



Evaluation of the Alberta Hail Suppression Project Using Radar Observations

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Motivation

Severe hailstorms are a common occurrence around the Calgary region in Alberta, Canada. Hailstorm induced property damages worth approximately 500 (CAD) million were reported in the last two decades alone. Insurance companies have funded weather modification programs since 1997 to reduce property damages from hailstorms. But there is a need to determine the feasibility of such programs. This has led to the commencement of a research aiming to evaluate the effectiveness of the Calgary weather modification programs. Statistical analysis of storms from data collected over several years is used to obtain an overall project effectiveness which would then be used in a cost-benefit analysis of the program. Results of this research would also be of immense help to atmospheric scientists working in the fields of cloud microphysics and cloud modelling.

Data

- The current project uses a C-band Doppler radar located at Olds-Didsbury Airport.
- The radar is operated with less than 4 minutes volume scans.
- Data from an Environment Canada operated C-band Doppler radar placed in Strathmore is also used.
- The Strathmore radar is operated with less than 5 minutes volume scans.
- Data is analyzed using the LIDAR Radar Open Software Environment (LROSE) software package to quantify the amount of damaging hail present within observed storms.

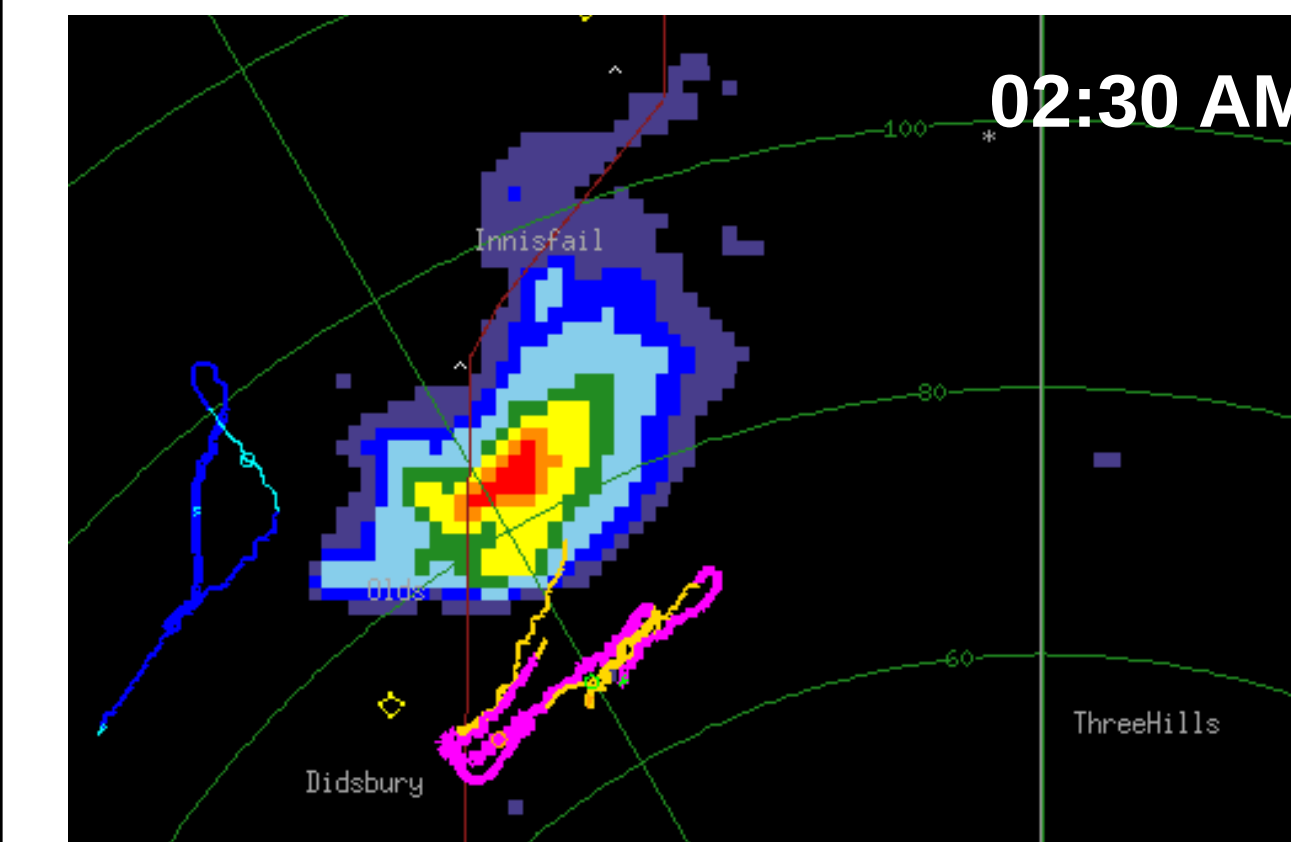
Hail Swath from July 8, 2013



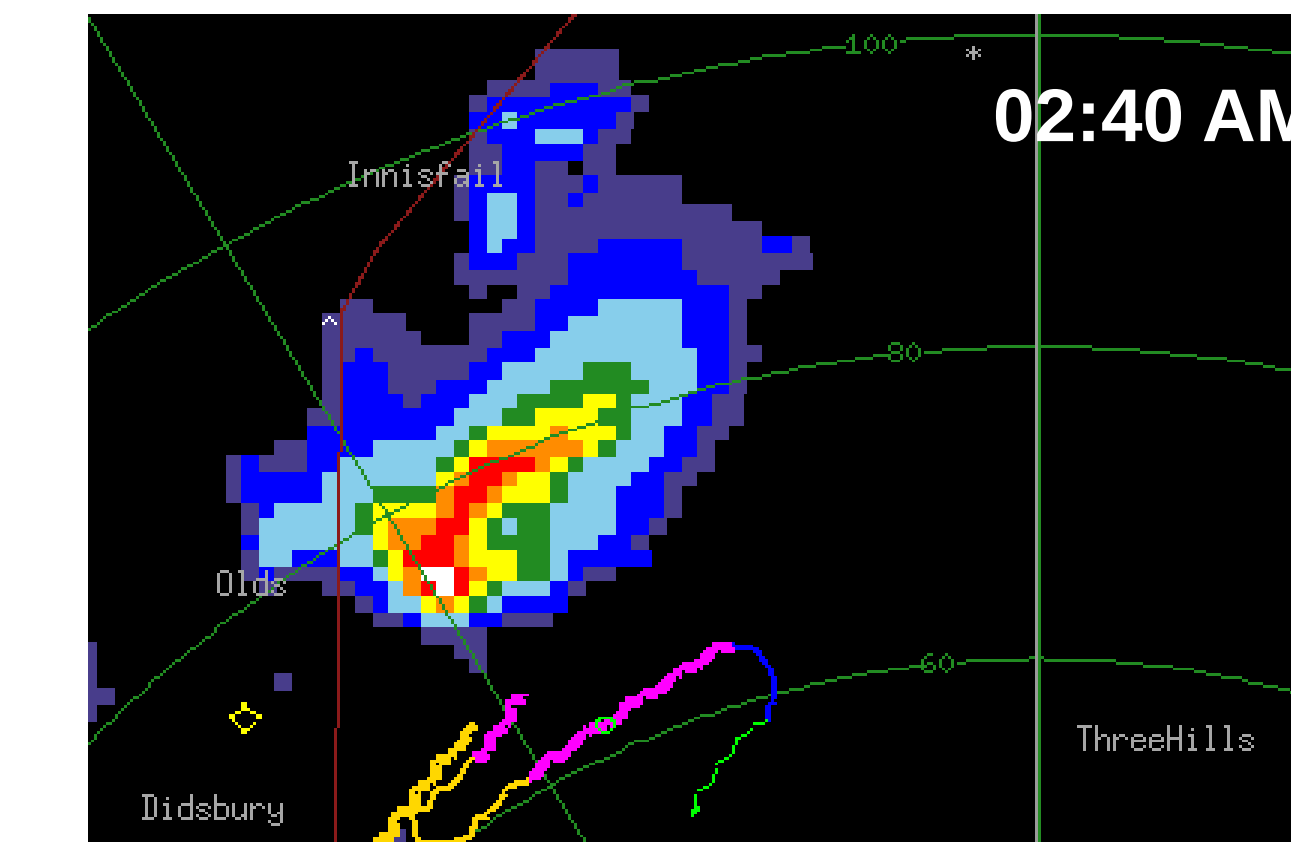
Methodology

- Storms are identified into three possible target categories, treated (seeded), non-treated (non-seeded) or non-analyzed.
- Two metrics, Vertically Integrated Liquid Water Content (VIL) and Area of Storm having reflectivity greater than 60 dBZ are used.
- Metric ratios are computed for both treated and untreated storms.
- The ratios are used to determine the overall effectiveness of the hail suppression process.

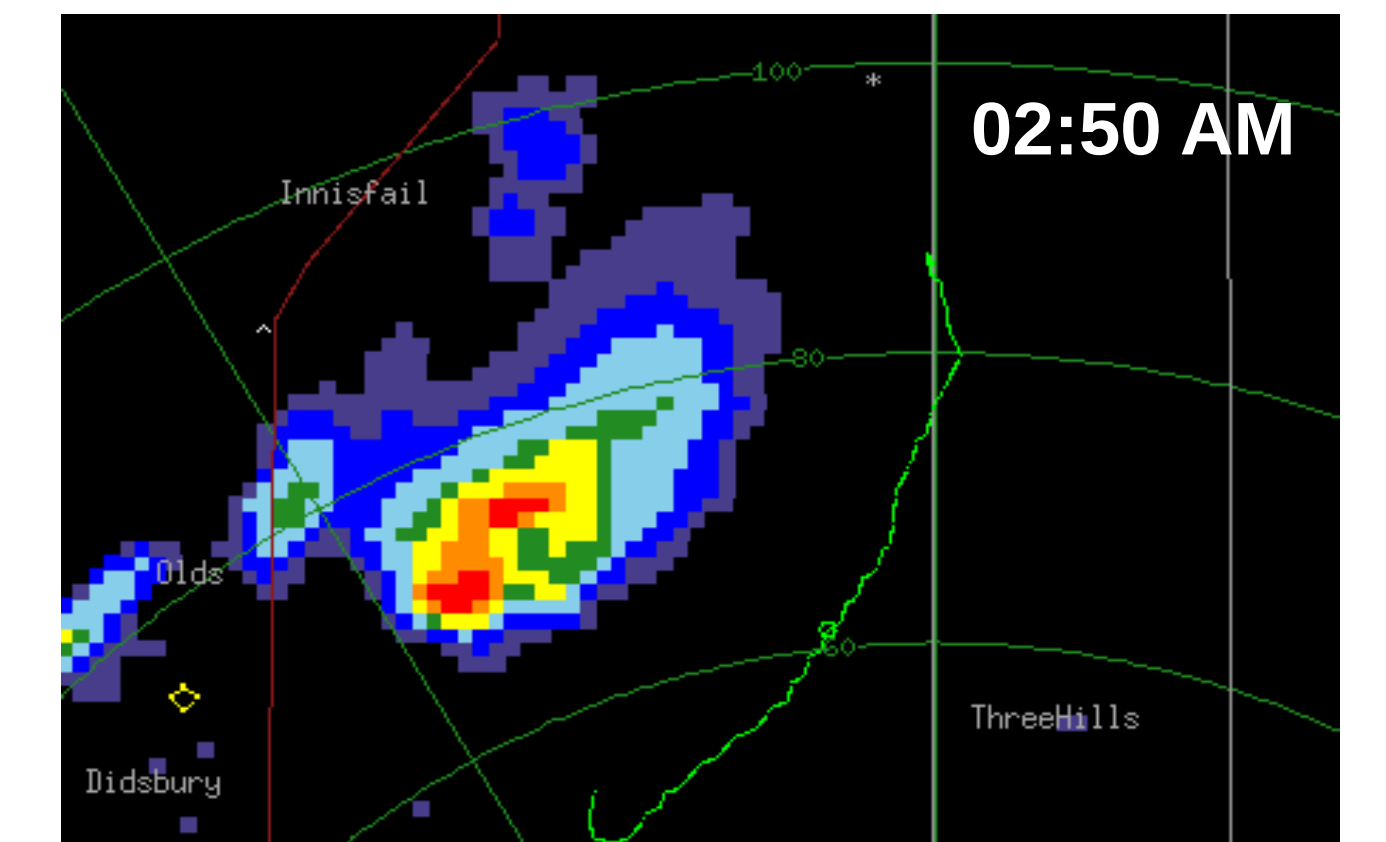
VIL Swath in a Seeded Target Case from July 10, 2017



