightning Flash: A lightning flash is a collection of pulses close in space and time that approximates the continuous ionized channels of a complete bolt of lightning.

Cloud-to-Ground Lightning (CG): Lightning that happens between opposite charges in a cloud and on the ground.

In-Cloud Lightning (IC): Lightning that occurs between opposite charges within a thunderstorm cloud.

Total Lightning Detection: The combination of all in-cloud and cloud-to-ground lightning activity.

Pulse Density: The number of lightning pulses per square mile per year.

Dangerous Thunderstorm Alerts (DTAs): Earth Networks patented advanced severe weather warnings that notify users of incoming storms up to 45 minutes before storm arrival.

Thunder Days: Any given day where lightning was detected in a certain area.

441,211,344

TOTAL LIGHTNING PULSES

TOTAL LIGHTNING

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



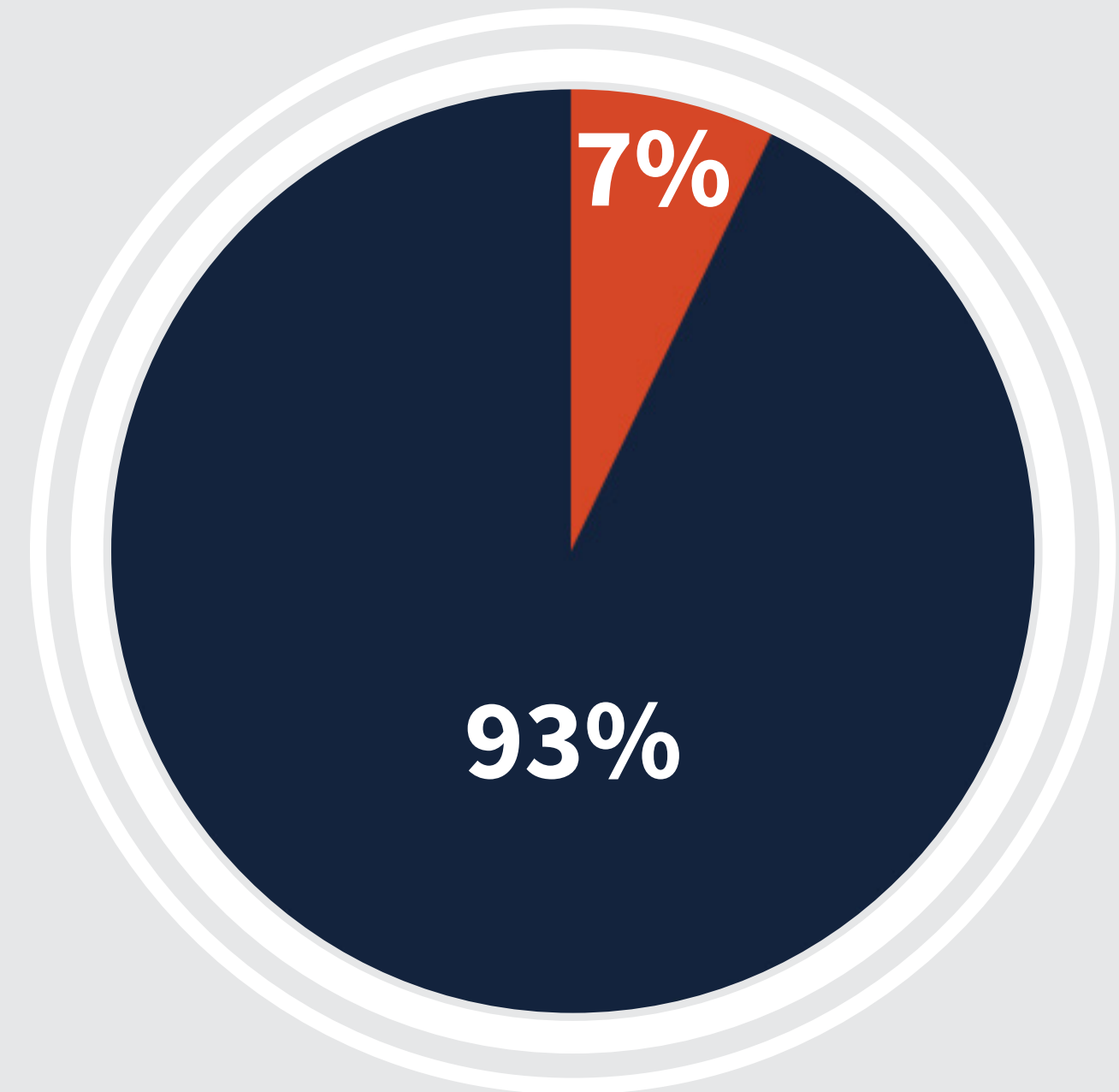
Cloud-to-Ground lightning:

