

# XSICEL 2021


Transición energética en la 4ta revolución industrial



Universidad  
Tecnológica  
de Pereira



UNIVERSIDAD  
**NACIONAL**  
DE COLOMBIA



# Identification of areas and elevated structures with the greatest amount of lightning impacts (Hotspots)

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# Contents

- I. Introduction
- II. Antecedents of the study of lightning flashes in Colombia
- III. Methodology
- IV. Results
- V. Conclusions

# I. Introduction - Hotspots





# I. Introduction - Data

**Losses**  
in oil production in  
Colombia  
**40**  
%

**Damage**  
in telecom.  
antennas  
**60%**

**Failures**  
in transmission  
lines  
**70**  
%



**Understanding +  
Characterization**



**Design of LPS and mitigation plans**

## II. Antecedents of the study of lightning flashes in Colombia

- The first characterization of lightning parameters was made between 1974 and 1988 with the first map that indicates the Keraunic Level (KN).
- KN measures the number of stormy days per year in a given region but is not very useful in determining the places with the highest lightning activity.
- The parameter of Ground Flash Density GFD is used, which measures lightning flashes per square kilometer per year as in (1).

$$GFD = k \times KN^a \quad (1)$$

Where k and a are valid constants for the places where they were developed.

# Colombian Total Lightning Detection Network with LINET technology



- Came into operation since September 2011

- Detects intra-cloud (IC) and cloud to ground (CG) lightning flashes

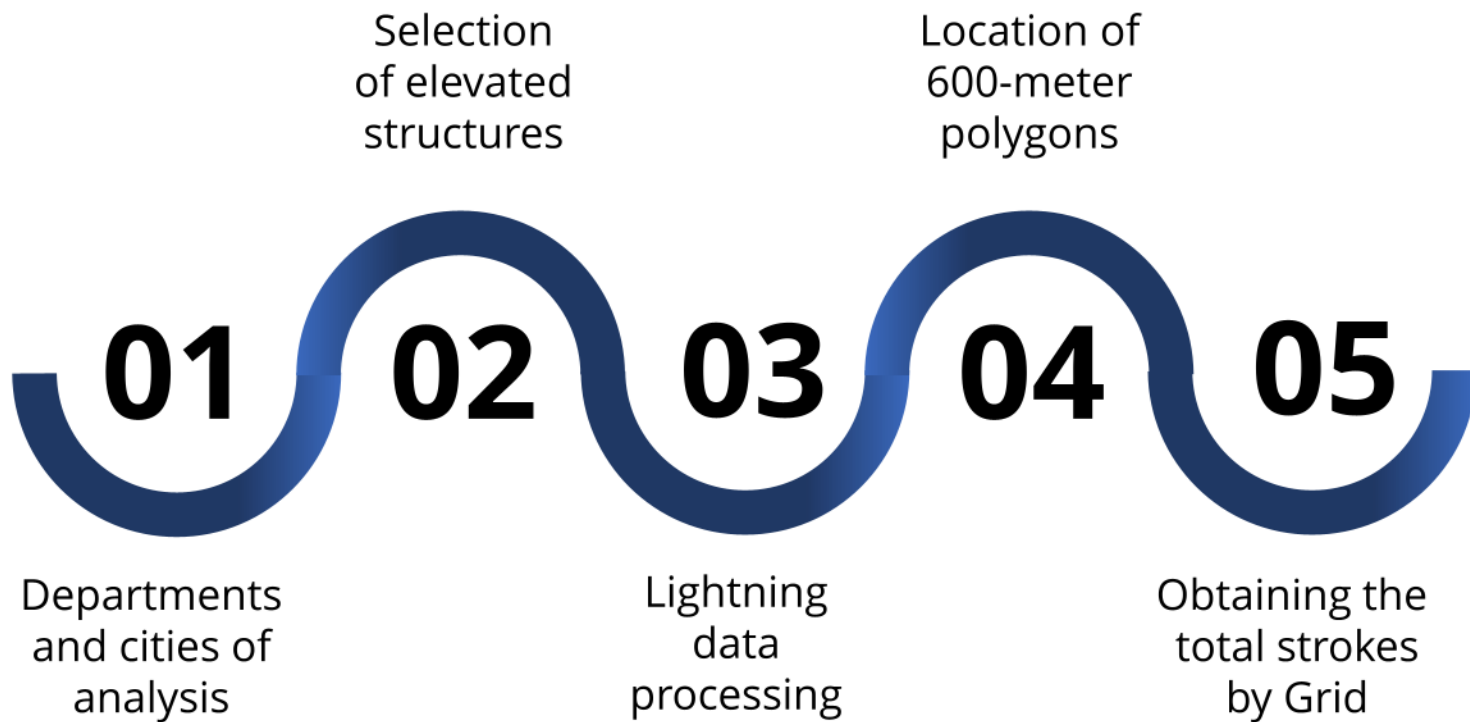
- Thirty stations are located in Colombia at distances between 120-240 km.

