An Analysis of Depolarization Streaks for Anticipating Thundersnow

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Key Findings/Results

- Preliminary results show that depolarization streaks appear on radar best with stratiform regions of snowfall.
- ZDR streaks seem to be less apparent in more cellular or lake-enhanced snowfall.
- Initial findings show that depolarization streaks in radar are a viable way for operational forecasters to anticipate lightning in the short-term.

Future Research

- Python scripts are needed to analyze more than five cases to establish a clear correlation between depolarization streaks and lightning in snowfall, so that operational meteorologists can better protect the public.

Acknowledgements

I would like to thank the Honors College for providing funding for this project, as well as GHRC for providing access to data. I would also like to thank the US Department of Energy for supporting ARM, which created the tools used to plot radar data used in the analysis of this research. Finally I would like to thank the Department of Atmospheric and Earth Sciences at UAH for providing direction and advising me throughout this research.

Explanation

- Right before lightning flashes, the orientation of the snowflakes change with the electric field, which can sometimes be seen on radar using what’s called Differential Reflectivity (ZDR).
- Streaks in ZDR have a noticeable correlation to lightning flashes in winter storms (Kumjian & Deierling, 2015).
- Although rare, lightning in snow storms can be very dangerous.
- Three cases of thundersnow were analyzed and found to have ZDR streaks present in the hours leading up to major flashes, including one that sent a New Jersey teacher to the hospital in March of 2018.
- This case study analyzes where ZDR streaks appear in snowstorms in relation to the lightning flashes detected by Geostationary Lightning Mapper (GLM), as well as cases where lightning was present and no streaks appeared on radar.

Case: Boston Maine NJ Teacher Colorado Michigan

<table>
<thead>
<tr>
<th>Date</th>
<th>ZDR Streaks</th>
<th>Lightning Detected</th>
<th>ZDR Max</th>
<th>Reason for No ZDR Streaks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan 4th, 2018</td>
<td>Yes</td>
<td>Yes</td>
<td>15Z</td>
<td>Possibly Tower initiated</td>
</tr>
<tr>
<td>Jan 20th, 2019</td>
<td>Yes</td>
<td>No</td>
<td>16Z</td>
<td>Too Cellular</td>
</tr>
<tr>
<td>Mar 7th, 2018</td>
<td>Yes (GLM)</td>
<td>Yes (GLM)</td>
<td>16Z</td>
<td>Low Light</td>
</tr>
<tr>
<td>Mar 13th, 2018</td>
<td>Yes (GLM)</td>
<td>Yes (GLM)</td>
<td>16Z</td>
<td>Lake</td>
</tr>
<tr>
<td>Apr 3rd, 2018</td>
<td>Yes (GLM)</td>
<td>Yes (GLM)</td>
<td>16Z</td>
<td>Too Cellular</td>
</tr>
</tbody>
</table>

A quick table summary of each case thoroughly analyzed so far including date of event, general area, time, whether or not ZDR streaks were present, if lightning was reported, and the type of storm that was studied.

Introduction

- Dual polarization radar uses a vertical and horizontal pulse to detect the types of particles in clouds.
- Different particles have different ratios of horizontal and vertical reflections.
- Snowflakes typically have higher horizontal values than vertical values.

A National Weather Service illustration of how dual polarization radar works, and how it can detect different particle types.

A valid case vs. a null case. The Denver snowstorm (03/13/2019) shows clear ZDR streaks due to the stratiform structure of the storm with Denver being marked by a yellow star, while the Michigan case (4/4/2018) is too cellular to produce clear depolarization on radar.