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

TOTAL LIGHTNING TYPE PERCENTAGES



Cloud-to-ground

31,549,740

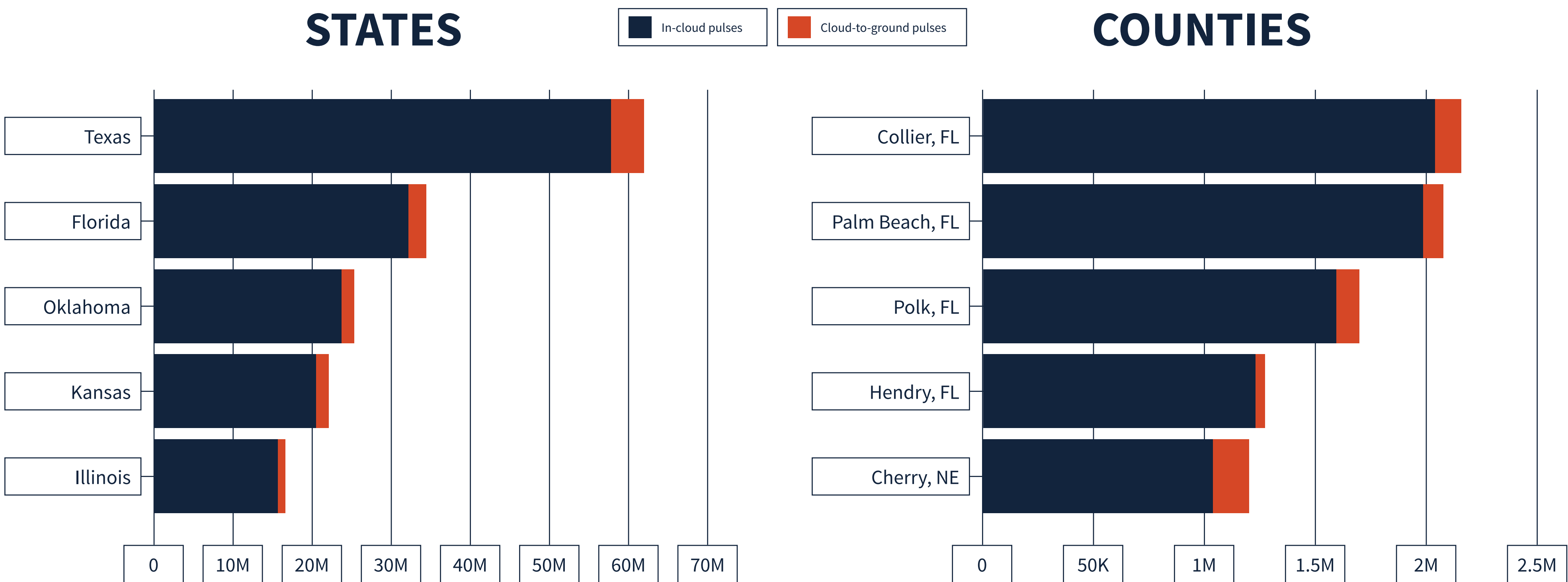


In-cloud

409,645,512

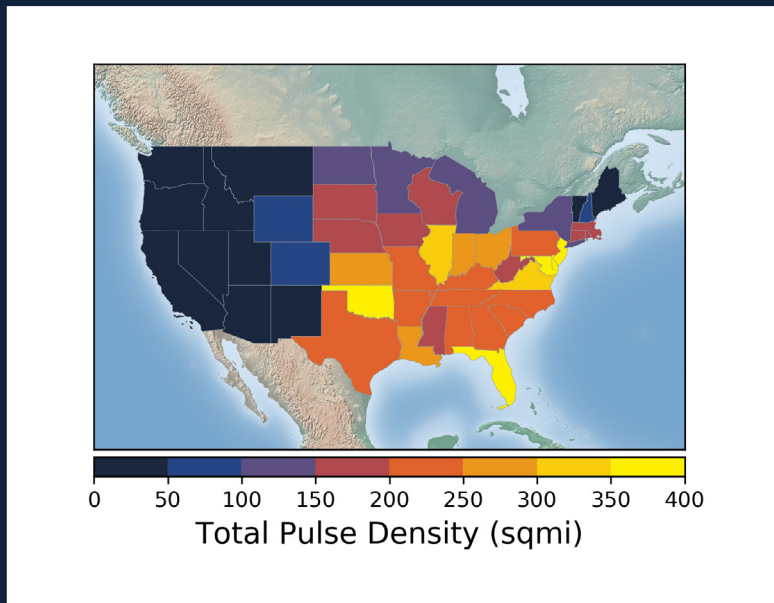
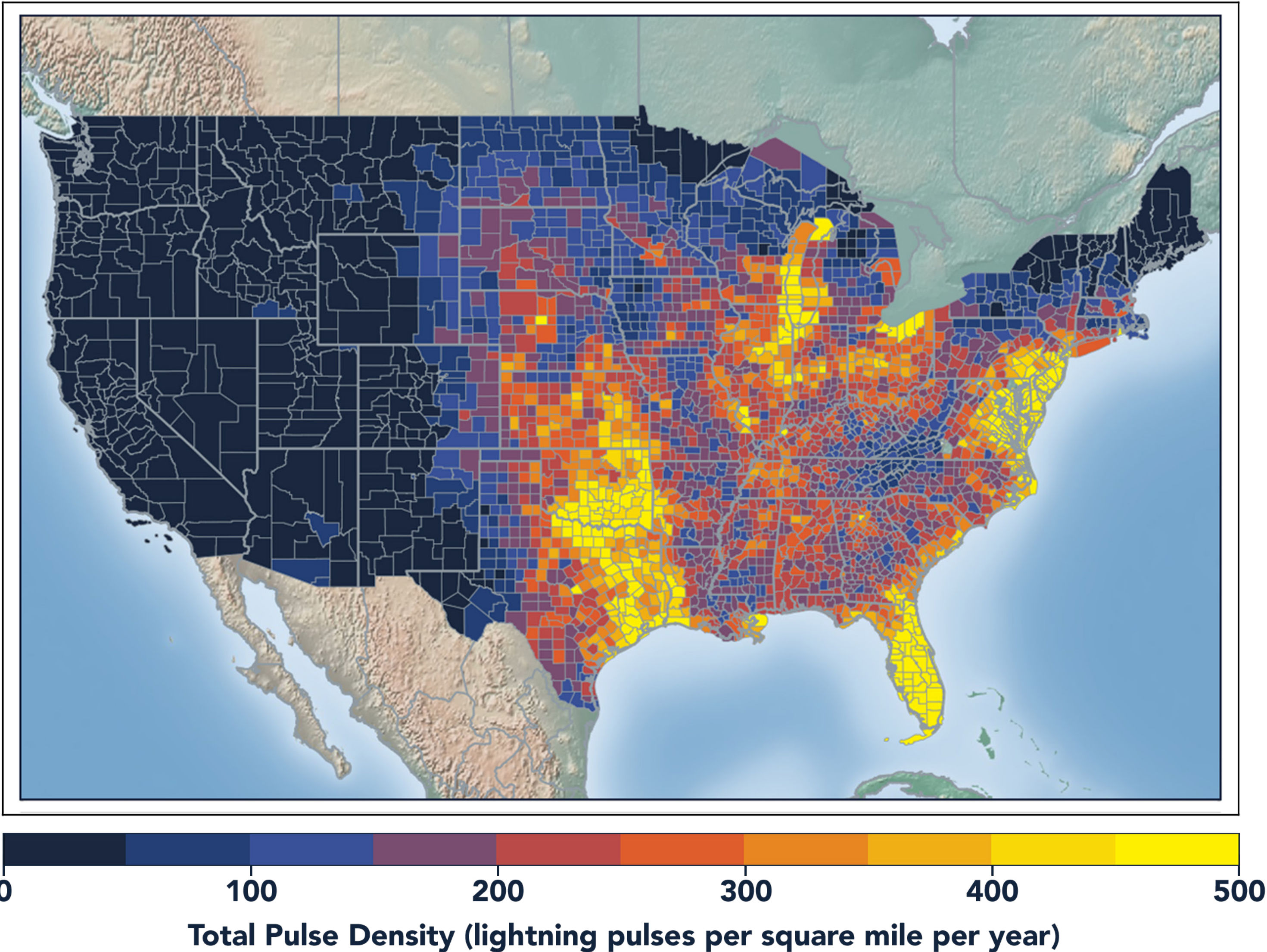
LIGHTNING COUNT RANKINGS

These states and counties saw the highest lightning counts during 2020:



Texas is the state with the most lightning in 2020. 3 of the 5 counties that experienced the highest lightning counts this year were also in the top 5 in 2019, including Collier, FL, Cherry, NE, and Palm Beach, FL. This year, Illinois made the list of the top 5 states with the highest lightning counts during 2020, replacing Nebraska.

