LIGHTNING JUMP ALGORITHM UPDATE

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GLM Science Meeting

12/01/10

Where we left you in '09

- Six separate lightning jump configurations tested
- Case study expansion:
  - 107 T-storms analyzed
    - 38 severe
    - 69 non-severe
- The "2σ" configuration yielded best results
  - POD beats NWS performance statistics (80-90%);
  - FAR even better i.e.,15% lower (Barnes et al. 2007)
    - Caveat: Large difference in sample sizes, more cases are needed to finalize result.
- M.S. Thesis completed and study accepted to JAMC (Schultz, Petersen, Carey 2009); forms the conceptual basis of the lightning jump ATBD

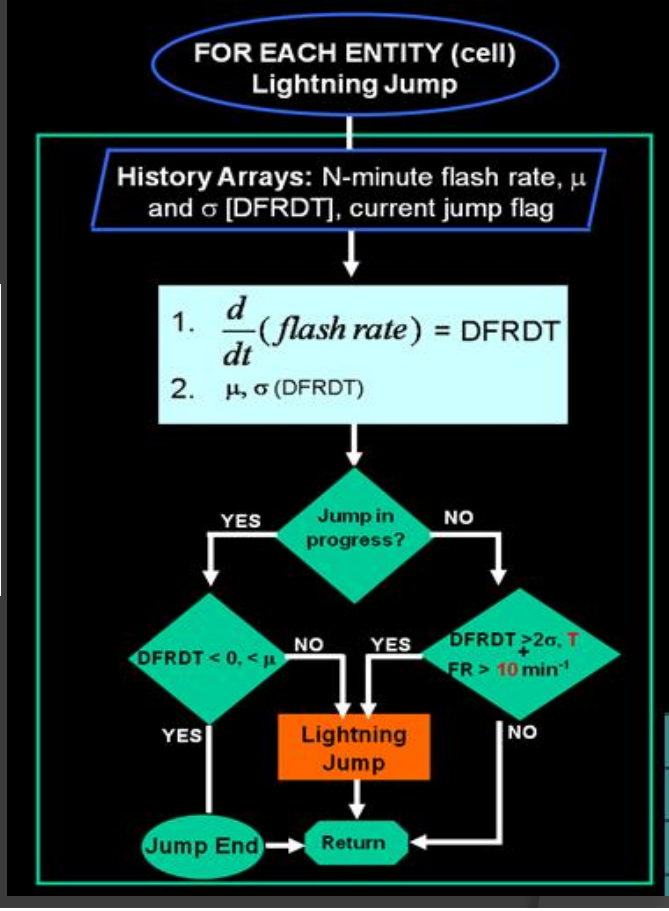
Thunderstorm breakdown:

North Alabama – 83 storms

Washington D.C. – 2 storms

Houston TX – 13 storms

Dallas – 9 storms



Algorithm	POD	FAR	CSI	HSS
Gatlin	90%	66%	33%	0.49
Gatlin 45	97%	64%	35%	0.52
2σ	87%	33%	61%	0.75
3σ	56%	29%	45%	0.65
Threshold 10	72%	40%	49%	0.66
Threshold 8	83%	42%	50%	0.67

Case Expansion

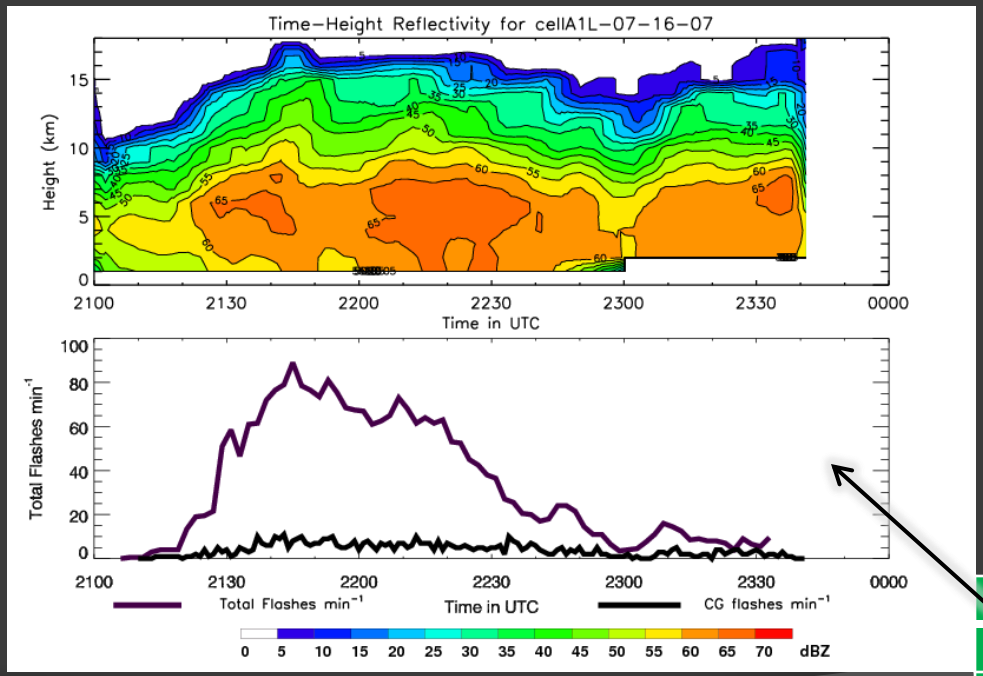
- Since, we've expanded to 638 thunderstorms
  - Primarily from N. Alabama (537)
  - Also included
    - Washington D.C. (49 and counting)
    - Oklahoma (30 and counting)
    - STEPS (22)
- Regional expansion has proven robust
  - POD: 82%, FAR 35%, avg. lead time: 22 mins.