- Errors below 300 m and efficiencies above 90%

- Each station consists of a magnetic field antenna and a GPS

- Provides data of time, latitude, longitude, amplitude, polarity, and type

# III. Methodology

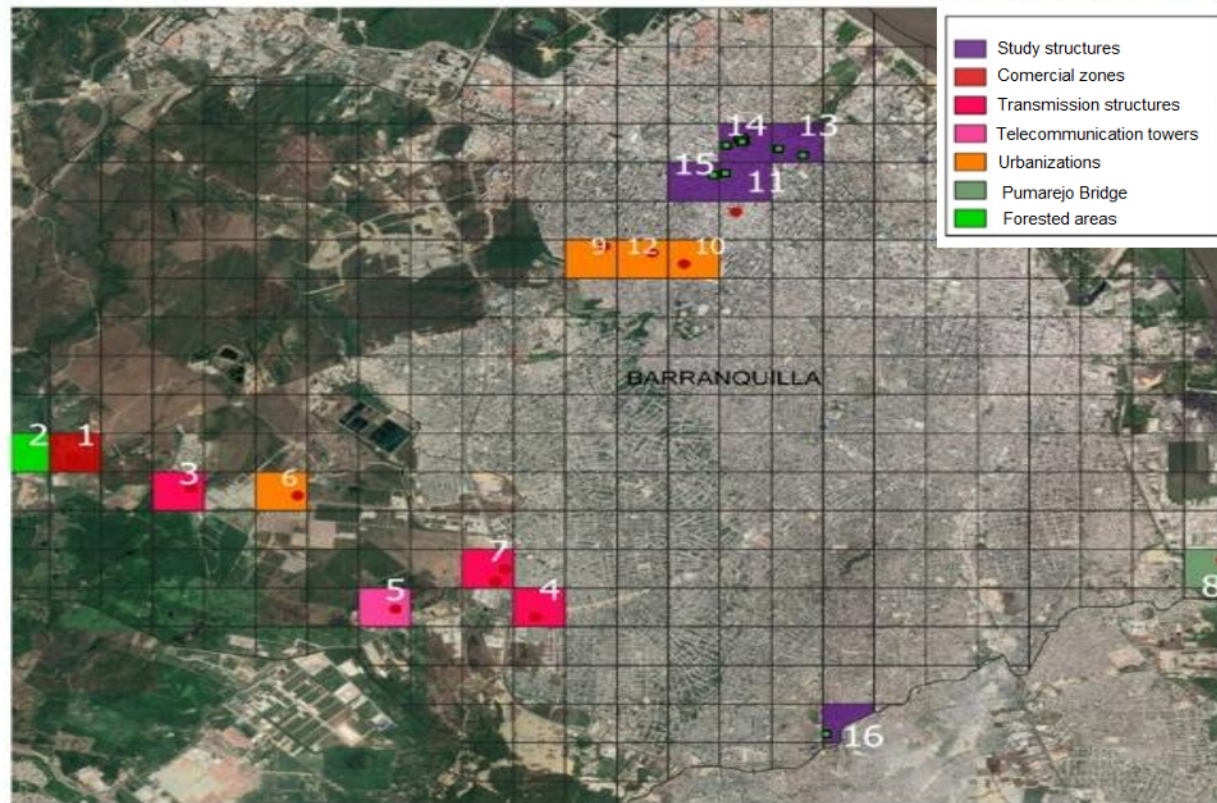


## IV. Results





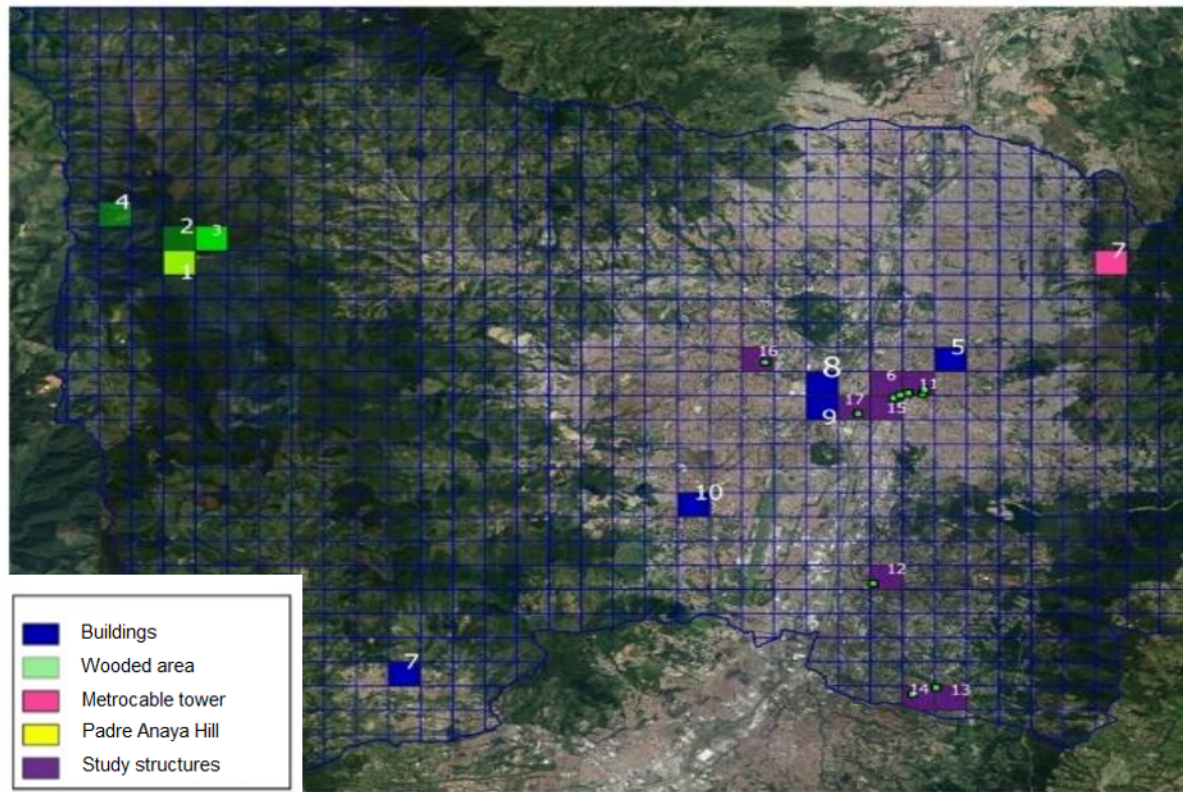
# Barranquilla



Pos	Type of area	Imp	H (m)
1	Commercial Zone	384	5
2	Wooded zone	352	-
3	Transmission struct.	291	45
4	Transmission struct.	264	45
5	Telecom. tower	213	35
6	Urbanization (6)	207	18
7	Commercial area	188	10
8	Pumarejo Bridge	188	45
9	Urbanization (10)	176	30
10	Transmission struct.	176	16
11	Building (14)	167	42
12	Urbanization (16)	136	48
13	<b>Hotel B / keel (30)</b>	<b>107</b>	<b>92</b>
14	Building (13)	103	39
15	<b>-Green Towers (34) -The Icon (50)</b>	<b>76</b>	<b>101 148</b>
16	<b>Grattacielo (52) -Mirage 57 -Iluminatta -Solara Tower - Luxe Tower -Malibu Building</b>	<b>71</b>	<b>154 163 145 142 175 80</b>