TOTAL (CG+IC) PULSE DENSITY MAP



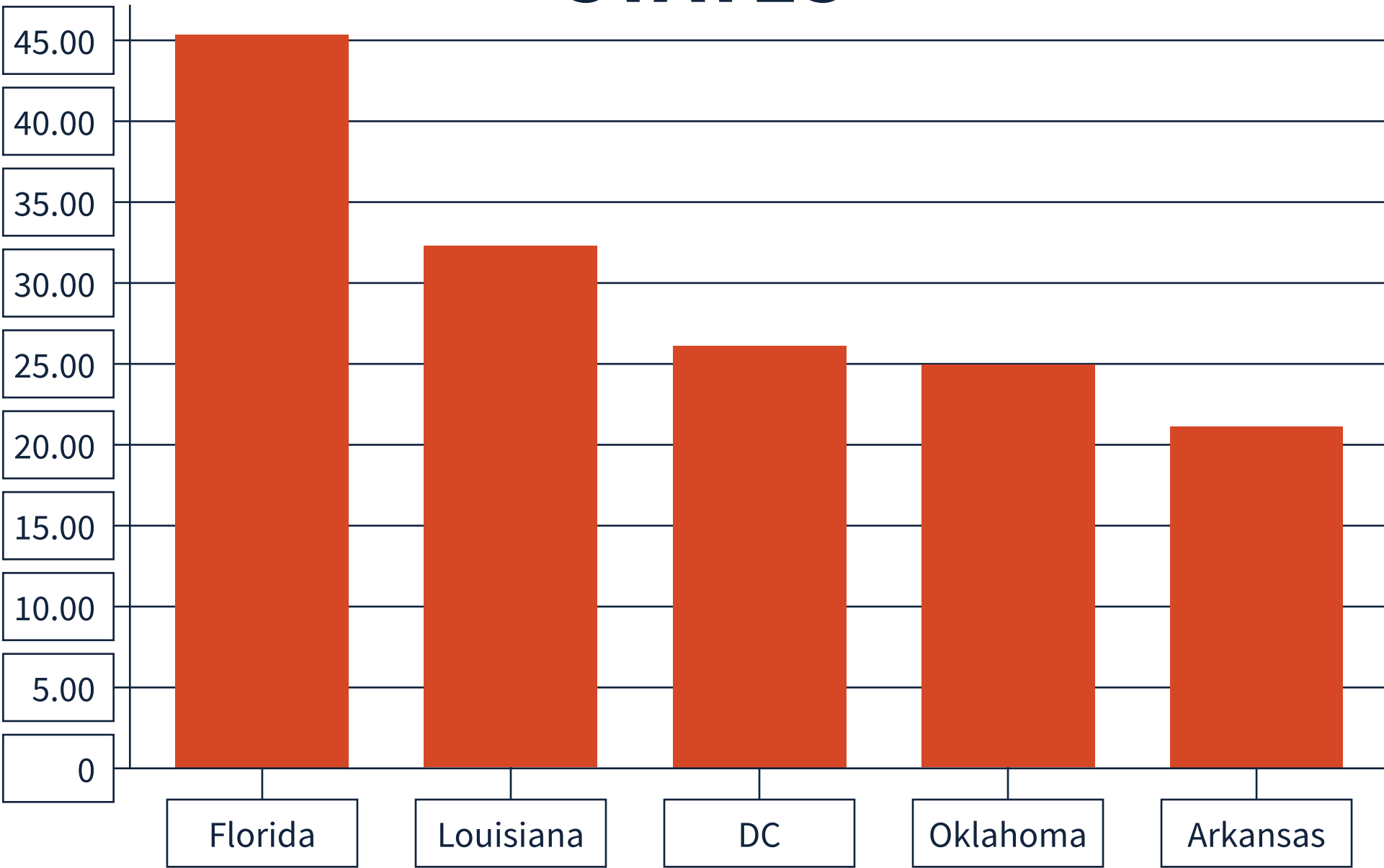
Pulse density is a better indicator of lightning activity than total lightning counts because it enables us to compare different sized areas (like states and counties) fairly.

We cluster pulses together into a flash. With every pulse we detect, we receive a more precise measure of lightning activity. At left, areas in bright yellow experienced the highest lightning pulse density per square mile in 2020.

