EARTH NETWORKS®

2019 EUROPE

TOTAL LIGHTNING REPORT

ABOUT THIS REPORT

The 2019 Europe Lightning Report was prepared by Earth Networks using the Earth Networks Global Lightning Network (ENGLN). The following report includes in-cloud, cloud-to-ground, and total lightning data from 33 countries in Continental Europe and the surrounding water bodies during 2019. Flash counts, rankings, Thunder Days, and Dangerous Thunderstorm Alerts (DTAs) in this report are from January 1, 2019 to December 31, 2019.

THE EARTH NETWORKS GLOBAL LIGHTNING NETWORK (ENGLN)

The lightning data in this report is derived from the Earth Networks Global Lightning Network (ENGLN), which monitors the combination of in-cloud and cloud-to-ground lightning strikes over 100 countries. With over 1,800 sensors, the ENGLN is the most extensive and technologically advanced total lightning network in the world. ENGLN 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 this insightful lightning report, we've included definitions of our frequently used report terminology below.

Lightning Pulse: A specific in-cloud or cloud-to-ground lightning strike

Lightning Flash: This report measures lightning flashes. A lightning flash is the complete bolt of lightning including the many forked branches. A single flash is a collection of pulses close in space and time. A cloud-to-ground flash contains one or more cloud-to-ground pulses