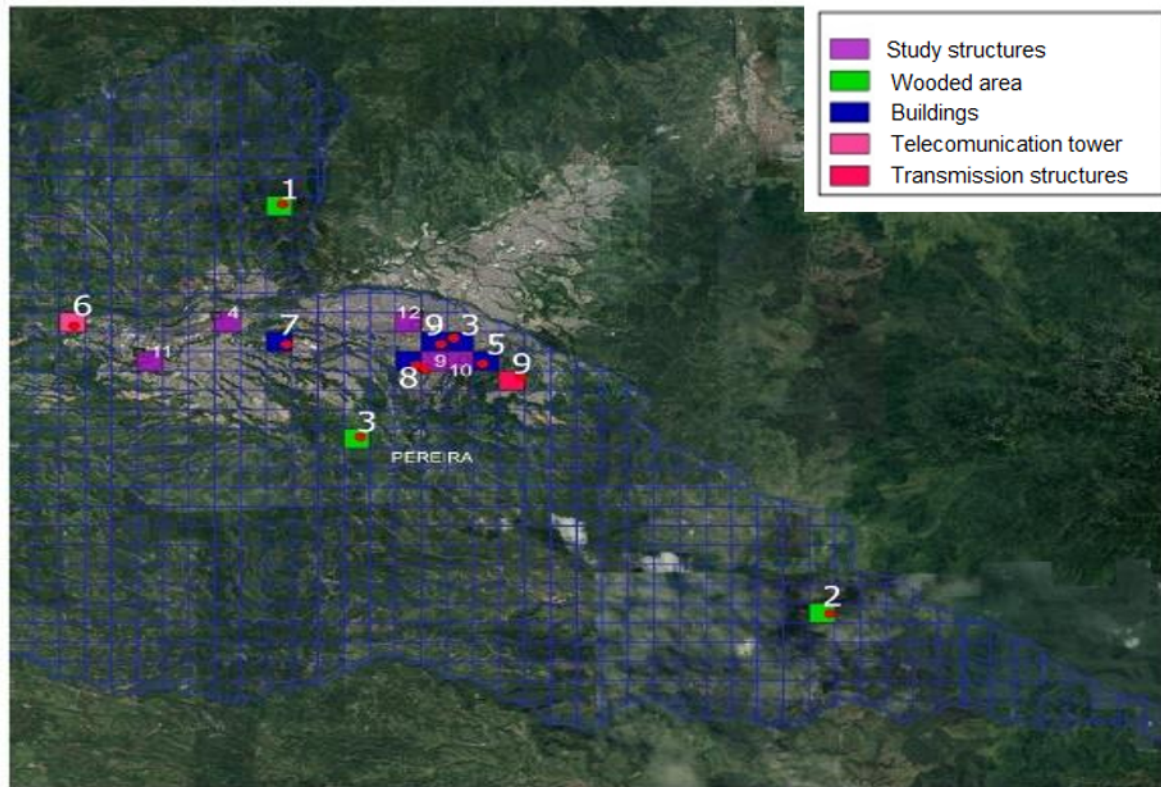


# Medellín



Pos	Type of zone	Imp	H (m)
1	Padre Amaya hill	417	30-45
2	Mountainous zone	365	-
3	Wooded area	260	-
4	Wooded area	100	-
5	- Santa Helena Tower (21) -San Miguel Tower (15) -Prado Tower (21)	95	60-65 45-50 62-65
6	<b>Popular bank</b>	<b>72</b>	<b>102</b>
7	-Building under construction (18) - Metrocable tower	65	50-55 -
8	Nuevo Naranjal Tower (22)	54	50-55
9	El conquistador (11)	53	27-33
10	Torres de Compostela (12)	50	33-36
11	-Coltejer Building -Cámara de comercio -Colseguros Building	49	175 139 97
12	<b>Business center Square</b>	<b>33</b>	<b>100</b>
13	Veracruz Tower	31	121
14	Q concept Building	30	111
15	Torre del café Building	26	160
16	Atanasio Girardot Stadium	24	42