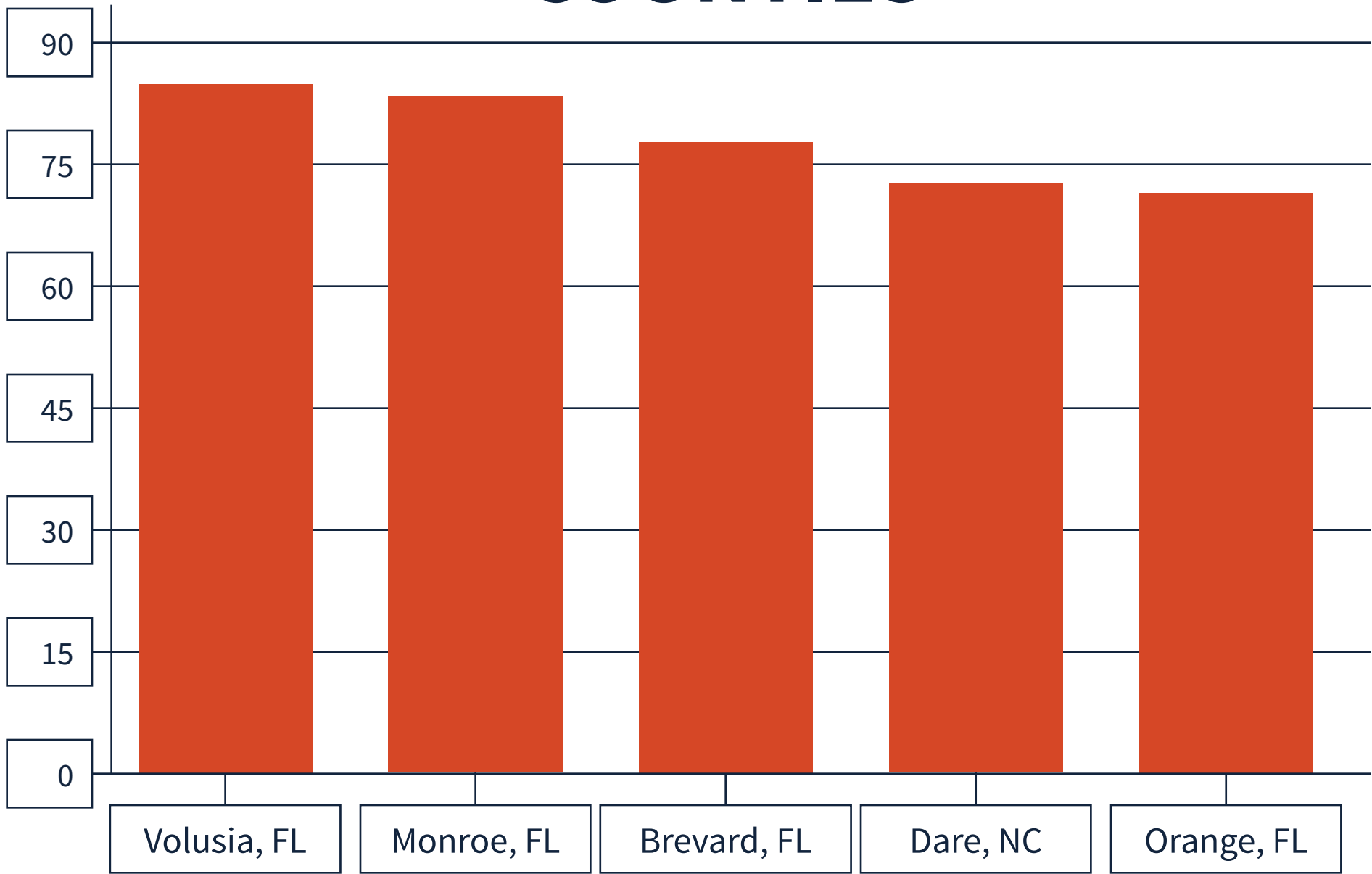
CLOUD-TO-GROUND PULSE DENSITY RANKINGS

The top states for cloud-to-ground pulse density show an extremely active hurricane season for the Gulf Coast, with Florida and Louisiana ranking highest for 2020. Five named tropical storms made landfall in Louisiana, breaking the state record for most strikes in a season.

STATES



COUNTIES



Cloud-to-ground Pulse Density
Cloud-to-ground pulse density is calculated per square mile and does not include counties under 300 square miles in area

This year, 4 out of the 5 top counties for cloud-to-ground pulse density are in Florida, including a repeat appearance by Monroe County. In addition, coastal Dare County in North Carolina made our list again this year.

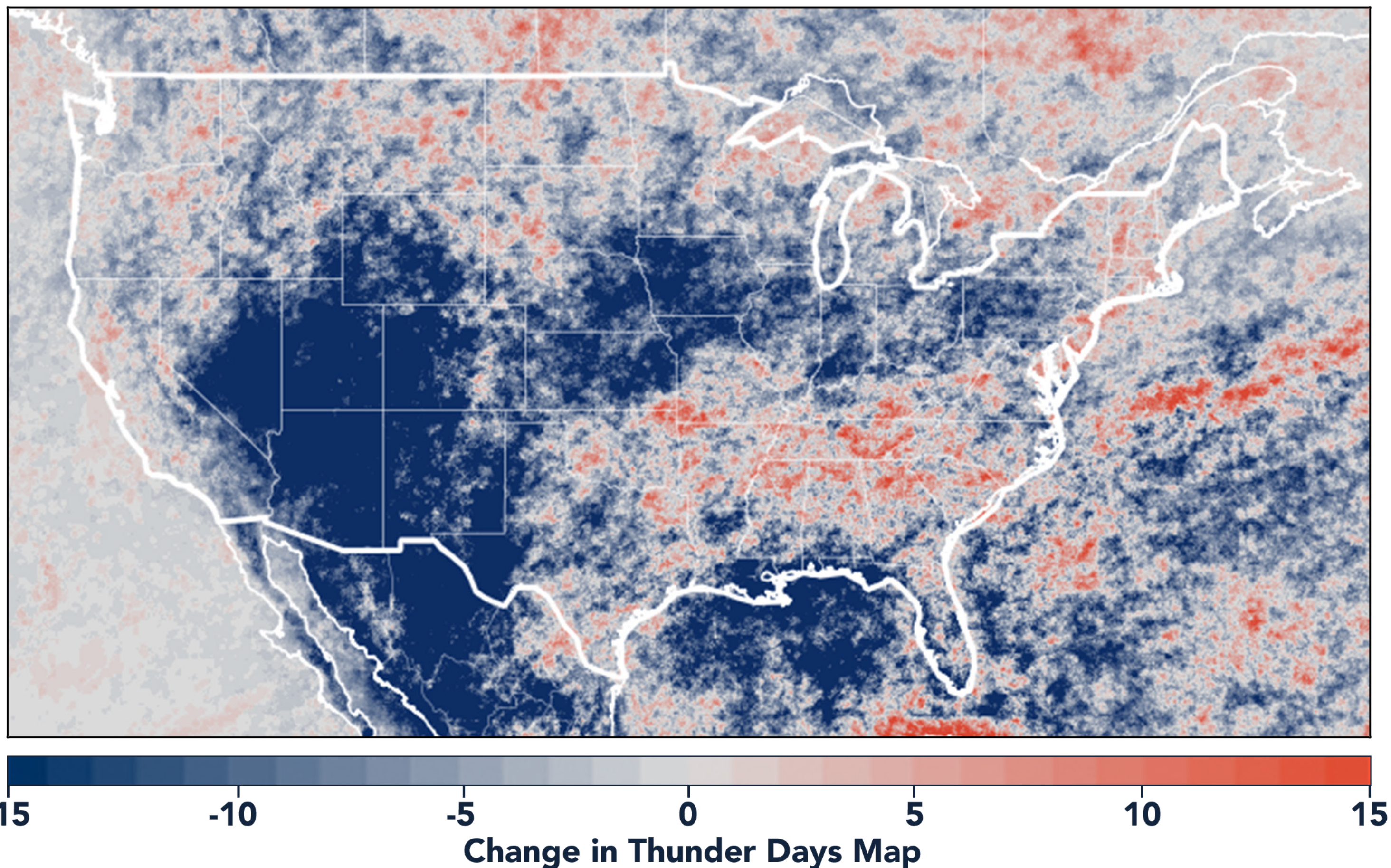
DANGEROUS THUNDERSTORM ALERTS IN THE U.S.



Earth Networks issued 29,401 Dangerous Thunderstorm Alerts (DTAs) in 2020. This year's map clearly shows the persistent drought conditions that have plagued the South and Southwest.

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

THUNDER DAYS



Thunder Days are the days we detected lightning over a certain area. The map shows a deviation from our 7-year average and illustrates our overall finding that lightning decreased about 15% from 2019.