DC LMA Results

	Gatlin	2 Sigma	3 Sigma	Thresh4	Thresh5
POD	0.88	0.79	0.60	0.57	0.43
FAR	0.66	0.44	0.29	0.50	0.39
CSI	0.32	0.49	0.48	0.36	0.34
HSS	0.48	0.66	0.65	0.53	0.51
PFAR	16.54%	30.36%	16.67%	34.62%	30.43%

Skill Scores, 2σ, DC LMA region

- 14 of 15 missed events by the 2σ algorithm were 1 tree knocked down
  - 64 severe events total for the DC sample.
- Lightning jumps observed before almost every hail and tornado case
  - 1 tornado missed in entire sample (remnants of TS Nicole)



Example, tornadic storm July 16, 2007

2132	wind	50	39.55	-76.62
2205	wind	50	39.52	-76.42
2215	torn	EF1	39.51	-76.41
2219	hail	1.00	39.52	-76.42

Proving the Utility of Total Lightning

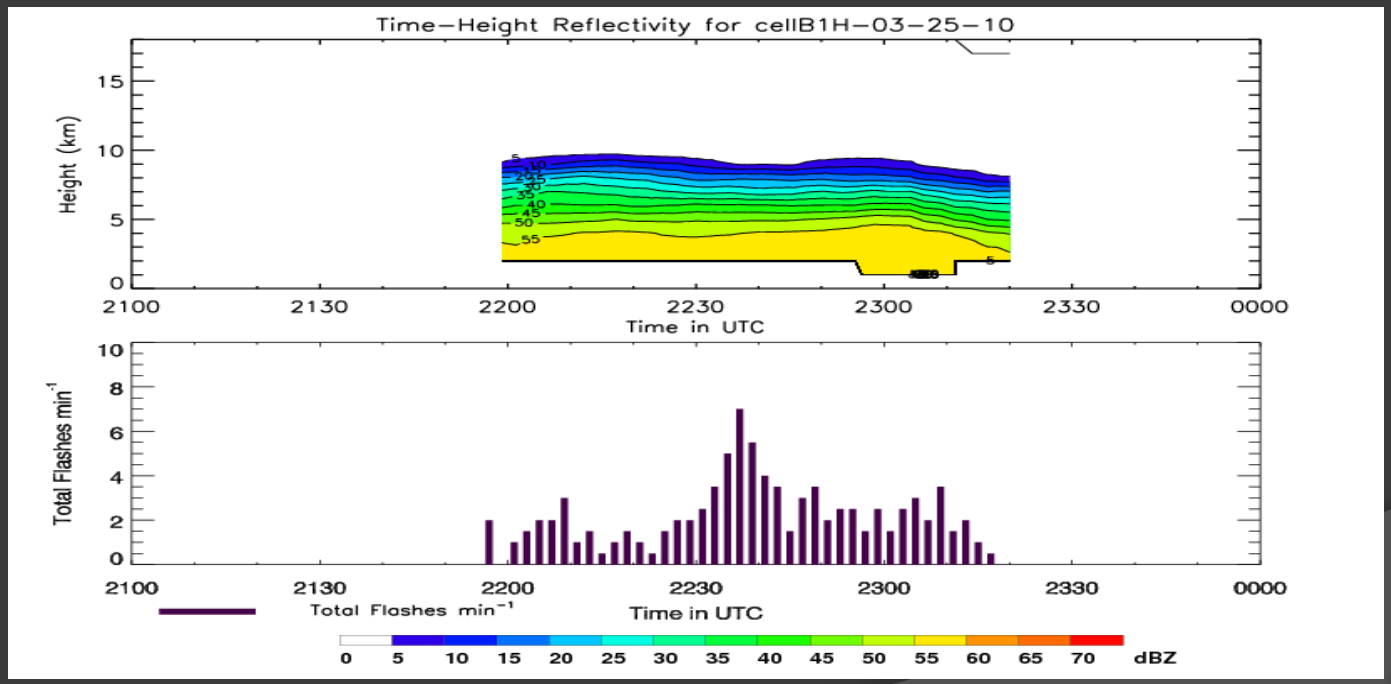
- Examined total and CG rates in 30 thunderstorm in four regions of country
  - Total lightning trends outperform CG lightning trends
- Schultz et al., WAF, accepted, editing