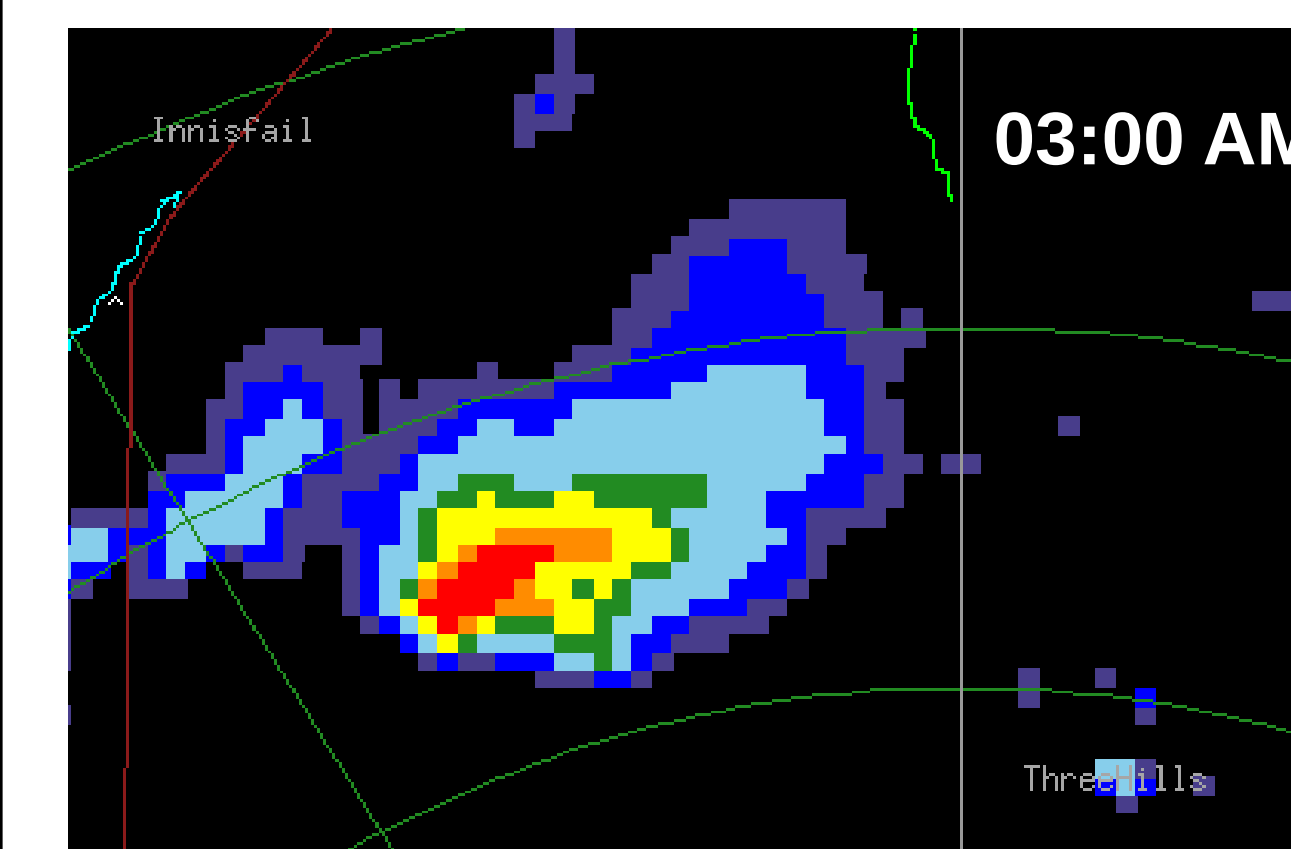
Seeding Starts