This year, the Southwest and Midwest experienced significantly less lightning than in previous years due to a persistent drought and weak monsoon. States in the Southeast experienced a substantial uptick in lightning activity this year, including Tennessee, North Carolina, South Carolina, Virginia, West Virginia, Georgia, Alabama, Mississippi, Florida, Louisiana, Arkansas, and Kentucky.

2020 LIGHTNING RECAP:



MIDWEST

How did thunderstorms and destructive winds cause a deadly derecho?



SOUTHEAST

Did the Southeast really experience more tornado watches than Tornado Alley?



WEST & SOUTHWEST

Why was the wildfire season so severe despite decreased lightning activity in the South and Southwest?

Lightning data depicts a vivid story about weather and climate across the United States. In the second half of this report, we will focus on what the data means. The following case studies show the impact of several notable 2020 meteorological events shaped by severe weather.



MIDWEST

Dangerous Derecho

On August 10, 2020, midwestern states from Nebraska all the way east to Indiana experienced extreme winds and a powerful line of thunderstorms referred to as a “Derecho.” According to the National Weather Service, maximum estimated winds reached 140mph and the maximum unofficial wind gust was 126mph. This catastrophic derecho was an historic event for 2020.

This derecho was uniquely characterized by long lasting wind gusts, up to 60 minutes as opposed to a typical derecho length of 10 to 20 minutes. The midwestern cities affected by this derecho sustained extreme damage to homes, power lines, businesses, and barns. Semi-trucks were blown off major highways. This was the single most expensive thunderstorm on record due to millions of acres of crops being destroyed. This derecho occurrence supports our evidence of high lightning pulse density occurring in the Midwest this year, as well as Illinois being one of the top 5 states with the highest lightning counts during 2020.

EARTH NETWORKS DETECTED 491,983 LIGHTNING STRIKES



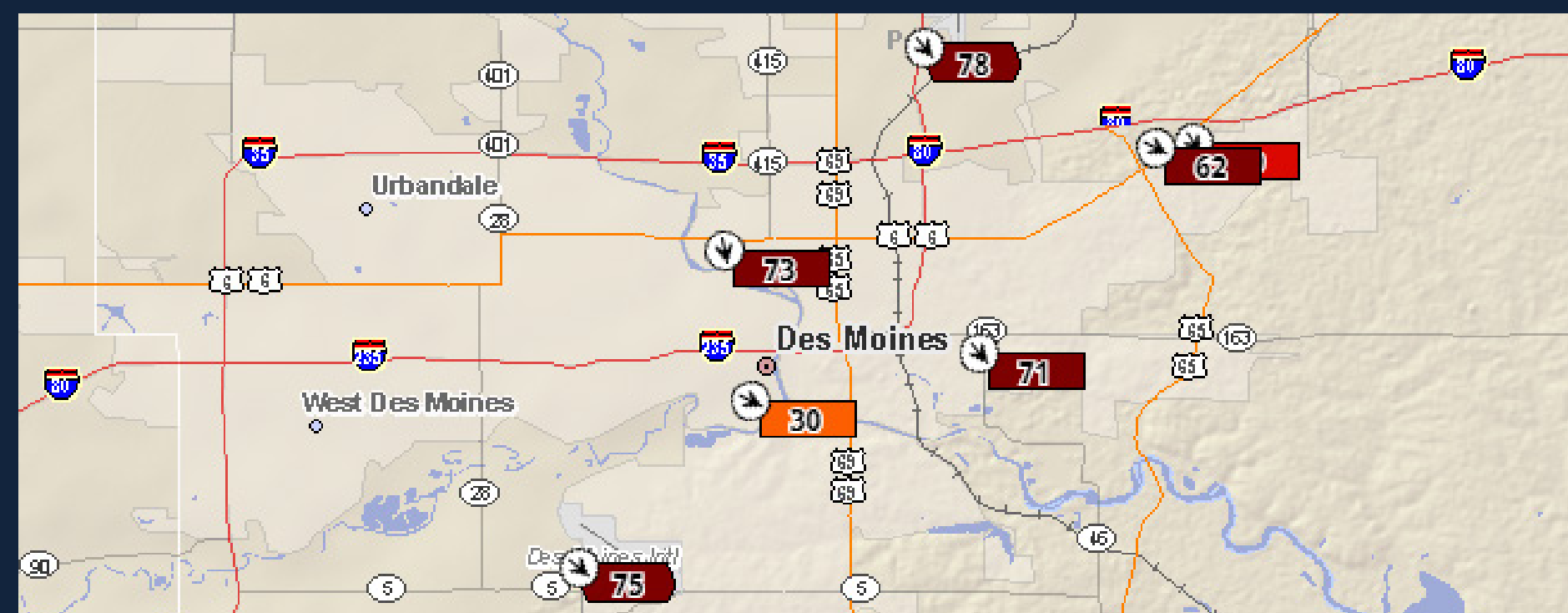
Cloud-to-ground
101,346



In-cloud
390,637

WHAT IS A DERECHO?

A powerful long-lived wind storm associated with a band of rapidly moving storms. Derechos usually travel in one direction along a relatively straight path.



Peak wind gusts in Des Moines, IA as seen on Sferic Maps during the storm.



An Earth Networks weather camera in Shorewood, IL gets pummeled during the derecho.