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

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

23,802,513

TOTAL LIGHTNING STRIKES

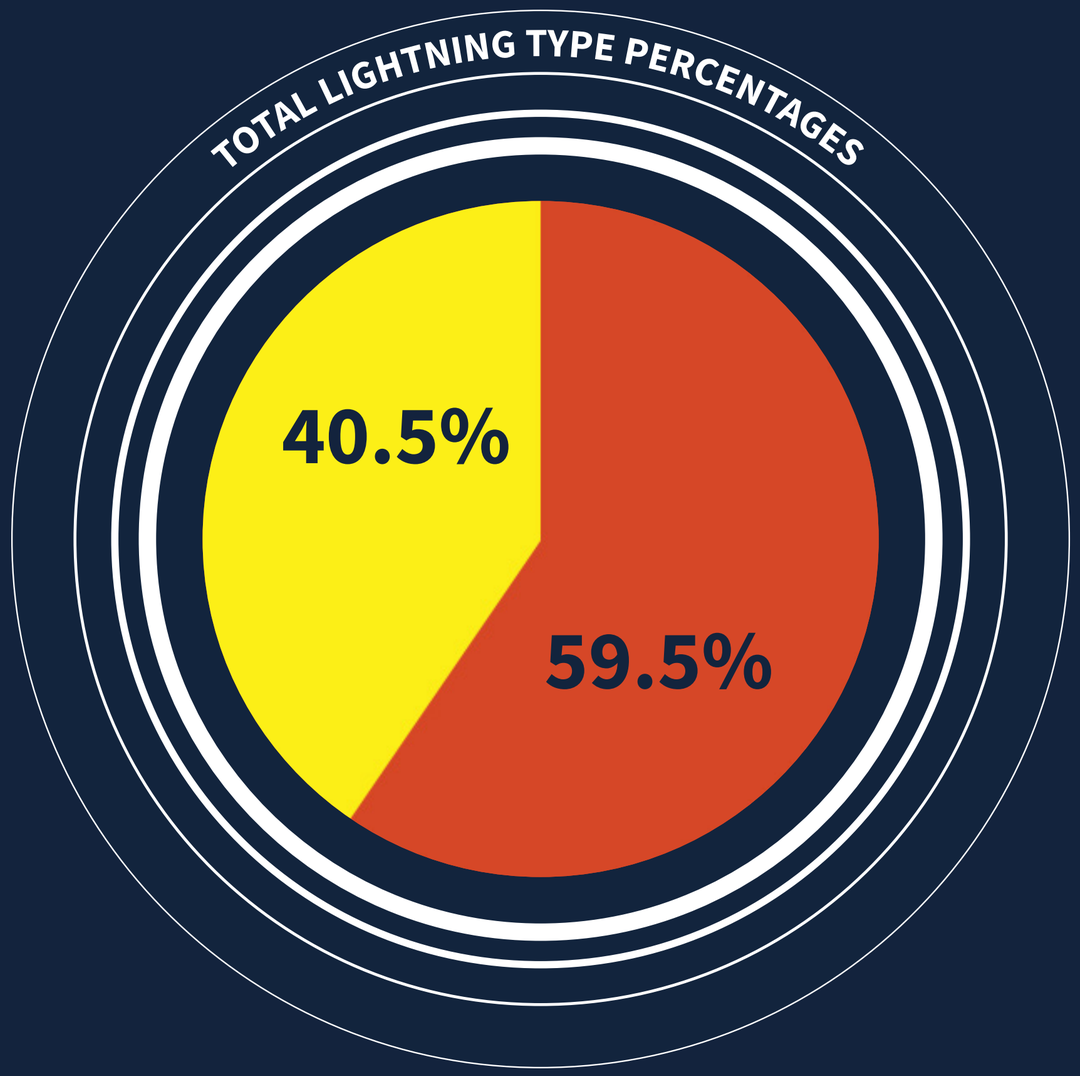
TOTAL LIGHTNING

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