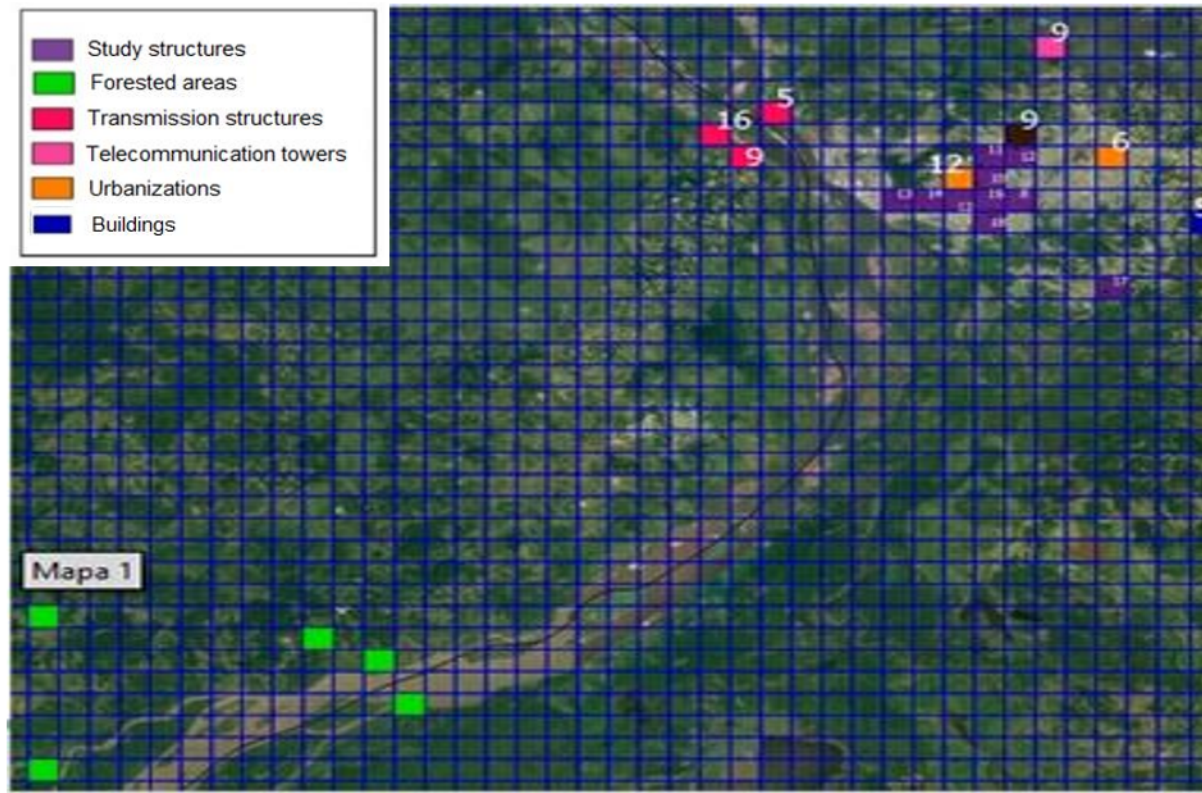
# Pereira



Pos	Type of zone	Imp	H (m)
1	Wooded area	100	-
2	Wooded area	66	-
3	Wooded area	60	-
4	Building (11)	60	33
5	Núcleo Tower (8)	60	24
6	<b>Pinares de alameda</b>	<b>51</b>	<b>90</b>
7	Building (8)	50	24
8	Telecom. tower	48	40
9	Building (7)	46	21
10	Building (9)	44	27
11	Transmission Tower	43	40-45
12	Building (21)	43	63
13	<b>Pinares campestre</b>	<b>43</b>	<b>63</b>
14	-Perla del Otún	41	63
	-Triología		65
	-Comercio Bank		75
	-Parque Bolívar		60
15	<b>Pinamar Building</b>	<b>27</b>	<b>80</b>
16	-El Otún newspaper	25	60
	-Villegas Stadium		95
	-Matecaña Airport		60