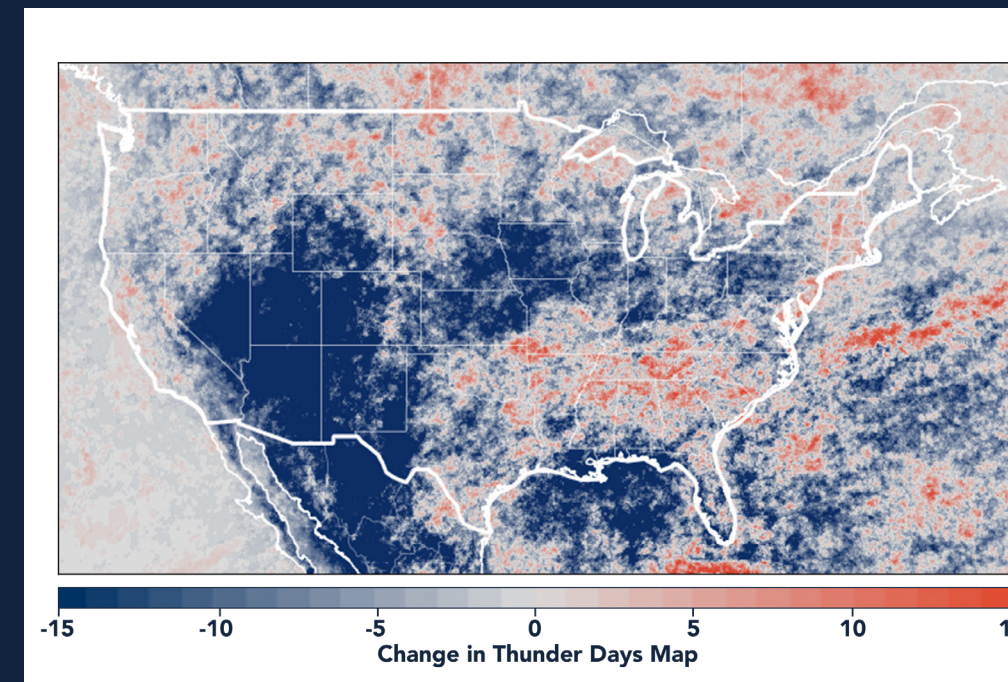


SOUTHEAST

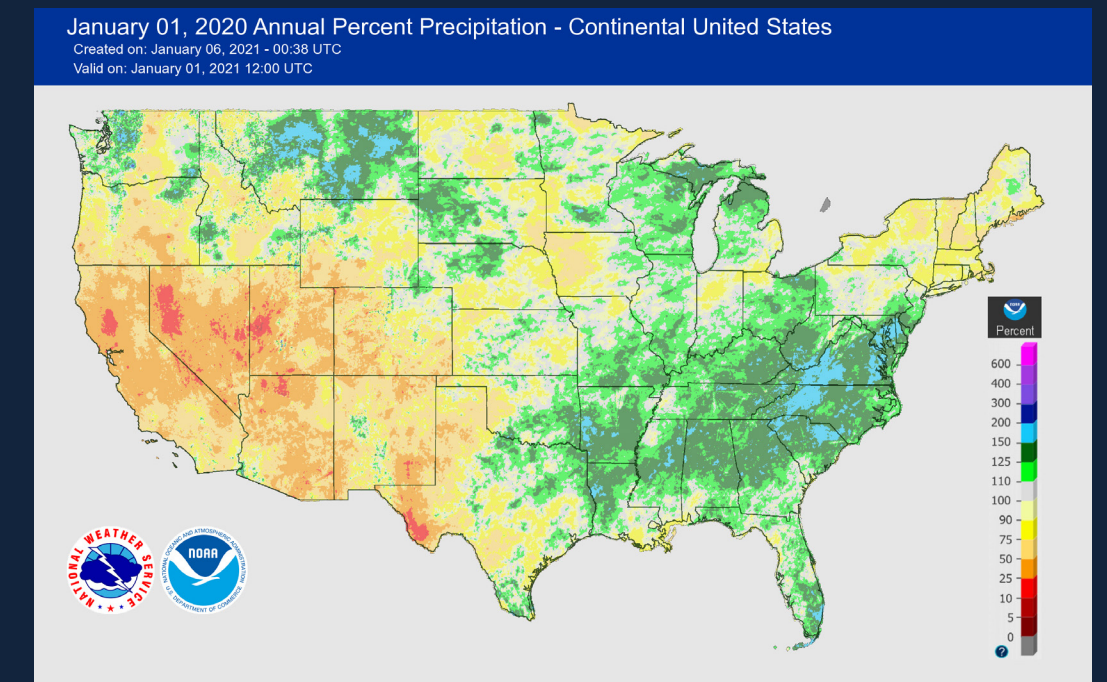
A Soaked Southeast

Highlighted in red on our Change in Thunder Days Map, the Southeastern U.S. has shown an increase in days affected by lightning over the 7-Year Average. There are two ways we see this manifested. First, in last year's report we profiled above-average tornadic activity in Tornado Alley. That's no surprise. But, in 2020 the NWS Storm Prediction Center actually issued more tornado watches for the Southeast (479) than for Tornado Alley (237).

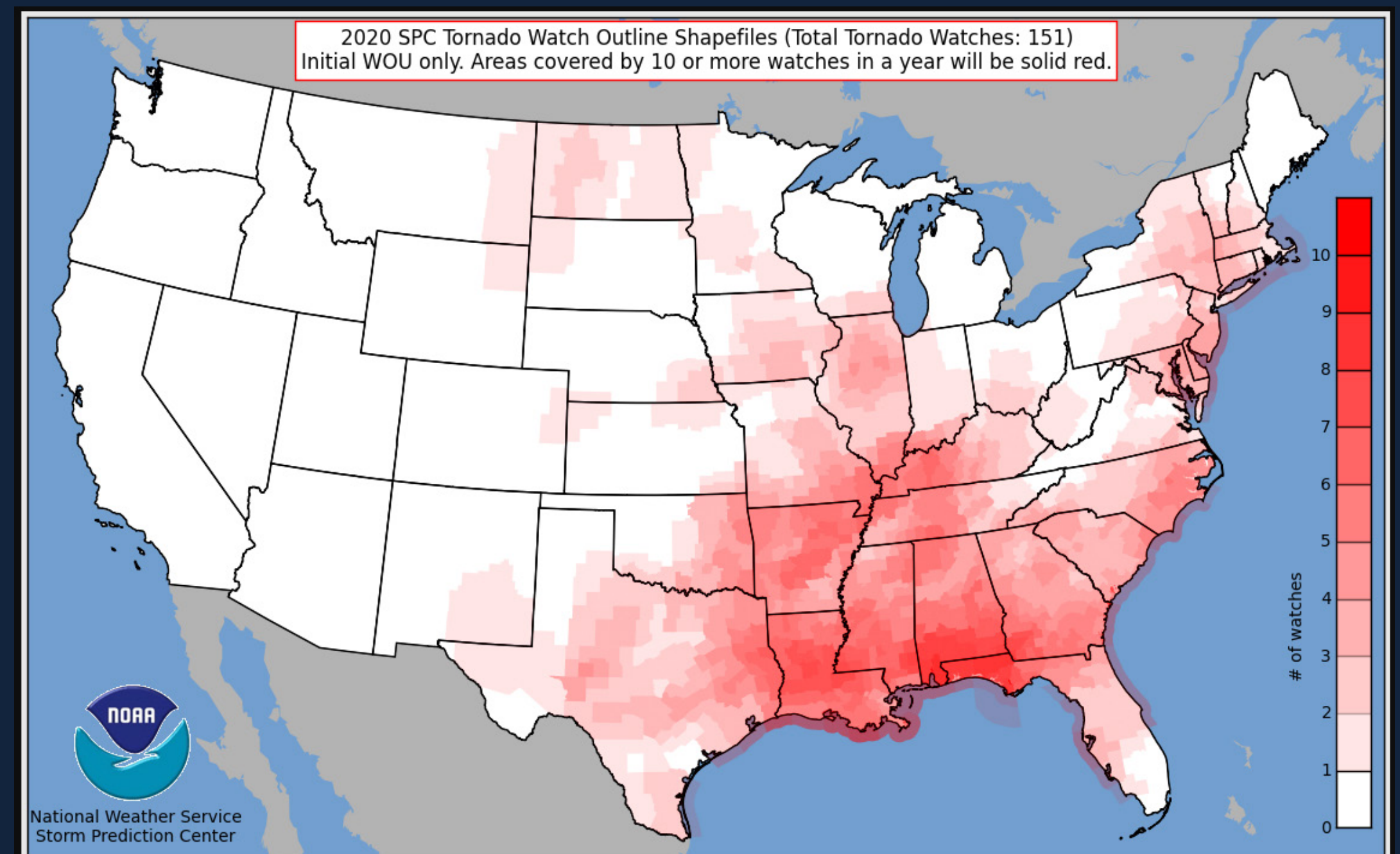
The solid red areas on the SPC Tornado Watch Map illustrate the areas most affected by severe weather. Second, this also correlates to a record-breaking tropical season, and the above-average rainfall that the Southeast has seen this year, which can be seen both on our Change in Thunder Days Map and the NOAA/NWS Annual Percent Precipitation Map shown here.