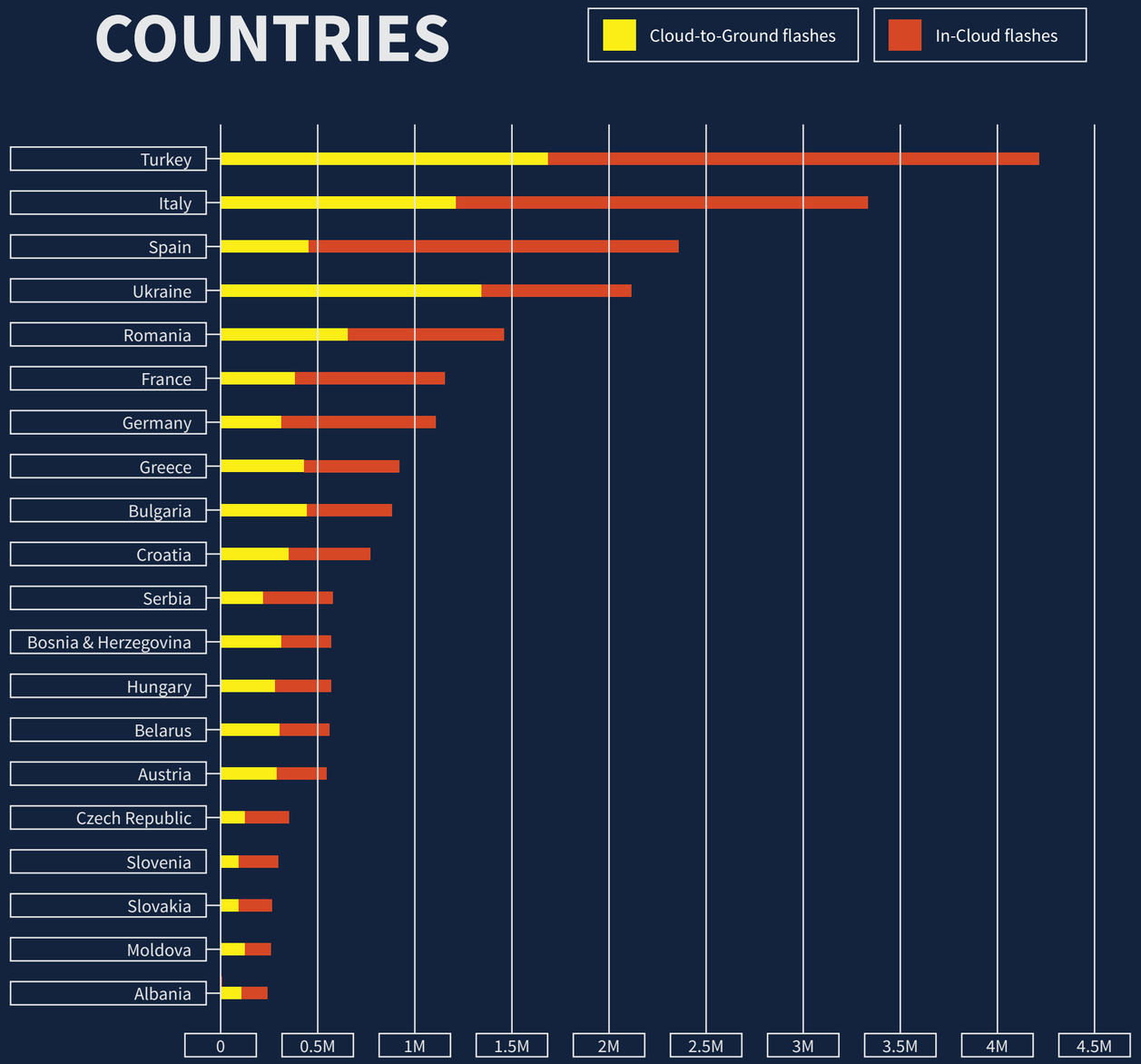
14,152,545
In-Cloud



9,649,968
Cloud-to-Ground

LIGHTNING FLASH COUNT COUNTRY RANKINGS

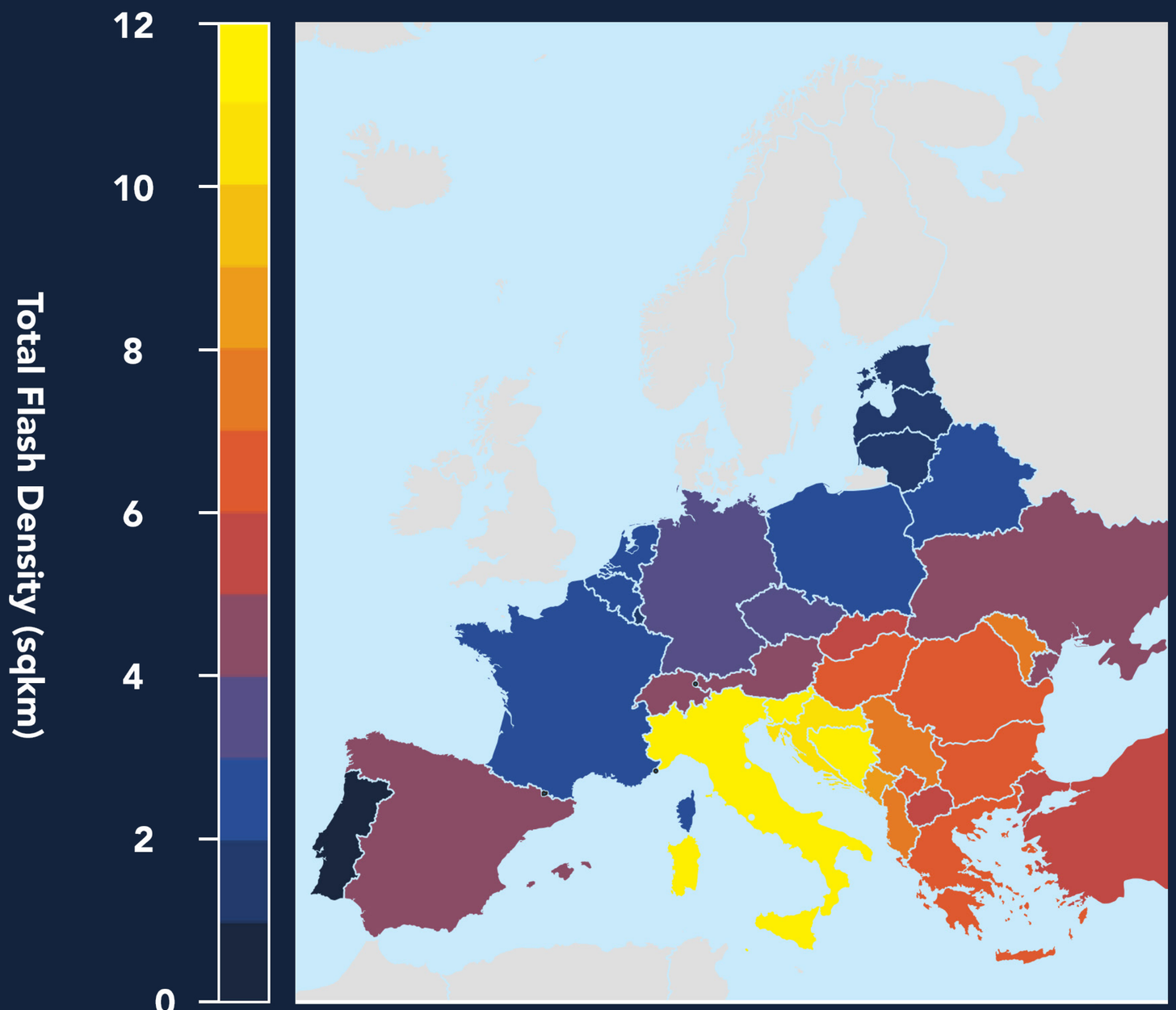
Which European countries saw the most total lightning flashes in 2019?



