# A Climatology of Total Lightning Information

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# Goals

- Make total lightning information useful to forecasters

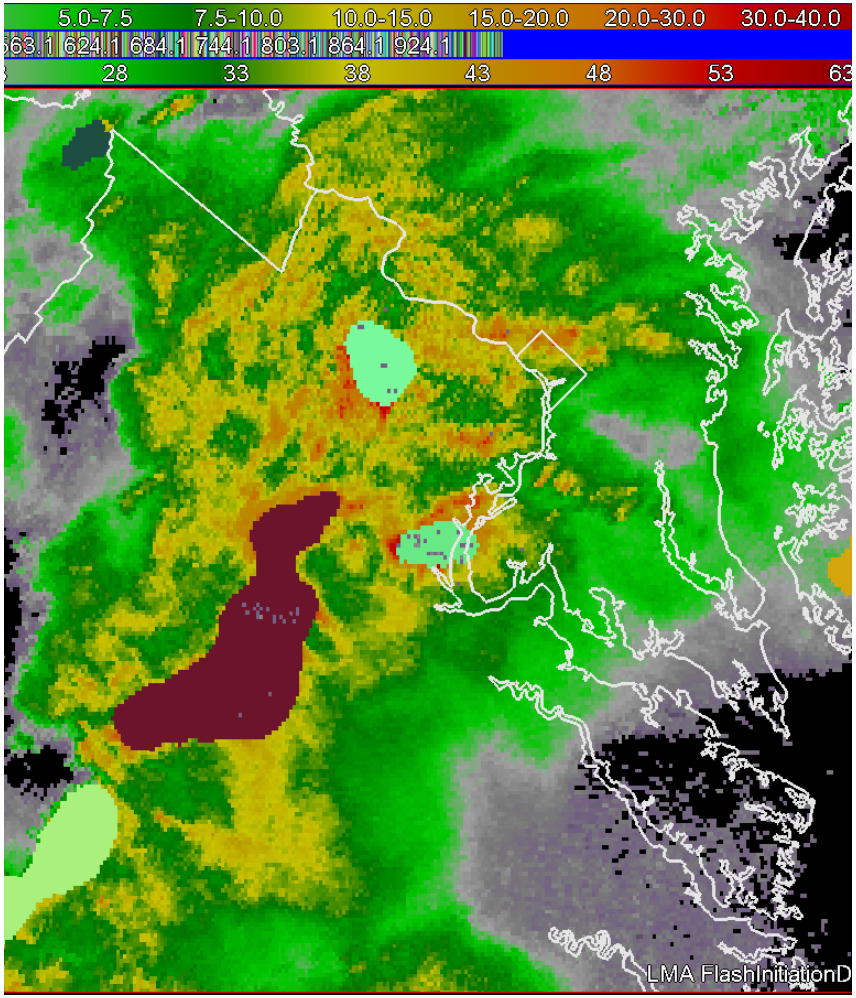
1. Examine the climatological characteristics of total lightning
2. Quantify relationships between total lightning and radar derived attributes in thunderstorms
3. Assess the ability of total lightning to delineate between hazardous and non-hazardous thunderstorms

- Do this all in the framework of a 5-year climatology

# Data

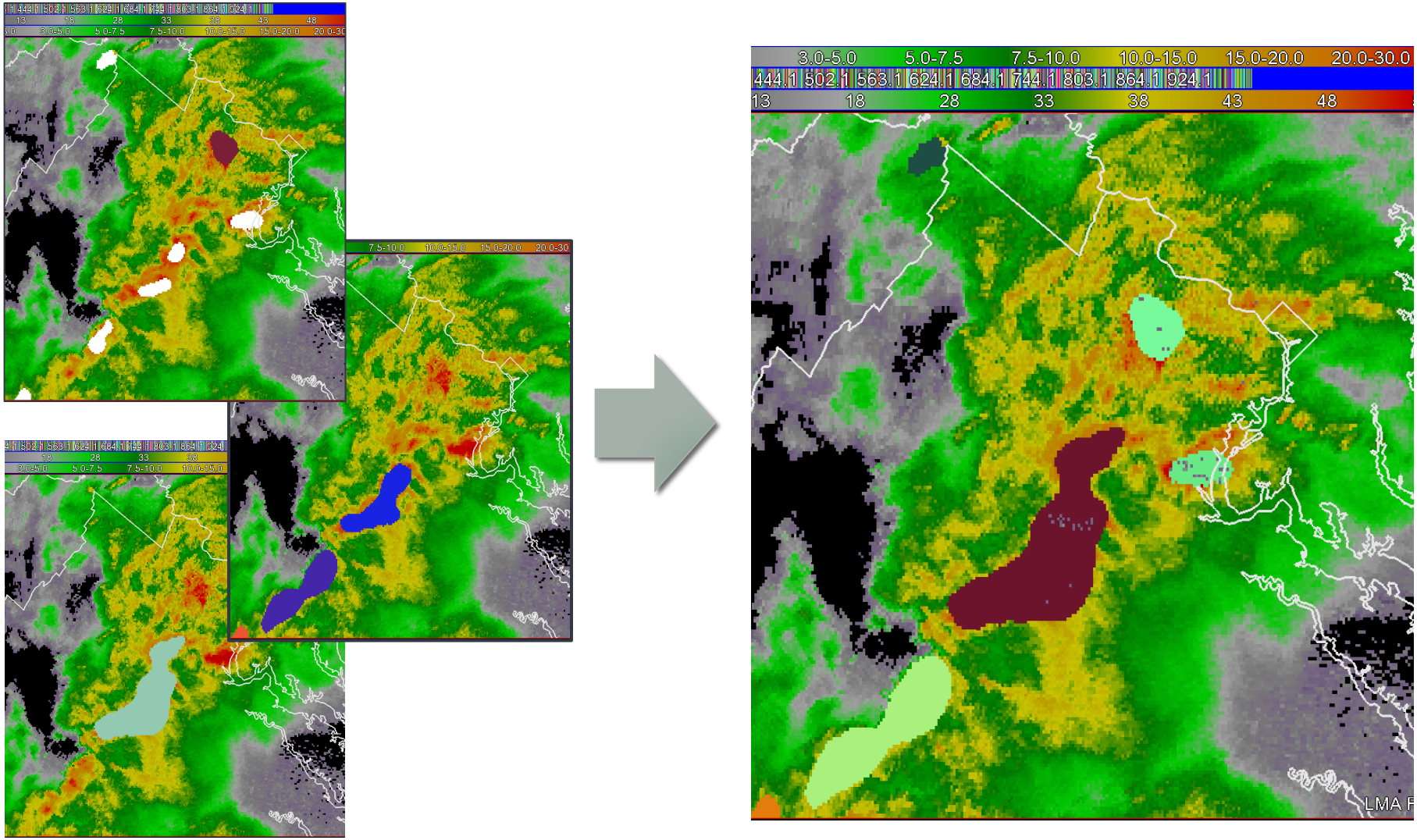
- 3 years (2009- 2011)
  - eventually 5
- Areas within 125 km of LMA network center
  - DCLMA
  - NALMA
  - OKLMA
  - OKLMA+WTLMA (2012)
- For each region, data from:
  - LMA
  - WSR-88Ds
  - RUC
  - NLDN
  - Severe reports (Storm Data)