Earth Networks Change in Thunder Days Map



NOAA/NWS Annual Percent Precipitation Map



National Weather Service Storm Prediction Center Tornado Watches 2020



WEST AND SOUTHWEST

Devastating Drought

The West and Southwest U.S. are in an extreme drought. The deadly 2020 wildfire season was the worst on record for California, with more than 30 deaths, thousands of properties destroyed, and over 4.1 million acres burned. While wildfires can be caused by humans, the majority of serious large wildfires are caused by lightning.

But in a year where lightning activity was down in most of the South and Southwest, why was the wildfire season so bad? In mid-August, very hot and dry air contributed to a series of rare thunderstorms over the Bay Area. In August 2020 alone, Earth Networks issued over 30 Dangerous Thunderstorm Alerts in California.

The high temperatures and drought conditions meant that any rain during those thunderstorms evaporated between the cloud and the ground, setting up a very dangerous situation for wildfires. Warmer temperatures also led to drier surface vegetation, which in turn resulted in easier fire initiation and spreading.

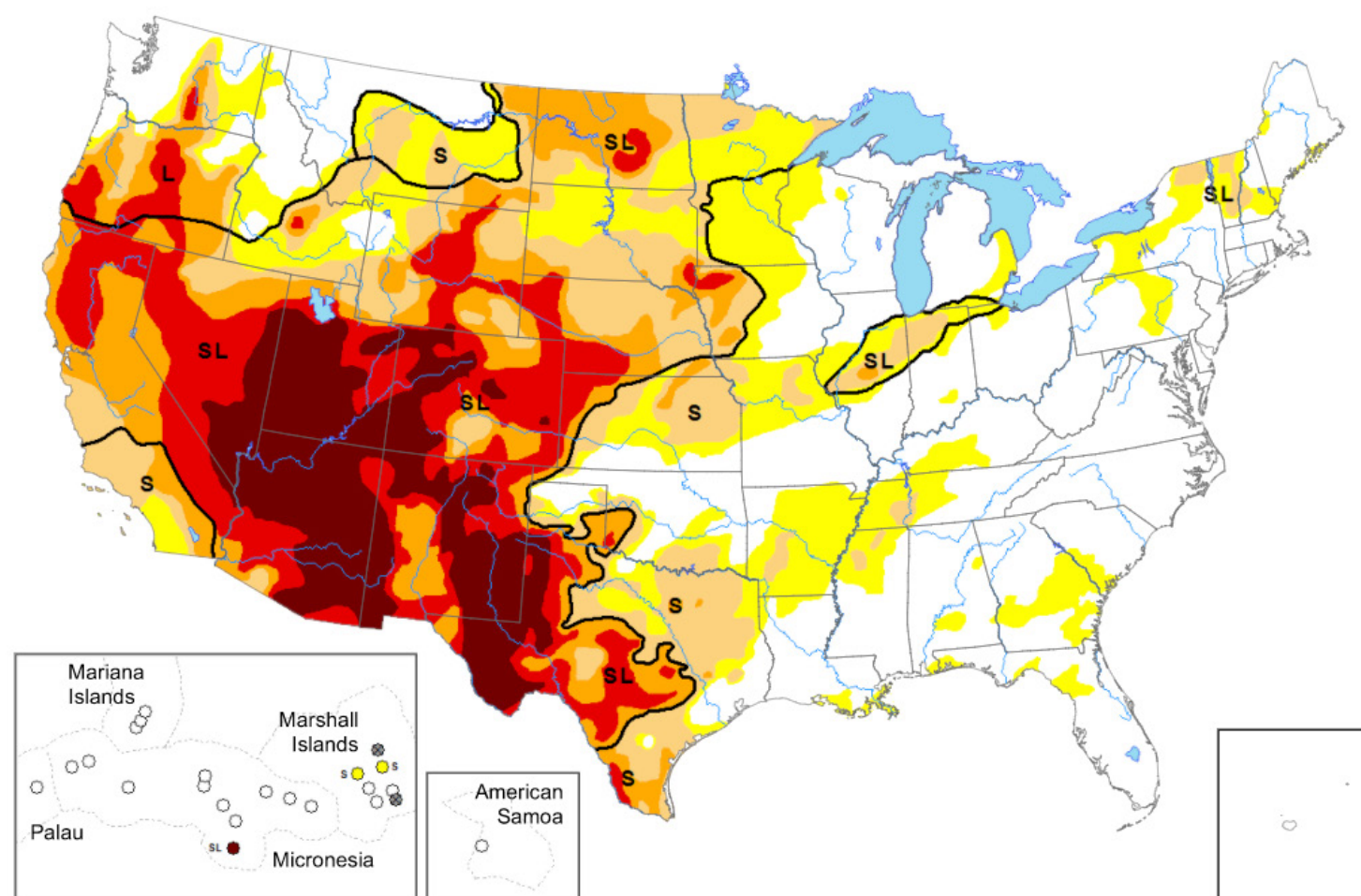
In addition to California, other western states such as Colorado and Oregon were affected by major wildfires. The image here depicts cloud-to-ground lightning that happened between August 16 and 19, 2020 in the regions affected by lightning-caused wildfires.