Country	Cloud-to-Ground Count	In-Cloud Count	Total Count
Turkey	**1,689,773**	**2,527,319**	**4,217,092**
Italy	**1,203,419**	**2,127,954**	**3,331,373**
Spain	**447,235**	**1,908,356**	**2,355,591**
Ukraine	**1,340,472**	**775,719**	**2,116,191**
Romania	**650,461**	**806,954**	**1,457,415**

Europe’s most active country for total lightning flashes in 2019 was Turkey, with 4,217,092 total flashes comprised of 2,527,319 in-cloud strikes and 1,689,773 potentially deadly cloud-to-ground strikes. We detected nearly 1 million less total flashes in the second place country, Italy. Spain, Ukraine, and Romania rounded out the top five European countries with the most total lightning flashes.

TOTAL (IC + CG) FLASH DENSITY MAP



Since large countries often see more lightning flashes than smaller countries, we use lightning density to better compare countries of different sizes. Total flash density is the number of total lightning flashes in a country divided by that country's area (in square kilometers).

The 2019 Europe Total Flash Density map shows us several yellow hot spots along the Adriatic Sea, including Italy, Slovenia, Croatia, and Bosnia and Herzegovina. This is most likely due to the rise of the Sea Surface Temperature (SST) for the Mediterranean in regards to to Climate Change.

TOTAL (IC + CG) FLASH DENSITY RANKINGS

The visible hotspots on the map account for four out of the top 10 European countries for flash density. Completing the top ten include other countries along the Adriatic Sea, including Montenegro, Serbia, Albania, Moldova, and Bulgaria.

Country	Cloud-to-Ground Density	In-Cloud Density	Total Density
Slovenia	**1.65**	**8.51**	**13.09**
Bosnia & Herzegovina	**1.66**	**5.69**	**11.09**
Italy	**1.47**	**7.06**	**11.05**
Croatia	**1.35**	**6.25**	**10.27**
Montenegro	**1.17**	**4.27**	**8.84**
Serbia	**1.30**	**3.67**	**7.36**
Albania	**0.77**	**3.75**	**7.26**
Moldova	**1.44**	**3.99**	**7.15**
Bulgaria	**1.25**	**3.84**	**6.99**

