

A Spatiotemporal Analysis of dBZ Altitude and Lightning Variability in EF2+ Tornadoic Storms Across the Canadian Prairies



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INTRODUCTION

- It was found that the Canadian Prairies have some of the highest lightning flash densities in the country [2]
- In Canada, there is an average of 97 tornadoes that occur each year (ratings are assigned using the EF Scale) [3]
- Past studies suggest that tornadoes can manipulate the charge distributions within a supercell [4] [5]
- Enhanced uplift before confirmed tornadoic activity forced rapid altitude increases of the 40dBZ echo top [6]

OBJECTIVE

To explore how lightning flashes and dBZ altitudes change in both space and time before, during, and after confirmed tornadoic storms across the Canadian Prairies in recent years

METHODOLOGY



After a tornado occurs, ground and satellite surveys are conducted to collect tornado data for analysis

The Canadian Lightning Detection Network (CLDN) consists of more than 80 sensors across Canada and can differentiate between CG and IC flashes and identify the polarity, location, and time



Radars across Canada run on a 6-minute scan cycle to obtain reflectivity and velocity data at 17 different elevations (angles) that can be used to show different atmospheric levels

Python was used to create a tracking algorithm that follows the storm cell and measures dBZ echo top altitudes and lightning flash rates over time



Fig. 1. EF4 tornado near Didsbury, Alberta, on July 1, 2023 [1]

Reflectivity Hook Echo and Velocity Couplet

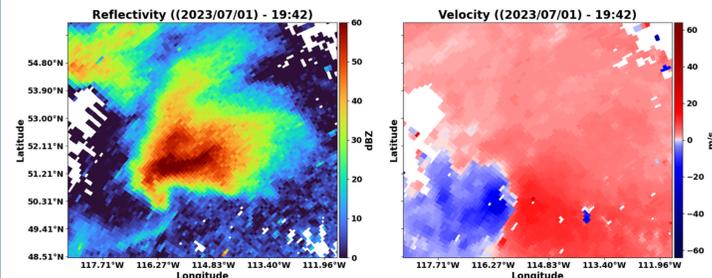


Fig. 2. Reflectivity and velocity radar scans taken 3 minutes prior to the Didsbury, AB, EF4 tornado event

Cell Tracking & Lightning Verification

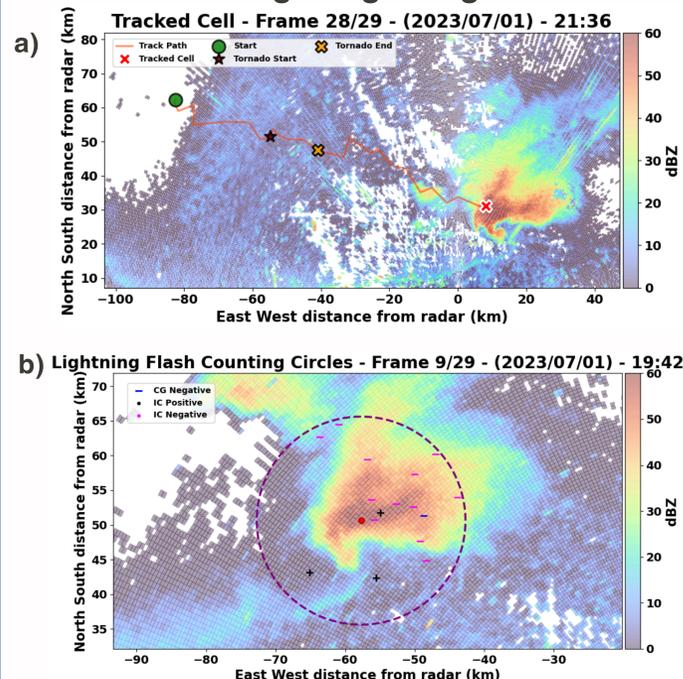


Fig. 3. Didsbury event a) tracking algorithm path, and b) lightning mask verification products (circle radius is set to 15km for this case)