# DATA PROCESSING




- Grids created in WDSS-II
- Storms automatically classified as supercell or non-supercell
- Id'ed and tracked storms with w2segmotion
- To be considered, storms must:
  - Last for > 30 minutes
  - Have lightning
- Decorrelation time (DCT) found
- Population sampled according to DCT (~10)

# FLATTENING ALGORITHM



# CLIMATOLOGICAL CHARACTERISTICS 2009-2011

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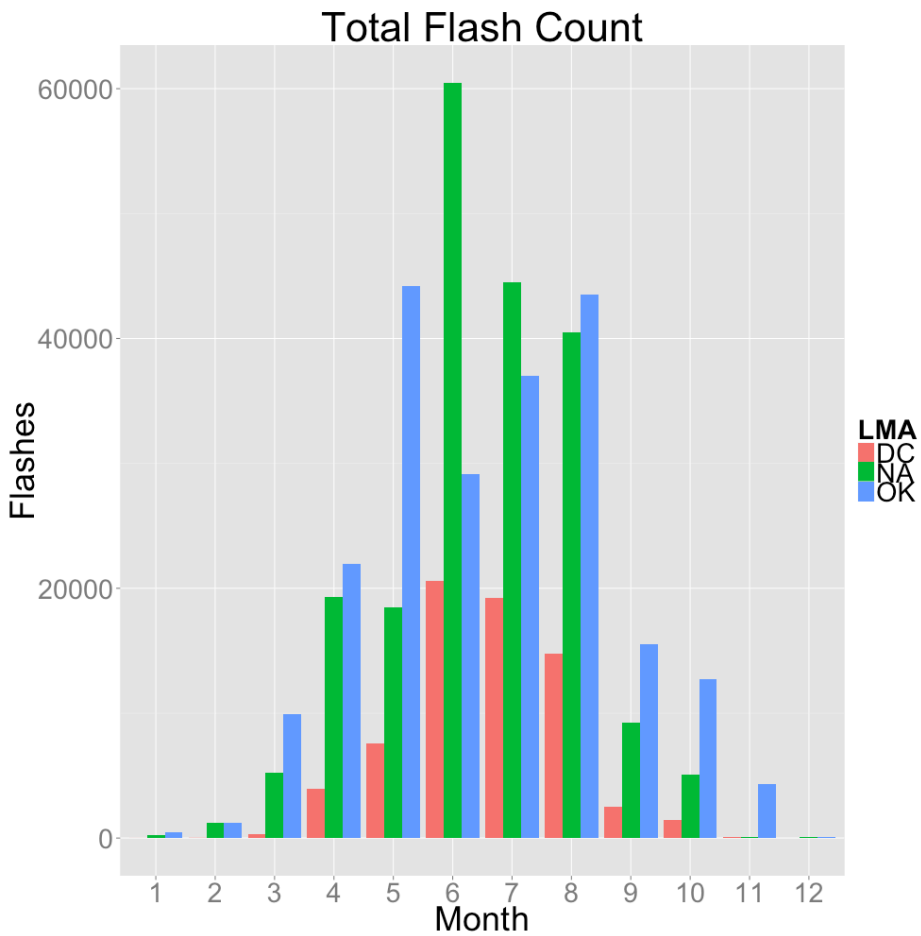
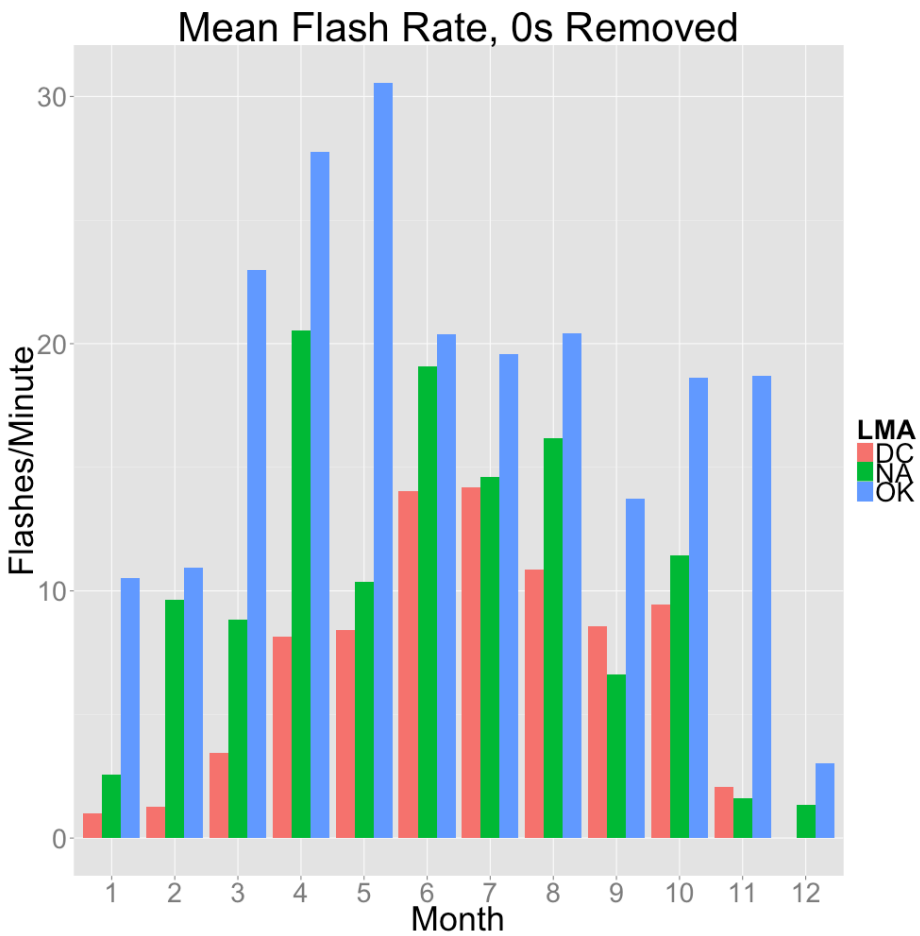
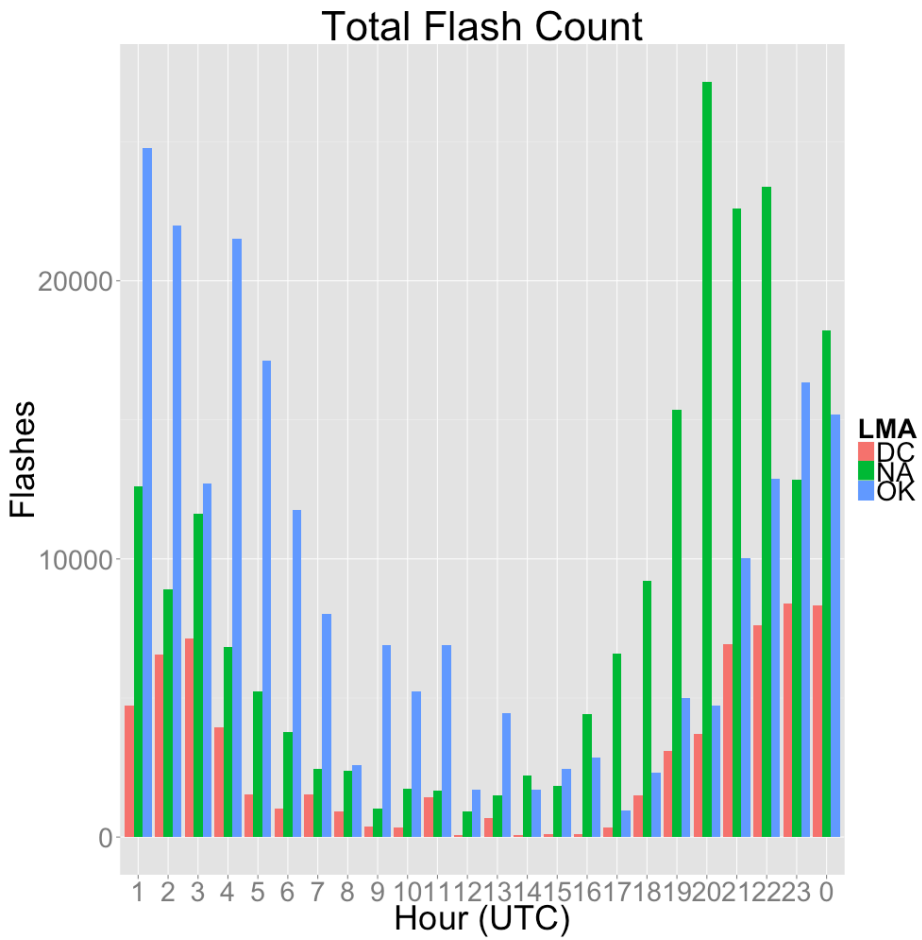