TABLE 2. Skill scores and average lead times using the sample set of 30 thunderstorms for both total lightning and CG lightning, correlating trends in lightning to severe weather

	POD	FAR	CSI	lead time (all)	lead time (tornado)
Total lightning	95%	26%	72%	25.54 mins	24.47 mins
CG lightning	65%	25%	54%	16.77 mins	19.73 mins

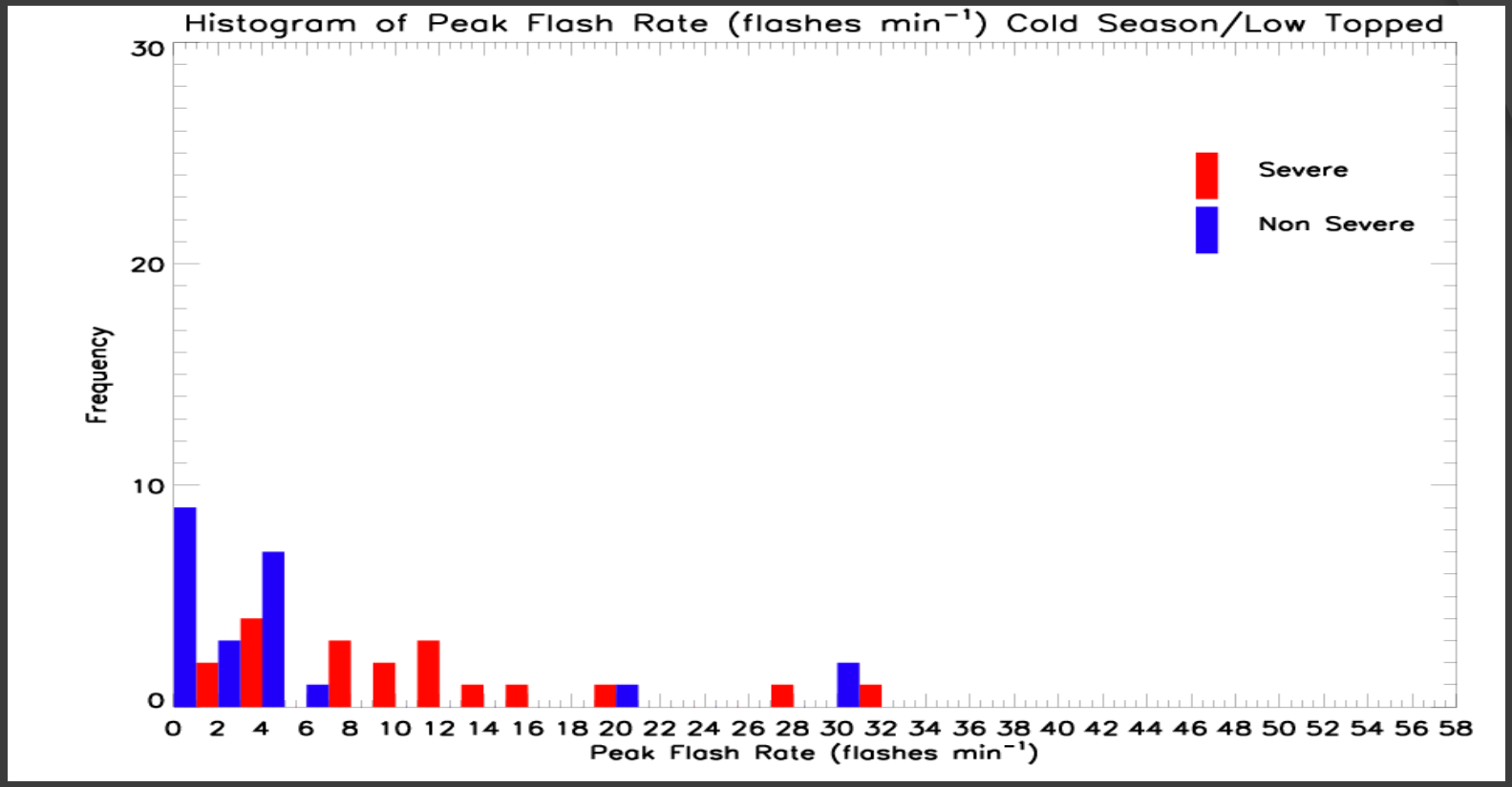
Low topped/cold season and tropical environments

