Iowa State University

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An Analysis of QLCS Lightning Distribution for Public Safety

Motivation

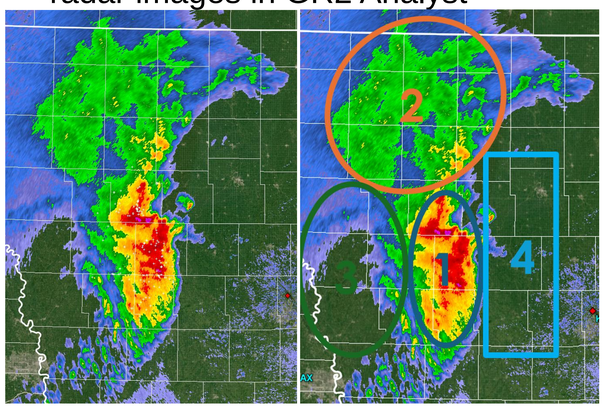
- 62% of lightning fatalities occur during outdoor "leisure" activities (Jensenius, *A Detailed Analysis of Lightning Deaths in the United States from 2006 through 2019,* 2020)
- Quasi-Linear Convective Systems (QLCS) are common in the Midwest and Plains region. Even if their risks of wind and hail are well warned, lightning can occur in areas removed from severe warnings or even rain.
- This study determines the locations of lightning strikes within these systems, and examines the effectiveness of the NCAA lightning policy given its relevancy to college student safety during sporting events

NCAA Lightning Policy

- **Initiate delay:** "when the leading edge of the storm is within 6* miles"
- **Resume play:** "30 minutes after the last flash of lightning within 6* miles"
- *8-mile threshold is used by DSM WFO
- Previous studies examined the effectiveness of the NCAA policy, but only looked at single cell thunderstorms (Vos, *ISU Senior Thesis,* 2020)

Methodology

- 10 QLCS cases within Iowa from 2019-2023 chosen using the SPC's Severe Weather Event Archive
- Overlayed lightning strikes onto radar images in GR2 Analyst



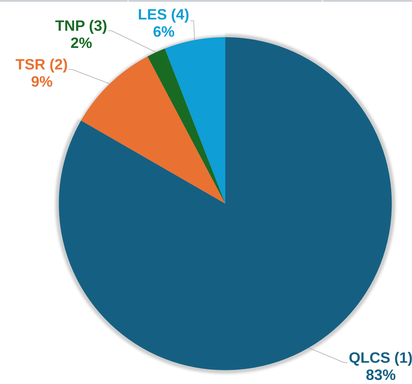
- Classified strikes based off their location relative to the leading edge (40 dBZ threshold) and the dBZ values where they occurred:

QLCS Strike Classifications	dBZ Range
1. Inside QLCS	≥ 40 dBZ
2. Trailing Stratiform Region (TSR)	25 – 40 dBZ
3. Trailing Non-Precipitation (TNP)	< 25 dBZ
4. Leading Edge Strikes (LES)	< 40 dBZ (when in front of the leading edge)

- For Leading Edge Strikes (LES (4)), measured the distance from the leading edge parallel to the storm motion vector
- Also used this data to identify strikes outside the parameters set by NCAA policy

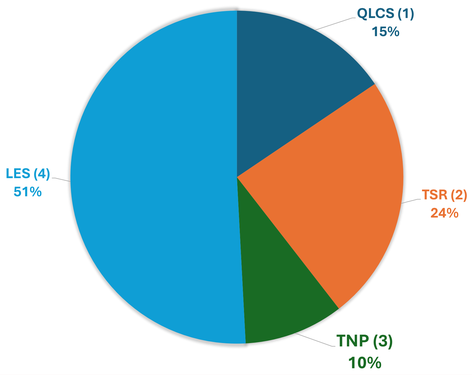
Results

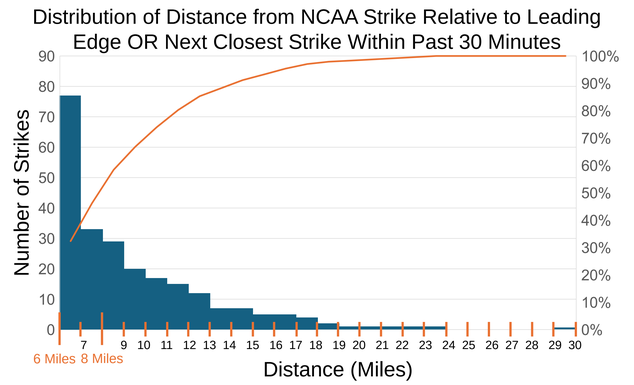
QLCS Strike Distribution	Number of Strikes	Percentage of Total Strikes
Cumulative	10305	100
QLCS (1)	8586	83.3
TSR (2)	922	8.9
TNP (3)	187	1.8
LES (4)	610	5.9



- NCAA Lightning policy is 97.8% effective at a 6-mile radius, 98.8% effective at 8 miles

NCAA Strike Distribution (6 miles)	Number of Strikes	Percentage of Total Strikes
Cumulative	237	100
QLCS (1)	37	15.5
TSR (2)	57	24.0
TNP (3)	23	9.7
LES (4)	120	50.6





Conclusions

- 92% of strikes occur in regions greater than 25 dBZ
- The NCAA Lightning Policy is effective (misses 2.2% of strikes at a 6 mile radius, and 1.2% at 8 miles)
- Biggest risk for strikes outside of NCAA Policy come with strikes in front of the storm (LES (4)), but 1 in 10 strikes occur without any rain after the storm has passed (TNP (3)), meaning that there is still some risk even after the storm moves through
- Additionally, most lightning fatalities occur when victims are already headed to safety (Jensenius, 2020), indicating that it is critical for people to take shelter as soon as the criteria are met for the NCAA policy, and that perhaps the 8-mile threshold should be standard practice

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