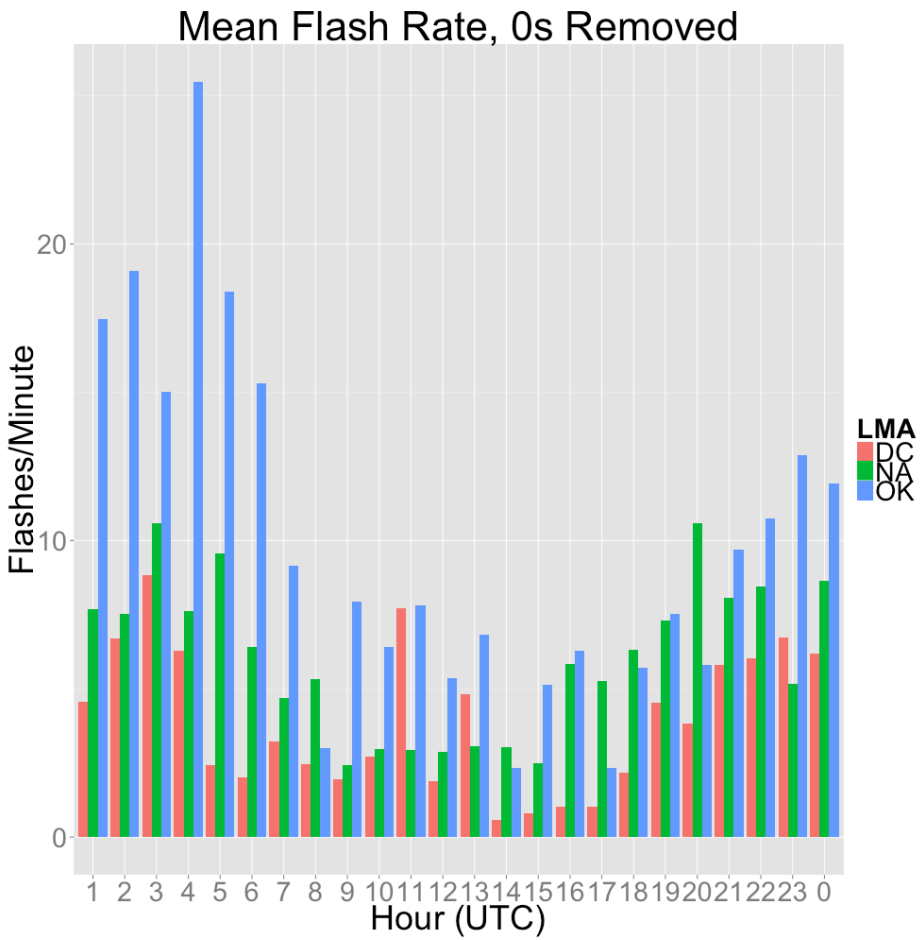




TFC DCLMA =70490 TFC NALMA = 204545 TFC OKLMA = 220118

n DCLMA =14247 n NALMA = 29088 n OKLMA = 20004

# CLIMATOLOGICAL CHARACTERISTICS



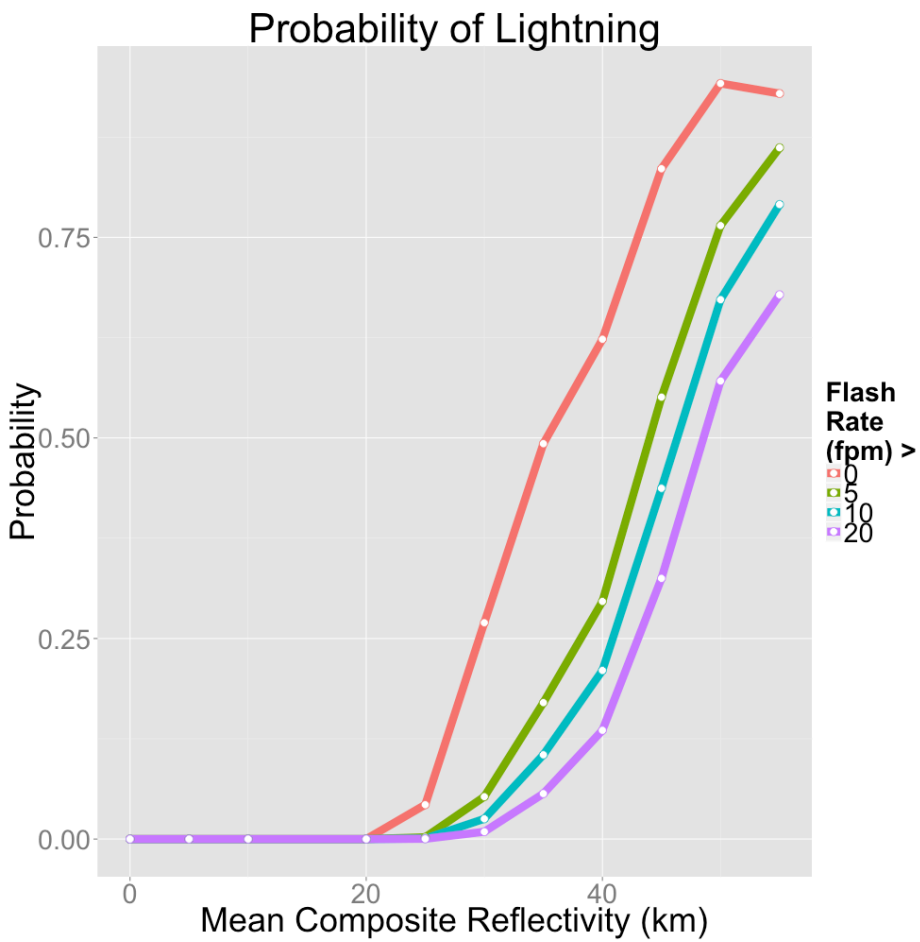



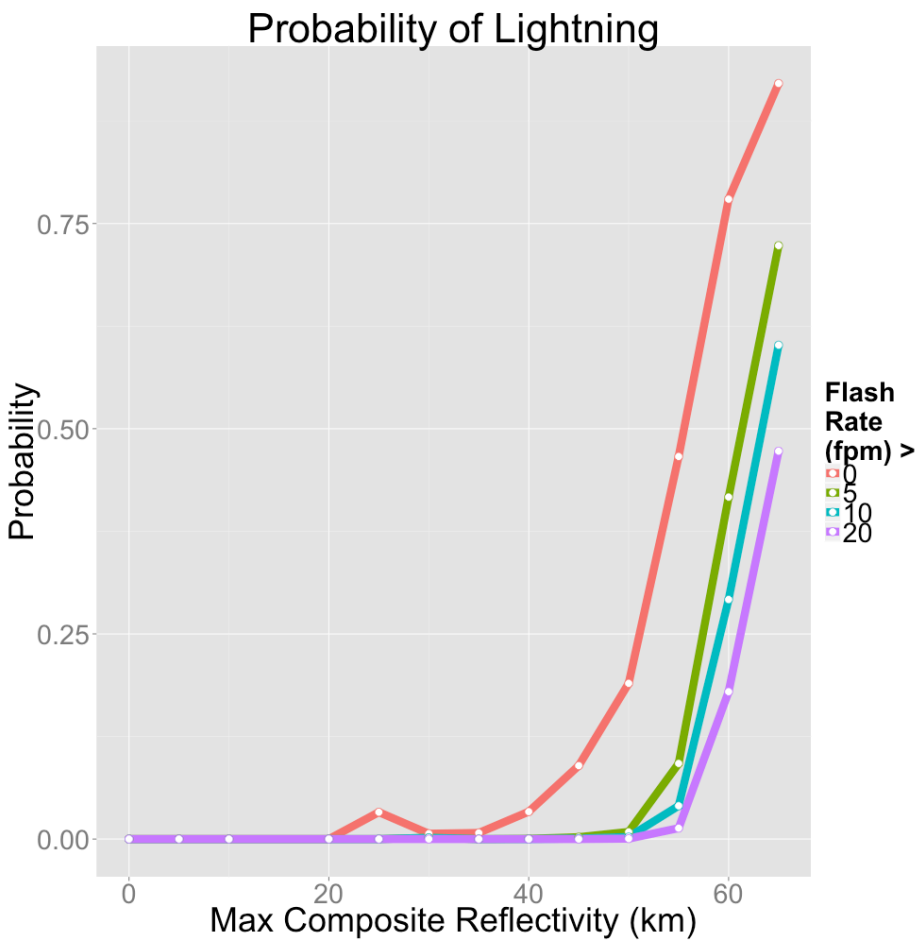
# Attribute Comparison

Pearson's Correlation

| | Flash Rate | Flash Density | Mean FED | Max FED | |
|---|---|---|---|---|---|
| Mean Reflectivity | 0.43 | 0.49 | 0.56 | 0.47 | |
| Max Reflectivity | 0.37 | 0.37 | 0.40 | 0.48 | |
| Area of Composite Ref > 40 dBZ | 0.62 | 0.30 | 0.44 | 0.53 | |
| Area of Composite Ref > 50 dBZ | 0.77 | 0.46 | 0.61 | 0.63 | |
| Area of Ref > 30 dBZ at 0C | 0.34 | 0.10 | 0.19 | 0.29 | |
| Area of Ref > 40 dBZ at 0C | 0.66 | 0.34 | 0.48 | 0.56 | |
| Area of Ref > 50 dBZ at 0C | 0.78 | 0.48 | 0.60 | 0.62 | |
| Area of Ref > 30 dBZ at -10C | 0.50 | 0.23 | 0.34 | 0.44 | |