- 40% of misses in these environments.
  - Can we still provide utility by tailoring algorithm?
- Answer:
  - Tropical maybe, cold/low topped, tougher.



Time-height plot of reflectivity (top) and total flash rate (bot) for an EF-1 producing tornadic storm on March 25, 2010. Tornado touchdown time ~2240 UTC.

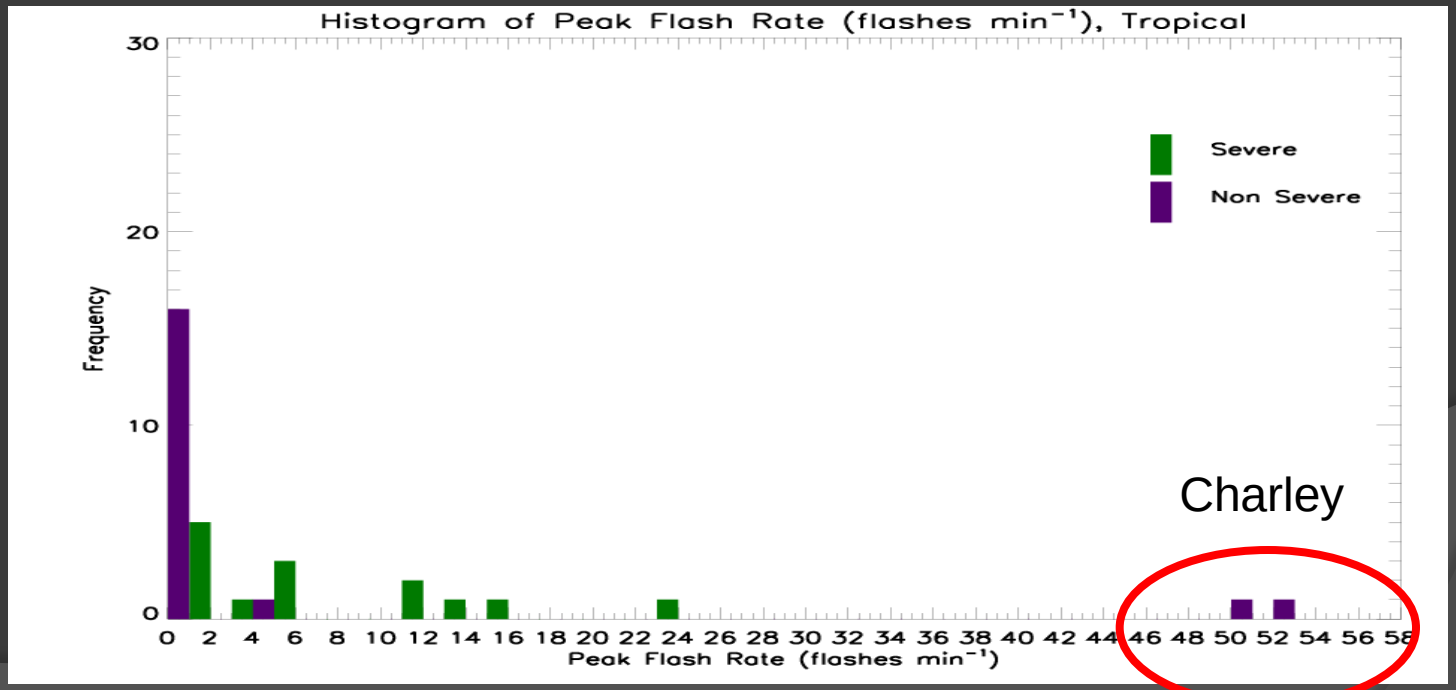
Cold Season/Low Topped

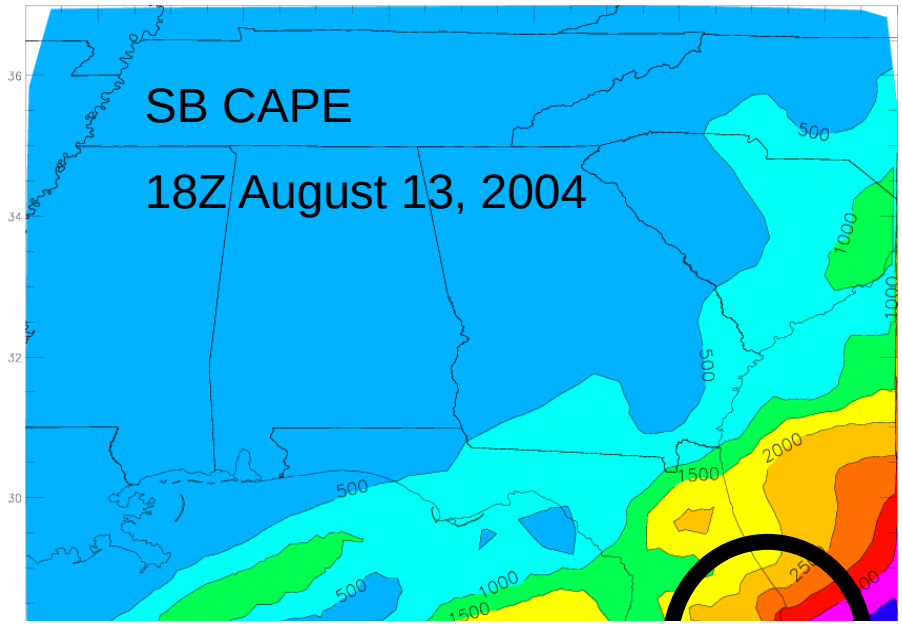


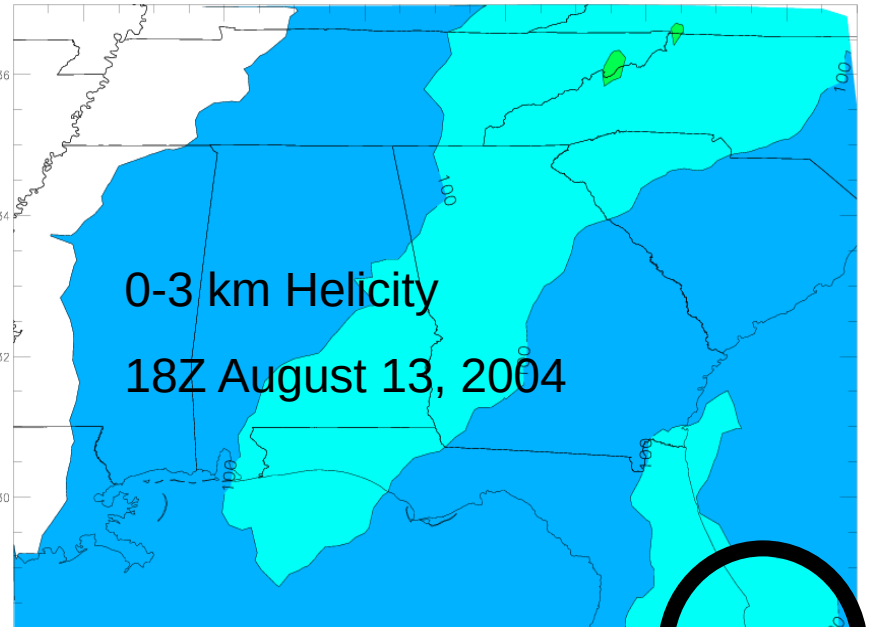
- Average peak flash rates:
  - Severe 11.53 flashes min^{-1}, all have at least 1 flash
  - Non Severe: 6.60 flashes min^{-1}
- Some separation occurs at 6 flashes min^{-1}

Landfalling Tropical Systems

- Analyzed 8 landfalling TC's within range of an LMA/LDAR
- Average Peak Flash Rates
  - Severe: 6.60 flashes min^{-1}, 5 storms w/o any flashes
    - w/o no flash storms, avg. flash rate 8.90 flashes min^{-1}
  - Non Severe 6.35 flashes min^{-1}
    - 0.29 flashes min^{-1} if non severe from Charley are removed