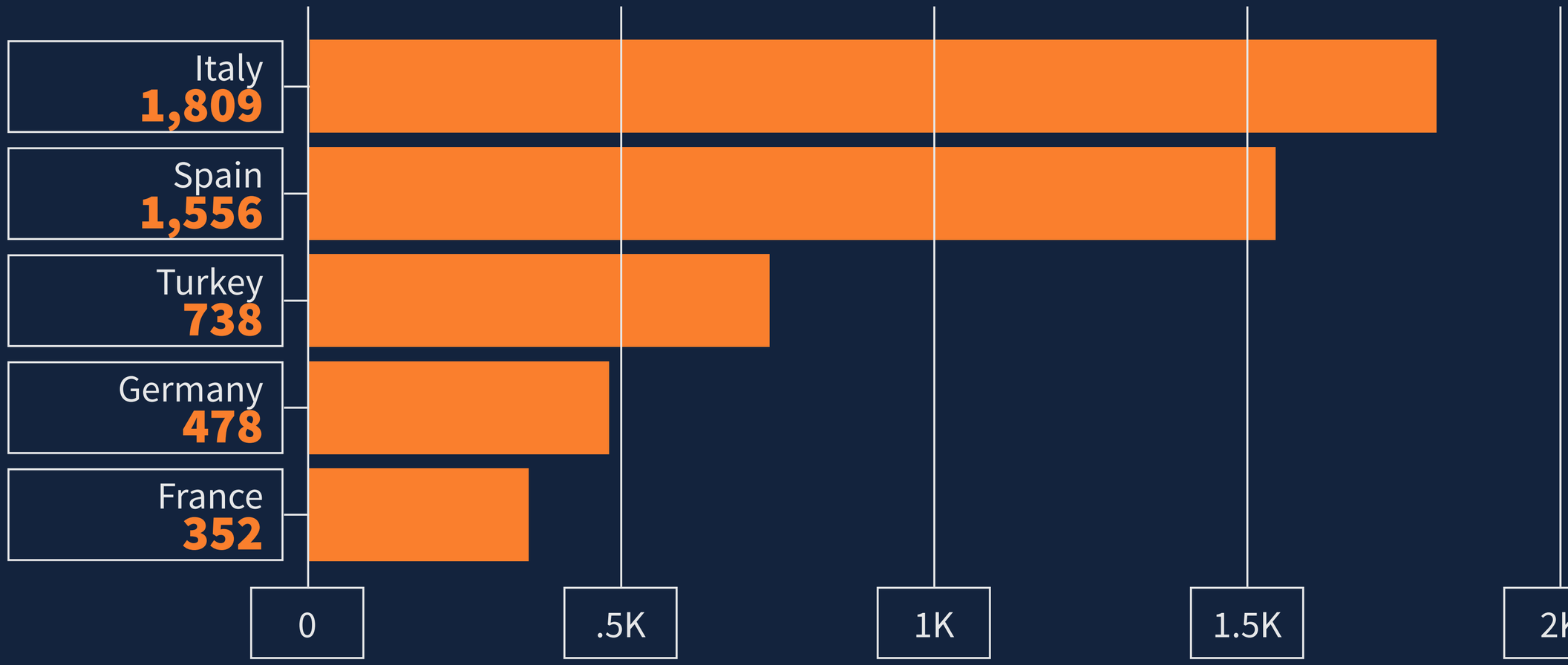
Flash Count vs. Flash Density in Action

Although we detected the most total lightning flashes in Turkey, it doesn't make the top 10 or even the top 15 countries for flash density. That's because Turkey is so much bigger than these other countries with more flashes per square kilometer.