| Area of Ref > 40 dBZ at -10C | 0.80 | 0.47 | 0.61 | 0.66 | ≥ .70 |
| Area of Ref > 50 dBZ at -10C | 0.77 | 0.50 | 0.62 | 0.61 | ≥ .50 |
| Area of Ref > 30 dBZ at -20C | 0.72 | 0.38 | 0.52 | 0.63 | |
| Area of Ref > 40 dBZ at -20C | 0.84 | 0.51 | 0.66 | 0.68 | |
| Area of Ref > 50 dBZ at -20C | 0.72 | 0.47 | 0.59 | 0.56 | |
| 15 dBZ Echo Tops | 0.48 | 0.48 | 0.47 | 0.58 | |
| 30 dBZ Echo Tops | 0.53 | 0.52 | 0.50 | 0.62 | |
| 40 dBZ Echo Tops | 0.56 | 0.54 | 0.52 | 0.64 | |
| Mean VIL | 0.60 | 0.70 | 0.74 | 0.64 | |
| Max VIL | 0.64 | 0.59 | 0.61 | 0.72 | |
| Mean VII | 0.60 | 0.69 | 0.71 | 0.65 | |
| Max VII | 0.66 | 0.60 | 0.61 | 0.73 | |
| Mean Low Level Shear | 0.23 | 0.22 | 0.27 | 0.24 | |
| Max Low Level Shear | 0.45 | 0.31 | 0.41 | 0.44 | |
| Mean Mid Level Shear | 0.45 | 0.46 | 0.55 | 0.49 | |
| Max Mid Level Shear | 0.51 | 0.37 | 0.47 | 0.51 | |