SB CAPE
18Z August 13, 2004


0-3 km Helicity
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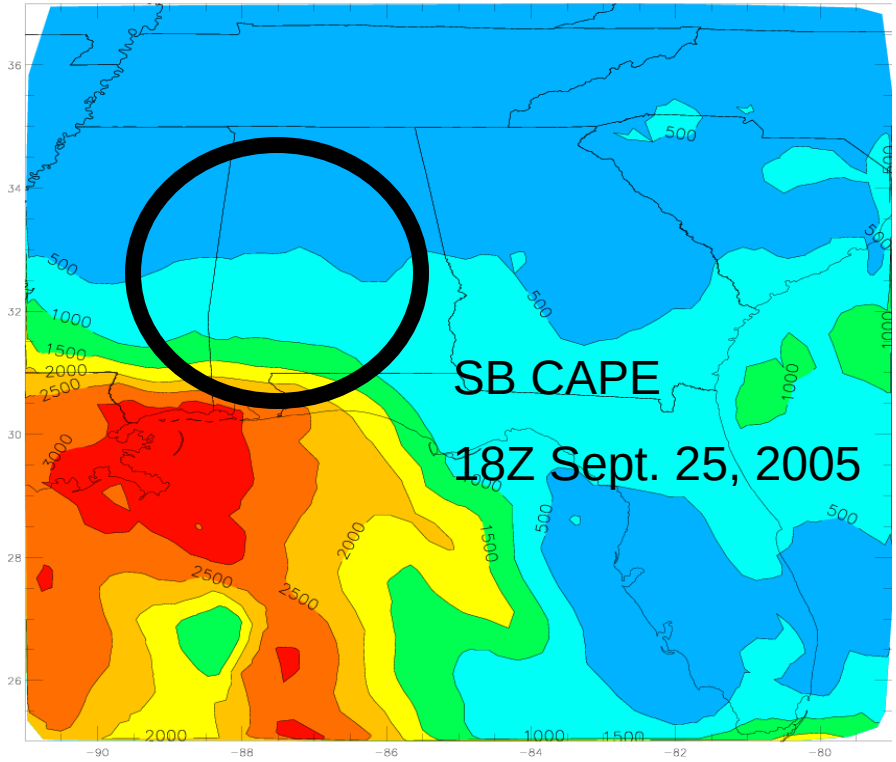
SB CAPE
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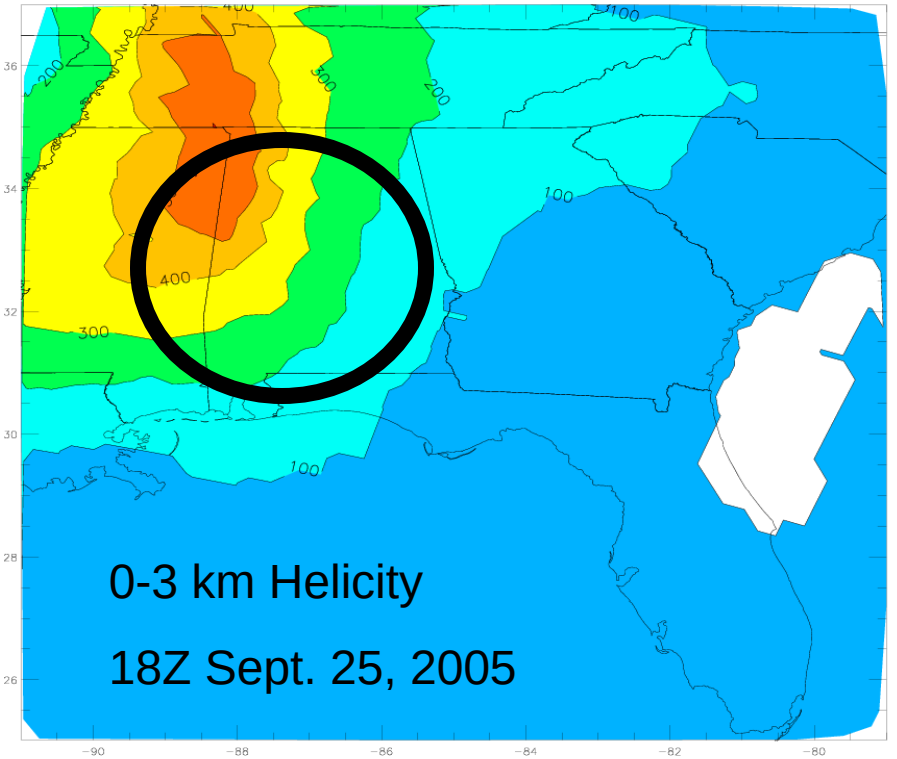
0-3 km Helicity
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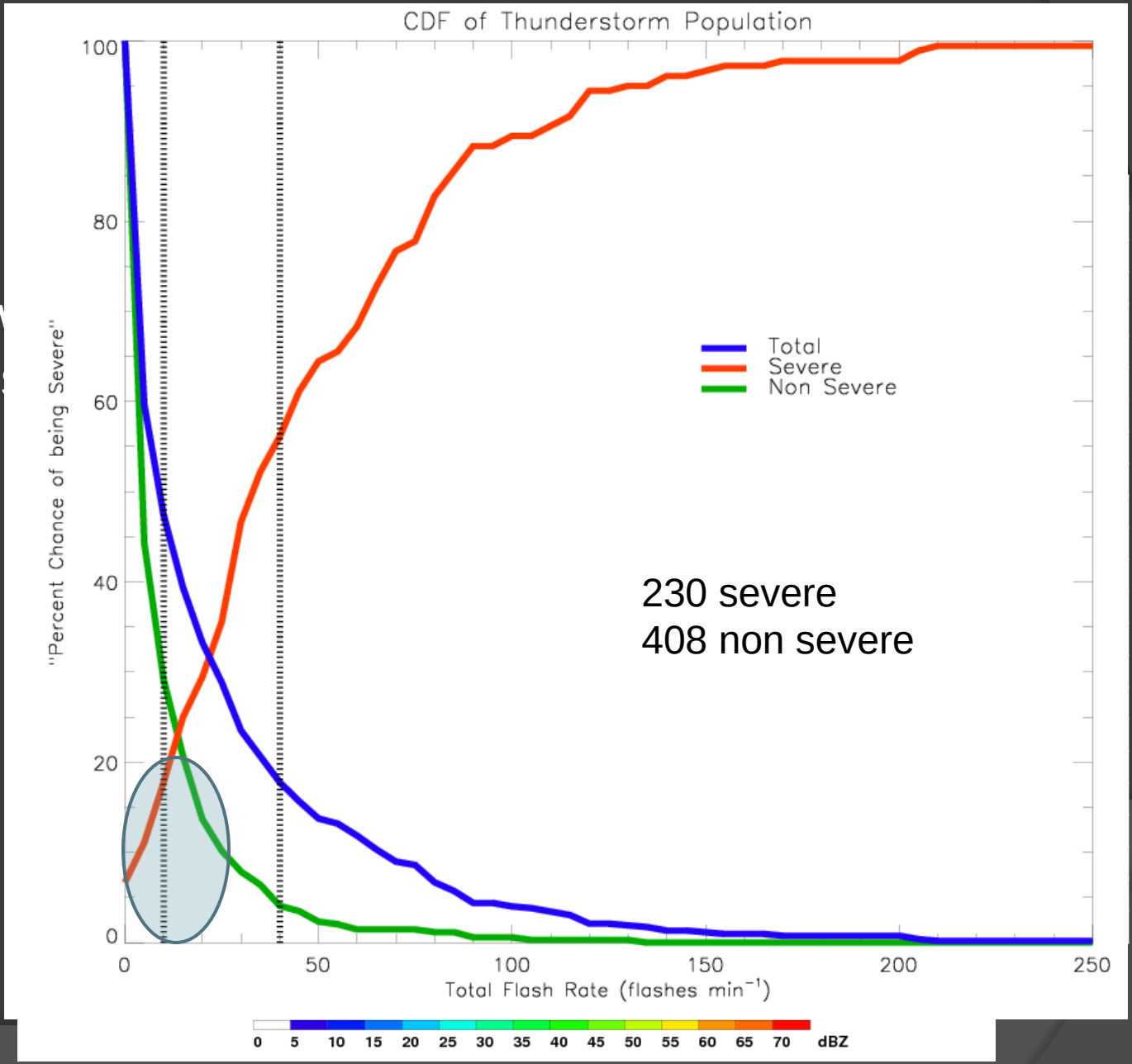