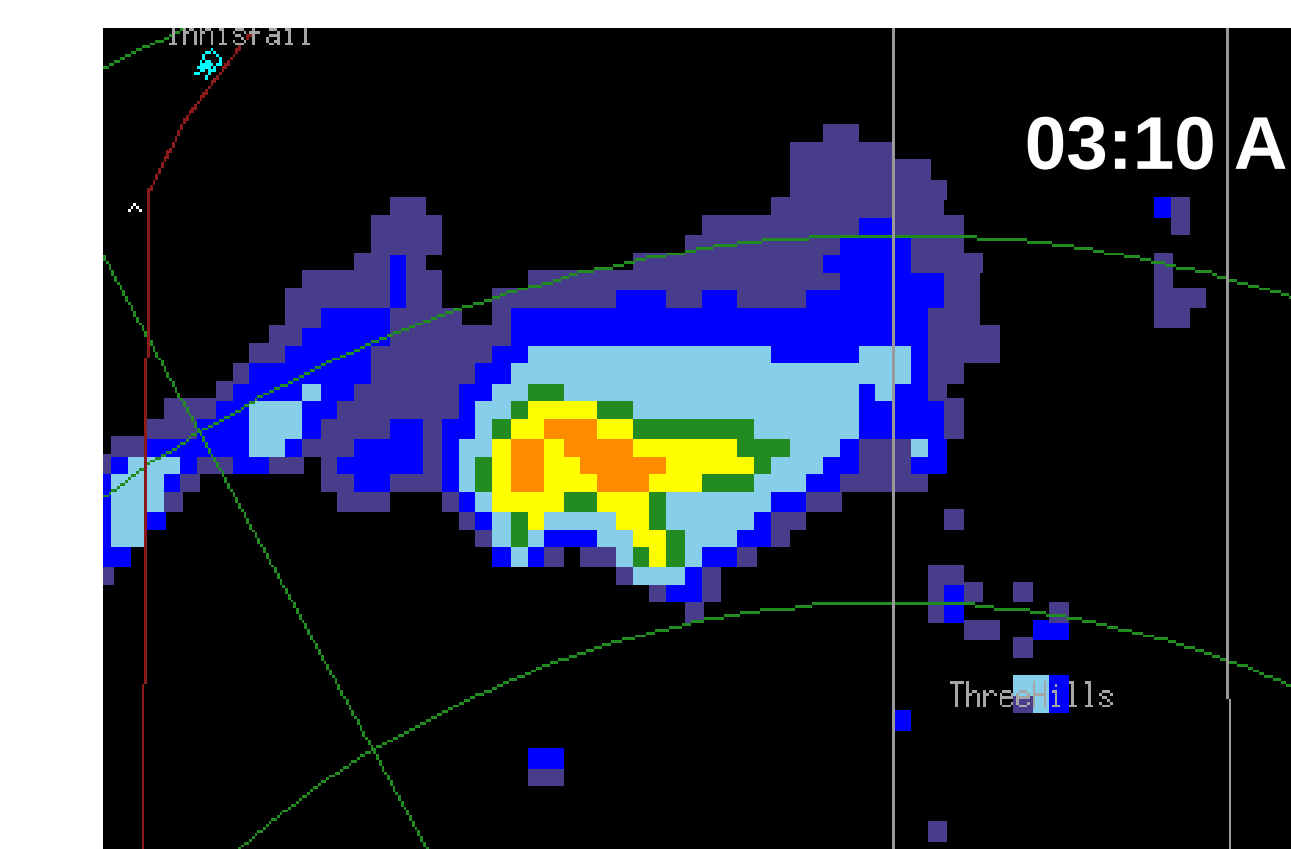