20,000+ lightning strikes were detected by ENTLN

Map released: December 31, 2020

Data valid: December 29, 2020



Drought Monitor Map



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THANK YOU

For additional insights or permission to use data or graphics from this report, please contact us at: info@earthnetworks.com or call 1 301.250.4000



APPENDIX

This table ranks all U.S. states by total lightning pulses, including in-cloud and cloud-to-ground from highest to lowest. Total number of thunder days in each state (the total number of days in the year when lightning was detected by ENTLN) are also included. The period covered is January 1, 2020 to December 31, 2020.

STATE	TOTAL LIGHTNING PULSES	TOTAL THUNDER DAYS
TX	63,683,799	278
FL	35,430,198	246
OK	26,159,420	205
KS	23,125,675	179
IL	16,785,149	166
NE	14,433,875	178
MO	14,081,658	184
VA	13,234,163	176
GA	13,016,803	217
OH	12,009,955	143
SD	11,940,870	156
LA	11,787,379	230
AL	11,448,621	202
AR	11,417,155	211
NC	10,666,834	203
PA	10,024,978	151
MS	9,236,279	210
IN	9,175,986	149
IA	9,121,097	140
WI	8,812,327	145
TN	8,458,373	186
MN	8,009,792	148
KY	7,974,926	166
MI	7,769,382	159
ND	7,634,287	131
SC	7,454,219	197
CO	7,360,769	185
MD	6,666,766	124
NM	5,819,550	196
MT	5,107,593	154
WY	4,951,397	166
NY	4,943,122	152
WV	4,684,226	150
AZ	3,532,759	151
NJ	3,465,297	96
UT	1,951,574	162
ID	1,518,171	172
MA	1,267,046	80
NV	1,237,862	146
DE	1,168,918	89
CA	956,187	151
OR	915,855	132
CT	802,252	70
NH	618,242	70
WA	402,333	117
ME	358,334	81
VT	354,695	75
RI	190,992	42
DC	44,204	47

APPENDIX

This table ranks the Top 100 U.S. counties by total lightning pulses including in-cloud and cloud-to-ground from highest to lowest. Total number of thunder days in each county (the total number of days in the year when lightning was detected by ENTLN) are also included. The period covered is January 1, 2020 to December 31, 2020.

COUNTY	STATE	TOTAL LIGHTNING PULSES	TOTAL THUNDER DAYS
Collier County	FL	2,178,694	153
Palm Beach County	FL	2,139,534	170
Polk County	FL	1,734,884	153
Hendry County	FL	1,292,001	158
Cherry County	NE	1,248,515	96
Highlands County	FL	1,185,866	148
Brevard County	FL	1,148,195	131
Glades County	FL	1,134,569	148
Osceola County	FL	1,115,022	142
Lee County	FL	1,078,696	141
Volusia County	FL	1,026,044	137
Broward County	FL	1,014,773	158
Osage County	OK	991,376	93
Miami-Dade County	FL	975,834	161
Harris County	TX	910,208	125
Okeechobee County	FL	853,888	142
McCurtain County	OK	846,562	103
Monroe County	FL	832,231	175
Hillsborough County	FL	807,880	139
Le Flore County	OK	805,769	96
Marion County	FL	794,335	140
Cameron Parish	LA	788,458	132
Orange County	FL	782,757	132
Martin County	FL	777,224	143
Brazoria County	TX	739,476	105
Clay County	TX	724,218	65
Lamar County	TX	692,713	81
Meade County	SD	678,221	77
Custer County	NE	673,672	78
Lake County	FL	668,383	135
Sabine Parish	LA	667,911	99
Vernon Parish	LA	662,578	111
Charlotte County	FL	659,745	141
Wise County	TX	652,045	68
Webb County	TX	650,705	74
Cooke County	TX	642,156	67
Union County	NM	628,785	101
Manatee County	FL	628,547	129
Denton County	TX	626,056	70
Pittsburg County	OK	619,219	90
Comanche County	OK	609,193	72
St. Lucie County	FL	598,187	132
Charles County	MD	581,710	66
Butler County	KS	577,947	64
Houston County	TX	577,016	102
Pushmataha County	OK	568,370	88
Sarasota County	FL	567,549	123
Cook County	IL	565,399	76
Lincoln County	NE	552,878	81
Montague County	TX	551,721	64

COUNTY	STATE	TOTAL LIGHTNING PULSES	TOTAL THUNDER DAYS
Val Verde County	TX	546,500	72
Campbell County	WY	546,384	85
Prince George's County	MD	544,786	62
Perkins County	SD	537,963	61
DeSoto County	FL	537,835	128
Baltimore city	MD	535,494	101
Jack County	TX	533,421	63
Walker County	TX	529,562	98
Anne Arundel County	MD	524,052	63
Pasco County	FL	514,168	127
Anderson County	TX	512,742	91
Grady County	OK	509,353	76
Las Animas County	CO	505,836	111
Colfax County	NM	505,510	113
Cowley County	KS	504,568	72
Montgomery County	TX	503,728	103
Garvin County	OK	496,793	74
Beauregard Parish	LA	494,780	109
Natchitoches Parish	LA	494,738	113
Stephens County	OK	489,324	67
Indian River County	FL	488,958	125
Pima County	AZ	488,870	83
Coconino County	AZ	488,214	96
Wilbarger County	TX	485,437	67
Navarro County	TX	482,564	75
Carter County	OK	478,940	71
Hardee County	FL	477,199	134
Yuma County	CO	470,765	84
Dallas County	TX	465,850	68
Ellis County	TX	462,891	69
Pennington County	SD	462,067	84
Matagorda County	TX	460,374	93
Choctaw County	OK	459,586	78
Tillman County	OK	459,470	70
Calcasieu Parish	LA	457,789	117
McLean County	IL	453,407	64
Liberty County	TX	451,289	119
Crook County	WY	450,837	77
Putnam County	FL	449,968	126
Kent County	DE	448,167	60
Grayson County	TX	447,213	68
Holt County	NE	443,782	64
Duval County	FL	443,404	112
Sussex County	DE	442,970	75
Edwards County	TX	442,367	66
Dorchester County	MD	440,662	71
Haakon County	SD	439,056	63
Levy County	FL	438,735	126
Smith County	TX	437,411	87
Fort Bend County	TX	435,691	94

REFERENCES

“Current Map.” *U.S. Drought Monitor*, droughtmonitor.unl.edu/.

US Department of Commerce, NOAA. *AHPS Precipitation Analysis*, water.weather.gov/precip/.

US Department of Commerce, NOAA. “August 10, 2020 Derecho.” *National Weather Service*, NOAA’s National Weather Service, 27 Sept. 2020, www.weather.gov/dmx/2020derecho.

US Department of Commerce, NOAA. “Midwest Derecho - August 10, 2020, Updated: 10/8/20 12 Pm.” *National Weather Service*, NOAA’s National Weather Service, 9 Oct. 2020, www.weather.gov/dvn/summary_081020.