# ATTRIBUTE COMPARISON



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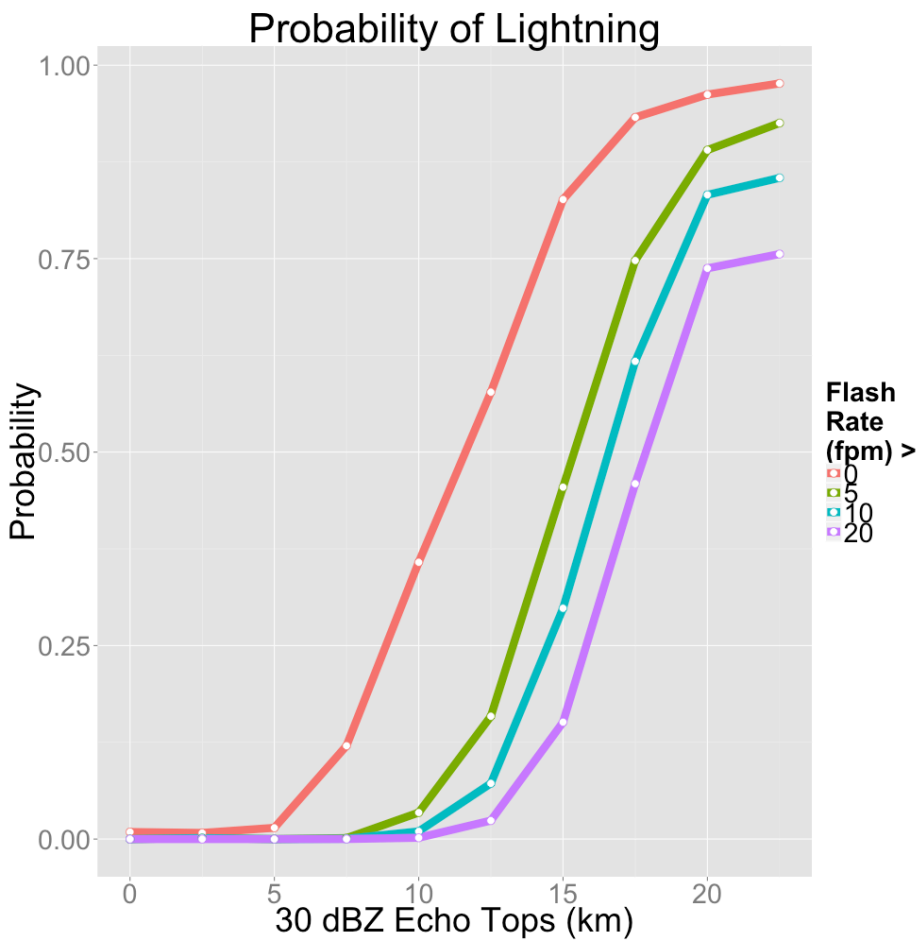