PRELIMINARY RESULTS

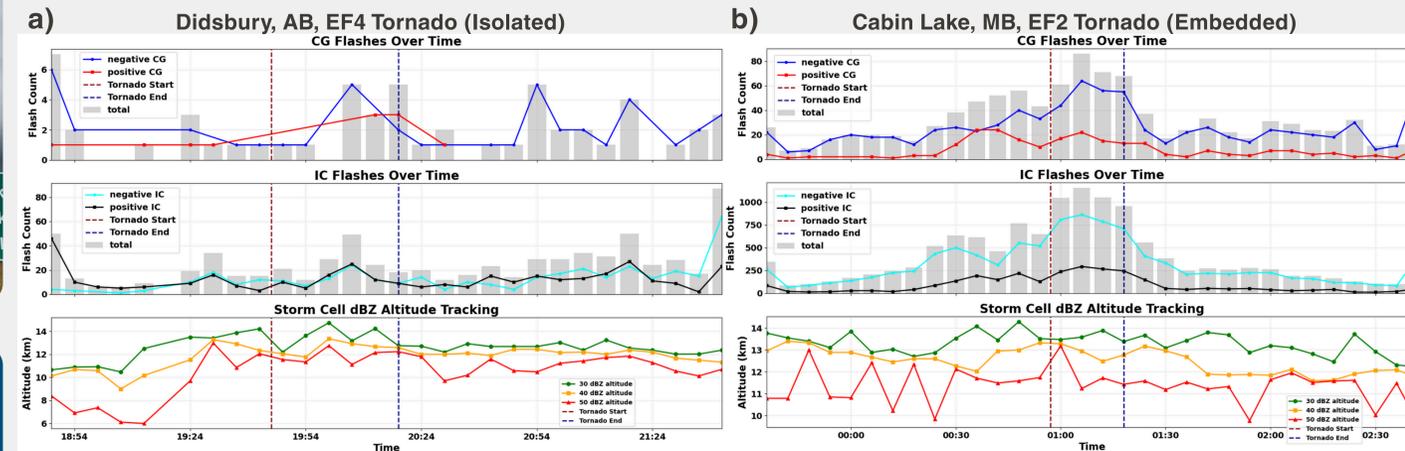


Fig. 5. Flash counts and dBZ altitude changes over time for a) the Didsbury, AB, EF4 tornado event and b) the Cabin Lake, MB, EF2 tornado event. For the CG plot, red and blue show positive and negative strikes respectively. For the IC plot, black and cyan show positive and negative strikes respectively. For the dBZ plot, the altitude changes of the 30dBZ (green), 40dBZ (yellow), and 50dBZ (red) are shown. The tornado start (dark-red dashed vertical line) and the tornado end (dark-blue dashed vertical line) times are also shown.

Period	+CG	-CG	Total CG	+IC	-IC	Total IC	Total Flashes
a)							
Before Tornado 19:12 - 19:45	3	4	7	41	51	92	99
During Tornado 19:45 - 20:18	6	9	15	77	76	153	168
After Tornado 20:18 - 20:51	4	6	10	54	49	103	113
b)							
Before Tornado 00:36 - 00:57	74	124	198	690	1802	2492	2690
During Tornado 00:57 - 01:18	67	219	286	1045	3169	4214	4500
After Tornado 01:18 - 01:39	32	114	146	490	1659	2149	2295

Table 1. CG, IC, and total flash counts before, during, and after the recorded tornado touchdown period. a) Shows the flash counts for the Didsbury, AB, isolated EF4 tornado. b) Shows the flash counts for the Cabin Lake, MB, embedded EF2 tornado.

NEXT STEPS

- Continue analysis on the remaining confirmed EF2+ cases
- Calculate statistical averages and correlations by combining all of the results from the study
- Write, revise, and submit the final thesis for evaluation and begin defence preparation

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