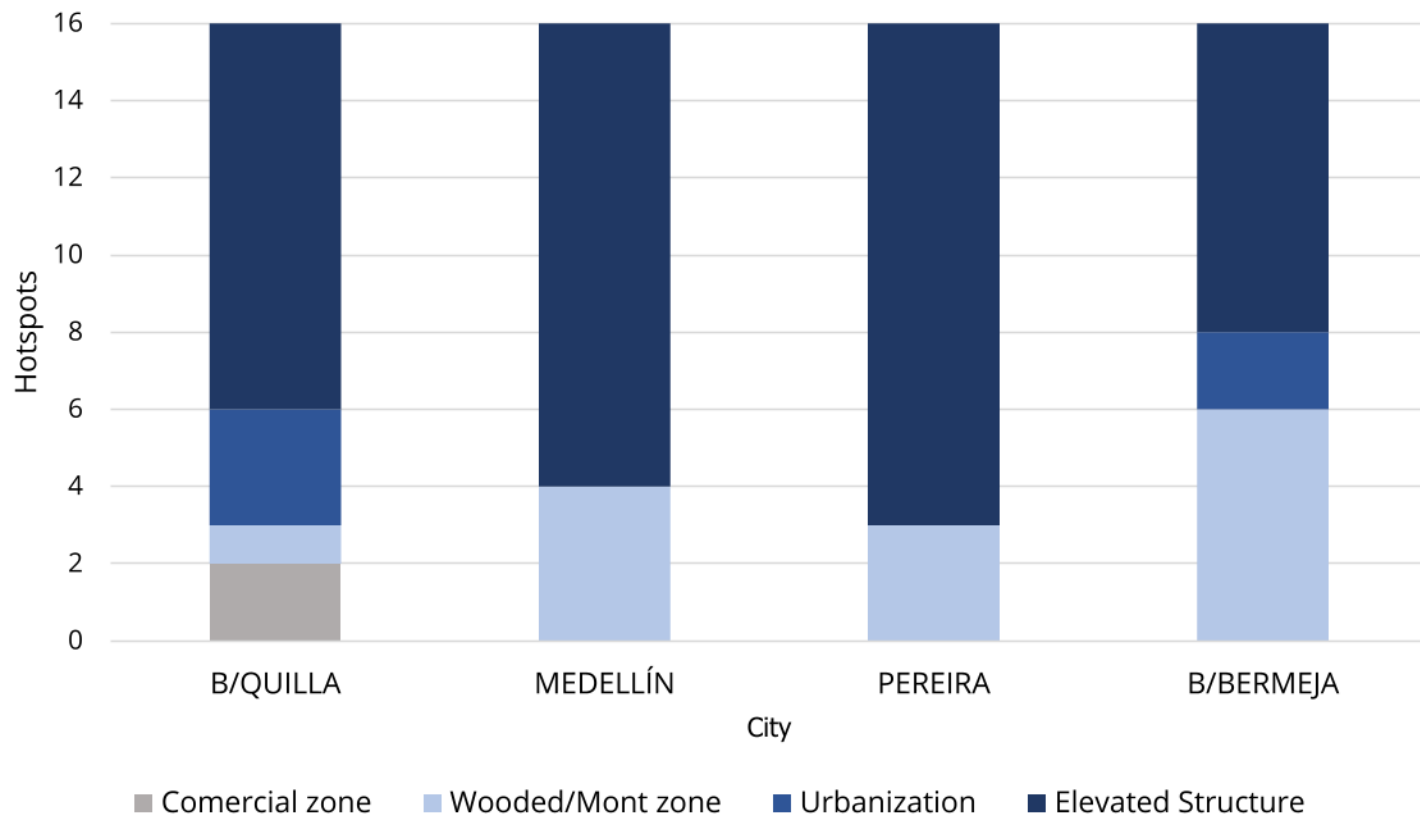


# Barrancabermeja



Pos	Type of area	Imp	H (m)
1	Wooded area	99	-
2	Wooded area	90	-
3	Wooded area	85	-
4	Wooded area	80	-
5	Transmission Tower	76	40-45
6	Urbanization	76	10
7	Wooded area	65	20
8	Wooded area	63	-
9	-Transmission Tower <b>-San Francisco Tower</b> -Telecom. Tower -Building (8) -Refinery	62	40-45 33 40 24 -
10	Urbanization	58	-
11	-Building (5) <b>-Plaza San Pedro</b>	55	15 <b>43</b>
12	<b>-Barvento Building</b> <b>-Palmetto Cond</b> <b>- San Silvestre SM</b>	52	<b>41</b> <b>37</b> <b>27</b>
13	Urbanization (5)	50	15
14	<b>Super Star Hotel</b>	<b>46</b>	<b>48</b>
15	<b>Terzetto Living</b>	<b>44</b>	<b>43</b>
16	Transmission Tower	43	40-45
17	<b>-Portobello Cond</b> <b>-Vivero Club</b>	38	<b>43</b> <b>33</b>
18	<b>48Park</b>	38	40