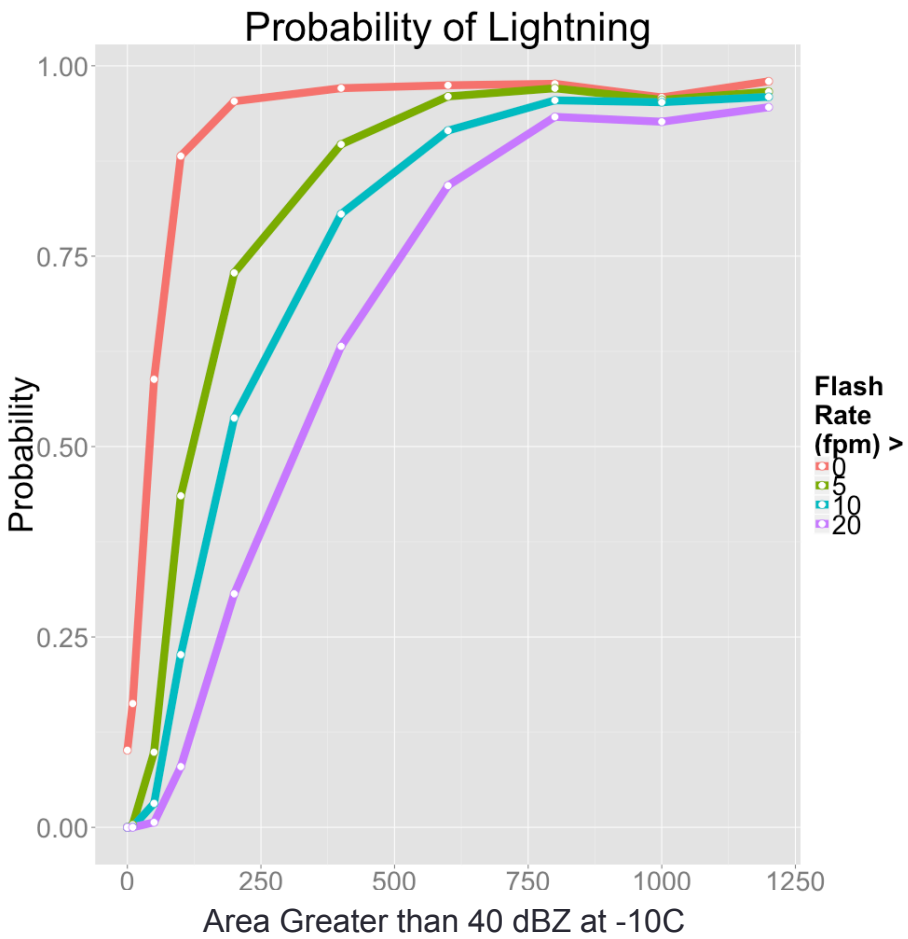
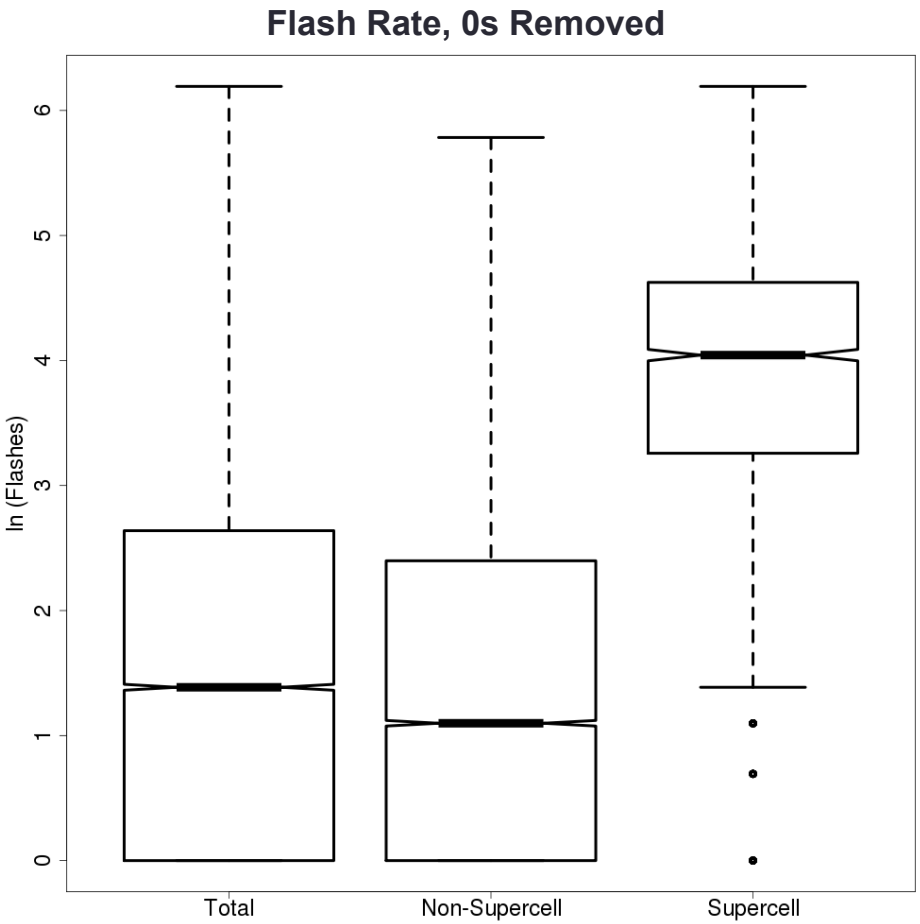