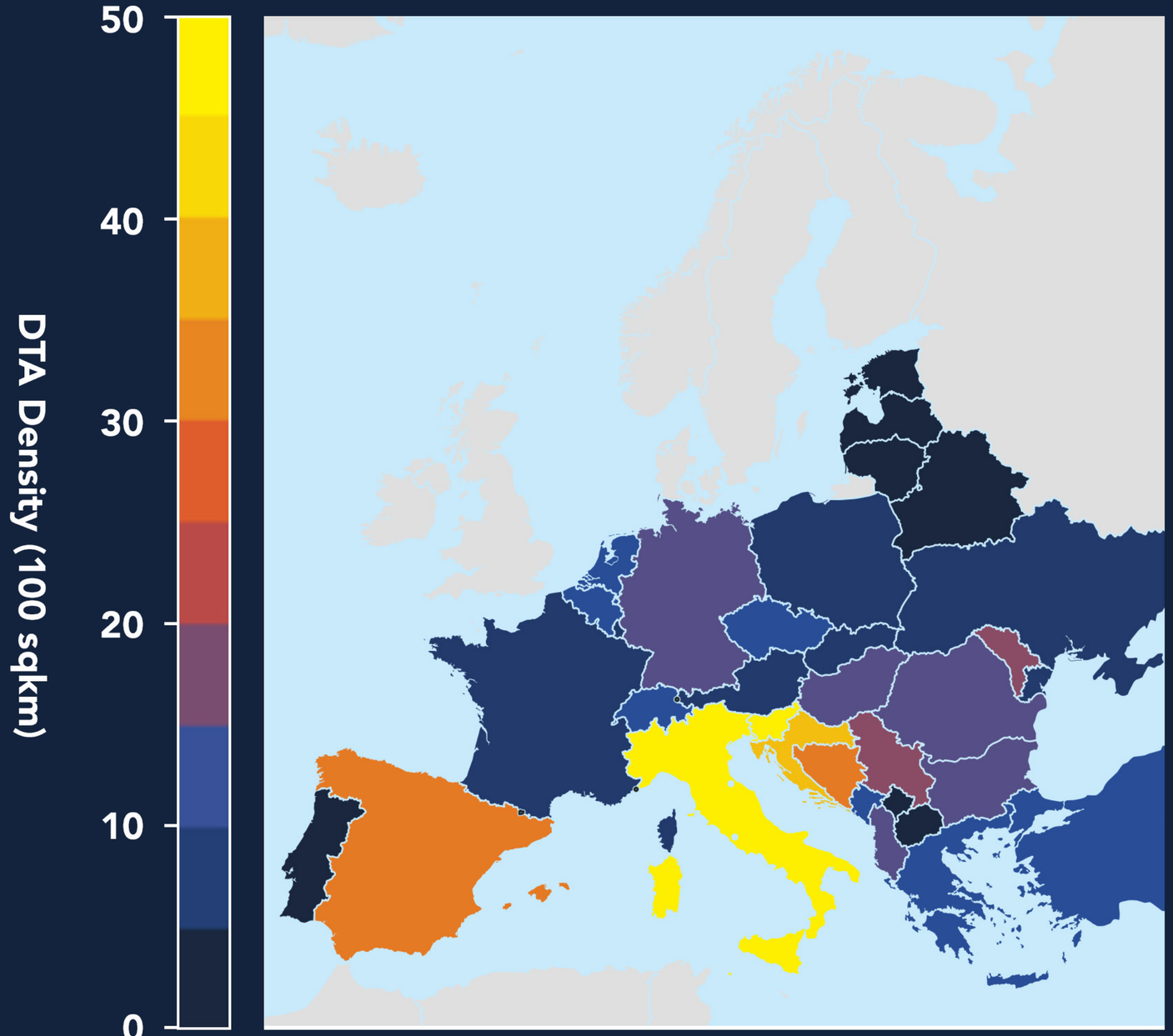
DANGEROUS THUNDERSTORM ALERTS

The ENGLN generated 7,372 Dangerous Thunderstorm Alerts (DTAs) throughout Europe in 2019. Italy and Spain were the only two countries with over 1,000 DTAs each. Turkey, Germany, and France completed the top five.

TOP 5 COUNTRIES - DTAs



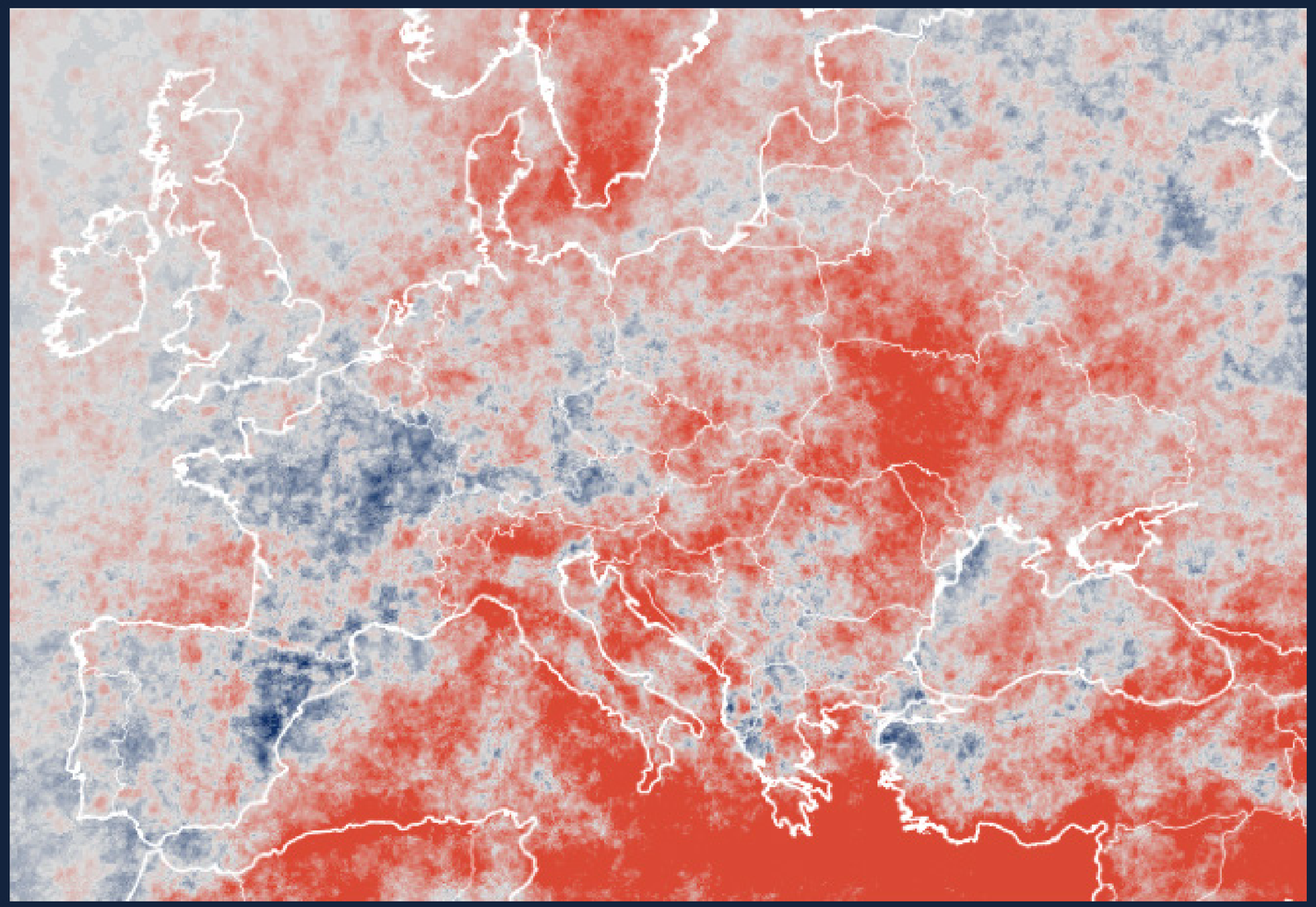
DANGEROUS THUNDERSTORM ALERTS DENSITY MAP



As with the difference between lightning flash counts and densities, DTA counts and densities also tell different stories.