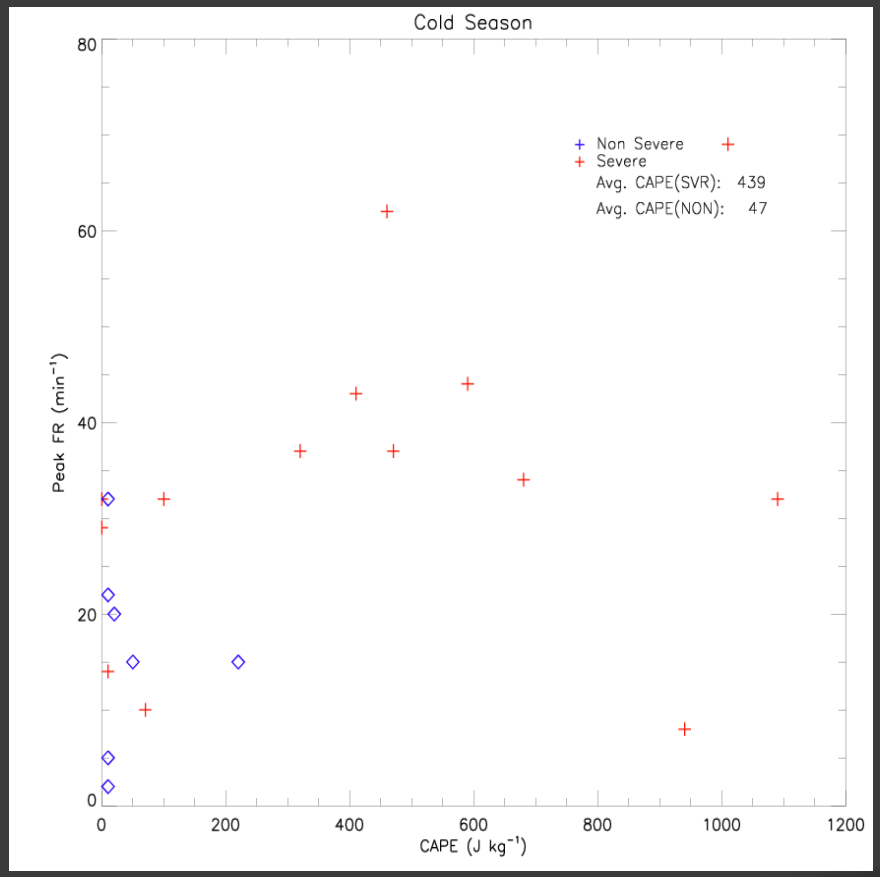
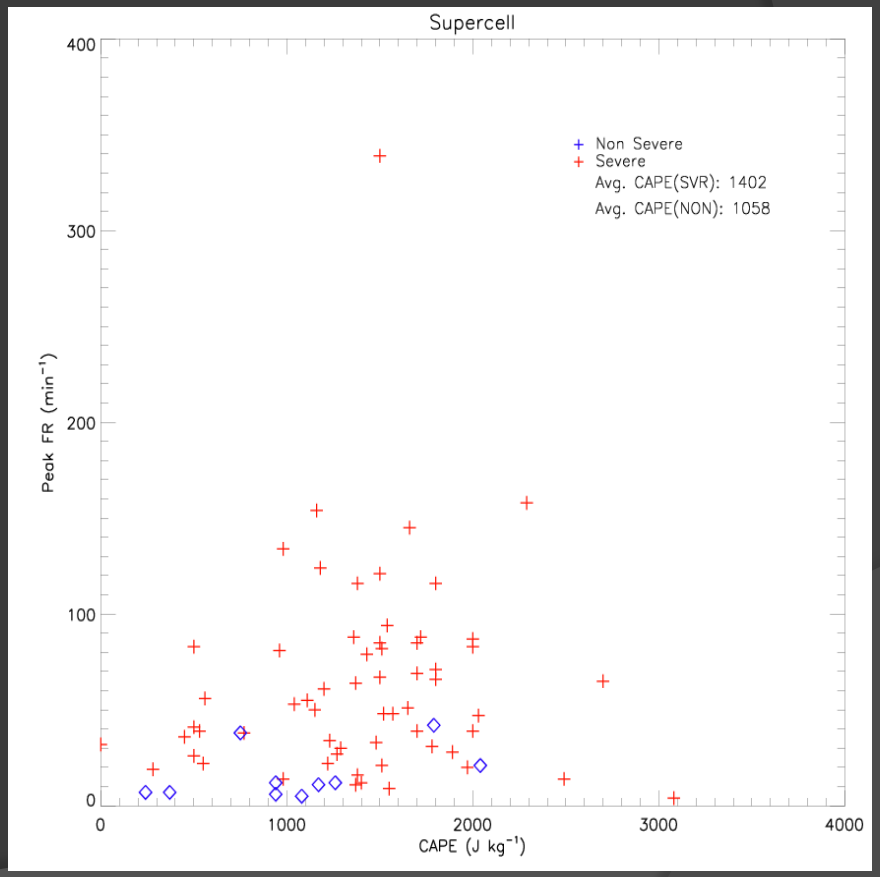
- e.g., 1117
  - Dow
    puls



Examining Environments

- Goal: Using commonly used environmental parameters to determine when total lightning will be of most use.





Other parameters; temp, theta, theta-e, RH, e,es, r,rvs, etc.

Future Work

- Incorporate other satellite/radar products
  - Have robust satellite dataset from GOES-O/P tests
    - In what capacity does high temporal satellite and total lightning information benefit nowcasting of storm growth and decay?
  - Reflectivity/rotation comparisons
- Testing of algorithm in real-time this summer at Redstone and White Sands
- Work the GLM lightning proxy along with the proxy in the cell tracking framework.