# Hazard Recognition

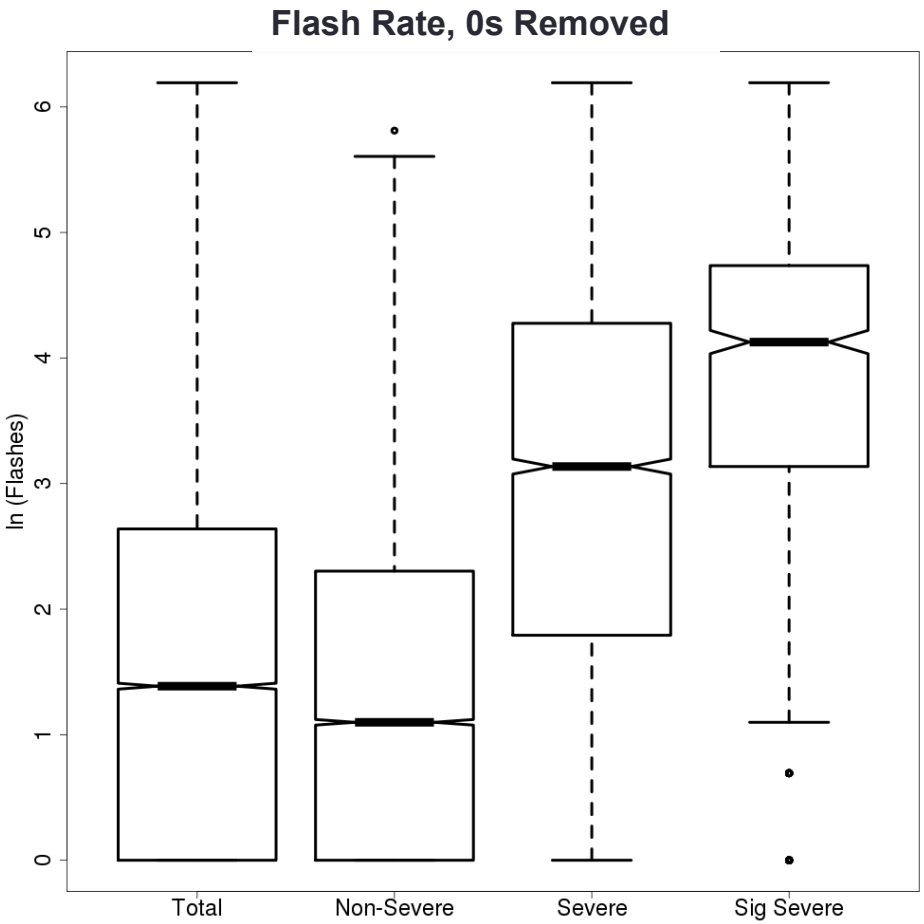
# HAZARD RECOGNITION




n=30763 μ=16.12

n=28520 μ=14.29

n=2243 μ=70.34



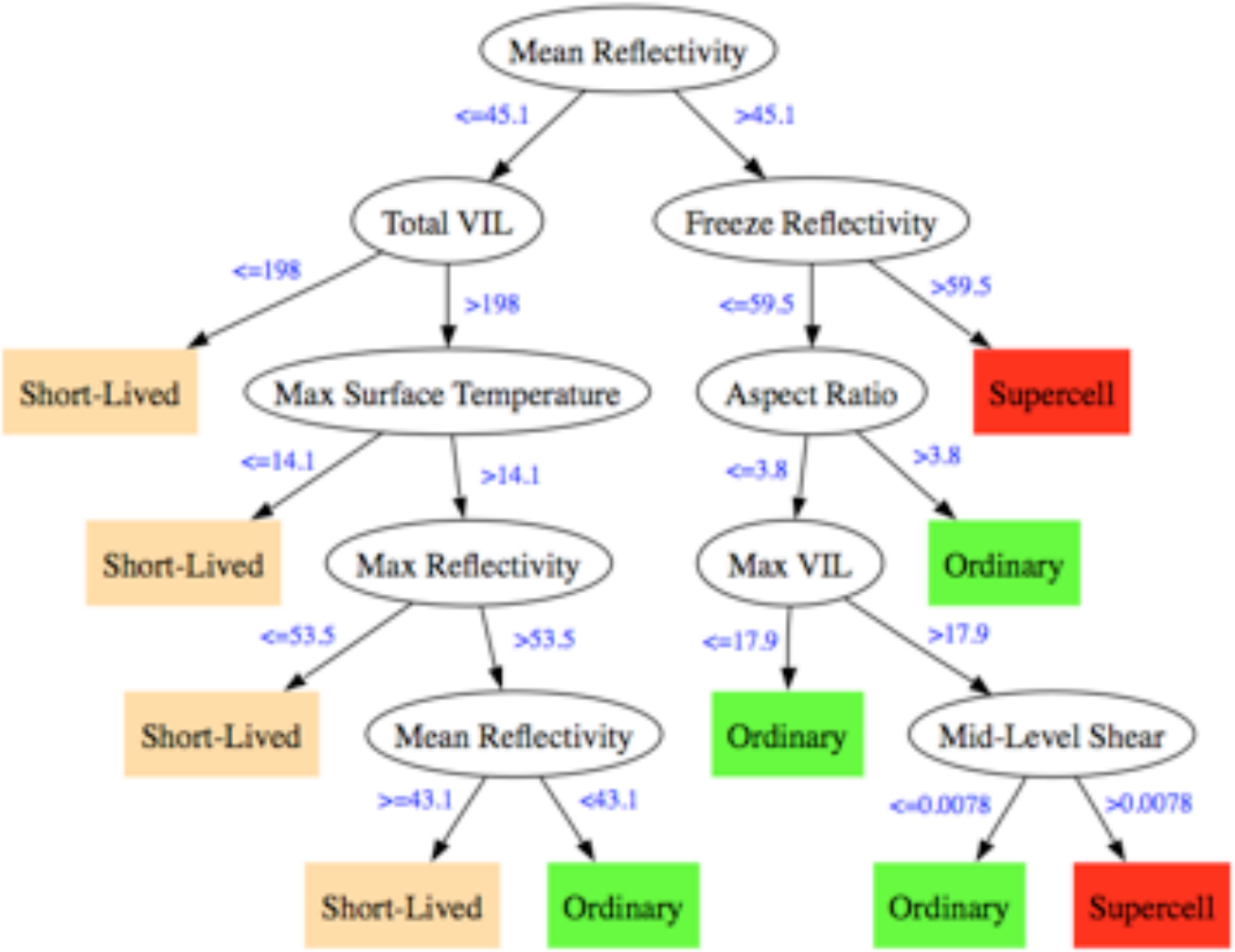

n=30763 μ=16.12

n=26462 μ=11.16

n=4301 μ=46.61

n=742 μ=77.90

# Going forward

- Finish processing
- Resampling to create confidence intervals
  - Bootstrapping
  - Permutation tests
- Additional methods to quantify relationships between attributes
  - Linear models
- Include methods to quantify the the relationship between total lightning activity and severe weather hazards
  - Logistic regression
  - Discriminant analysis
  - Skill scores

# STORM TYPING