This DTA density map shows that while Turkey, Germany, and France had a lot of DTAs due to their larger sizes, they didn't have as many per square kilometer and therefore didn't see storms as intense as places along the Mediterranean Sea.

THUNDER DAY ANOMALIES



Sometimes smaller storms can have a big impact, especially when you aren't expecting them. That's why we calculated Thunder Days, or the days we detected lightning over a certain area. The map shows the deviation of Thunder Days from normal. By "normal" we mean the average of thunder days according to ENGLN data over the last seven years.

This anomaly map shows that a lot of areas in Europe – especially over the Mediterranean and Adriatic Seas – have seen more Thunder Days in 2019 than normal. The dark blue areas indicate places that saw less Thunder Days than the seven-year average.

KEY FINDINGS BY GEOGRAPHY

There is a lot we can learn from lightning flashes, Dangerous Thunderstorm Alerts, and Thunder Days throughout Europe.

THE CENTRAL AND WESTERN MEDITERRANEAN

1

The increase of overall lightning activity including high flash densities, DTA counts and densities, and Thunder Days in the Central and Western Mediterranean can be linked to the rising of the Sea Surface Temperature (SST) of the Mediterranean due to Climate Change. With more heat and moisture comes more severe thunderstorms. Areas like France, Italy, southern Germany, Switzerland, western Austria, the Balkans, Greece, Turkey, Malta, and Cyprus are the most vulnerable areas.

WESTERN EUROPE

2

In 2019, Thunder Days and overall lightning activity increased in western Europe because of dry Tropical-Continental (TC) air masses. These air masses visited western Europe during the late spring, summer, and early fall. The TC air masses originated over the western and central Sahara and affected western Europe more frequently than average, leading to severe droughts in the area during 2019.

EARTH NETWORKS IN EUROPE

The best way to mitigate the financial, operational, and human risks associated with lightning strikes is with advanced monitoring and alerting technologies. Hundreds of organizations throughout Europe already rely on real-time lightning solutions from Earth Networks. Below are just some of the organizations that improve their operations with total lightning solutions.

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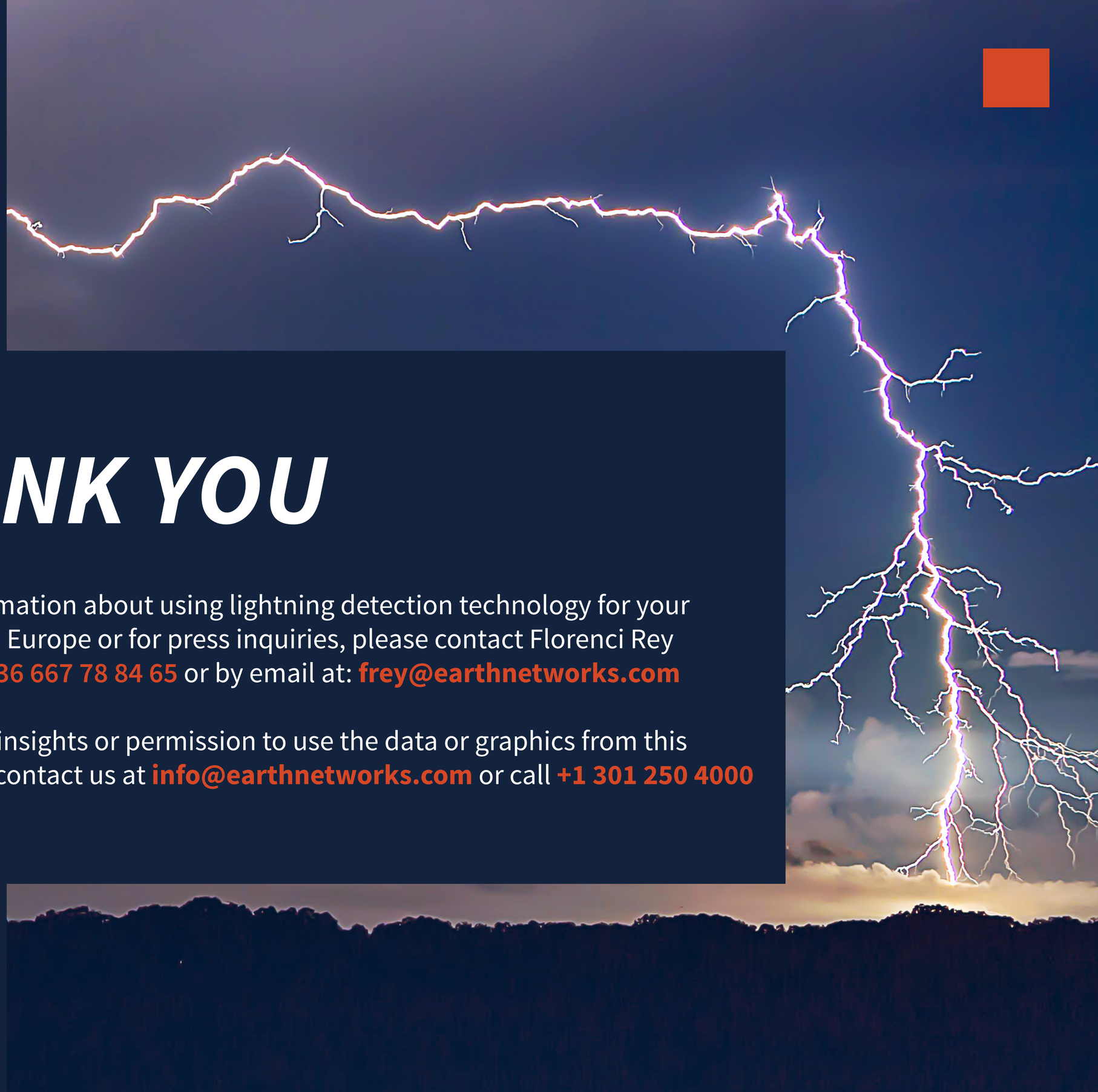
THANK YOU