## IV. Results



## V. Conclusions

- The first hotspots in the studied cities are far from the urban area, as observed in Medellín, Pereira, and Barrancabermeja.
- Most hotspots correspond to elevated structures.
- There is a marked influence of urban planning in determining the sites of high lightning activity.
- Urban planning and the presence of elevated structures increase lightning activity.

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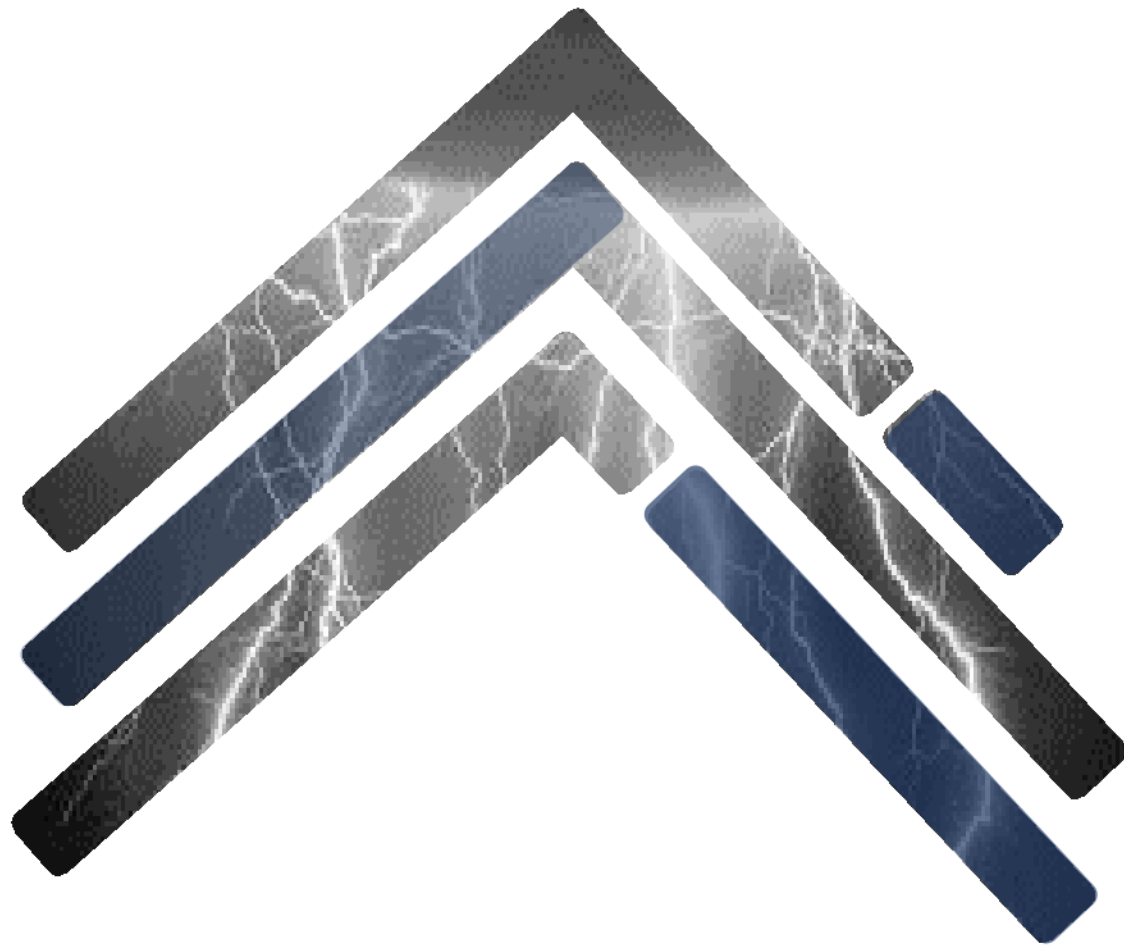


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Thanks