For more information about using lightning detection technology for your organization in Europe or for press inquiries, please contact Florenci Rey Benadero at **+ 36 667 78 84 65** or by email at: **frey@earthnetworks.com**

For additional insights or permission to use the data or graphics from this report, please contact us at **info@earthnetworks.com** or call **+1 301 250 4000**



APPENDIX

STATE	CLOUD-TO-GROUND	IN-CLOUD	TOTAL COUNT	NUMBER OF TDA ALERTS	NUMBER OF THUNDER DAYS
Albania	100,698	108,020	208,718	45	161
Austria	120,859	229,025	349,884	47	140
Belarus	288,646	263,481	552,127	61	111
Belgium	22,722	57,495	80,217	34	71
Bosnia and Herzegovina	275,933	291,410	567,343	160	164
Bulgaria	349,825	426,662	776,487	167	153
Croatia	227,112	354,174	581,286	229	189
Cyprus	18,876	28,918	47,794	9	103
Czech Republic	94,065	202,969	297,034	93	103
Estonia	31,639	19,219	50,858	0	57
France	382,980	775,719	1,158,699	352	322
Germany	308,528	800,658	1,109,186	478	167
Greece	453,927	434,042	887,969	160	246
Hungary	231,185	335,201	566,386	122	121
Italy	1,203,419	2,127,954	3,331,373	1,809	299
Kosovo	35,015	30,719	65,734	3	83
Latvia	52,067	35,868	87,935	0	71
Lithuania	36,435	30,015	66,450	2	77
Luxembourg	1,362	2,416	3,778	1	29
Macedonia	71,612	60,936	132,548	8	101
Malta	1,151	609	1,760	0	41
Moldova	106,819	135,371	242,190	68	99
Montenegro	63,215	58,992	122,207	17	137
Netherlands	34,123	71,897	106,020	51	90
Poland	424,124	496,946	921,070	149	152
Portugal	25,985	37,853	63,838	9	82
Romania	650,461	806,954	1,457,415	326	157
Serbia	286,083	284,479	570,562	145	137
Slovakia	123,746	135,497	259,243	37	109
Slovenia	92,977	172,539	265,516	106	122
Spain	447,235	1,908,356	2,355,591	1,556	213
Switzerland	56,899	125,113	182,012	41	121
Turkey	1,689,773	2,527,319	4,217,092	738	319
Ukraine	1,340,472	775,719	2,116,191	349	181
TOTALS	9,649,968	14,152,545	23,802,513	7,372	4,728

* Lightning flash count data from January 1, 2019 - December 31, 2019