Seeding Continues



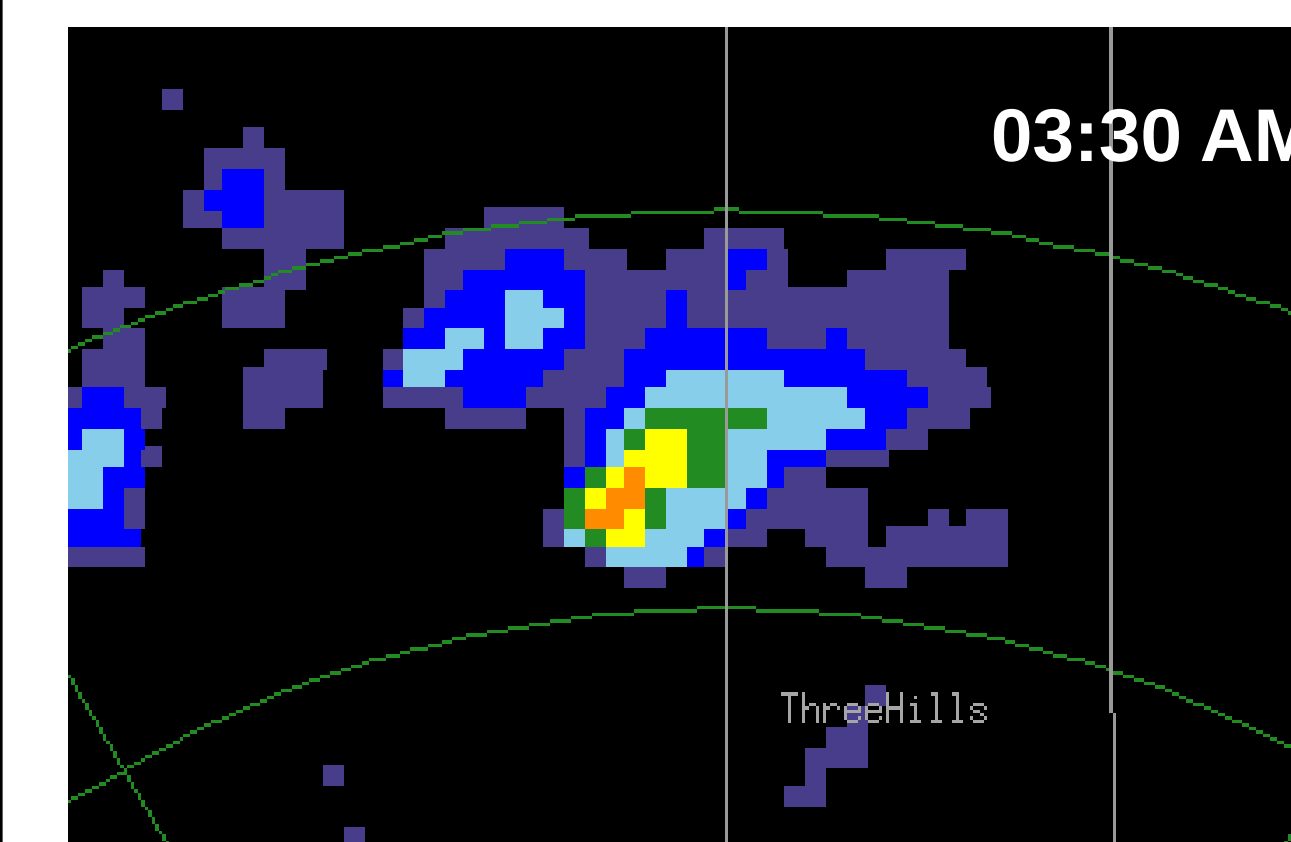
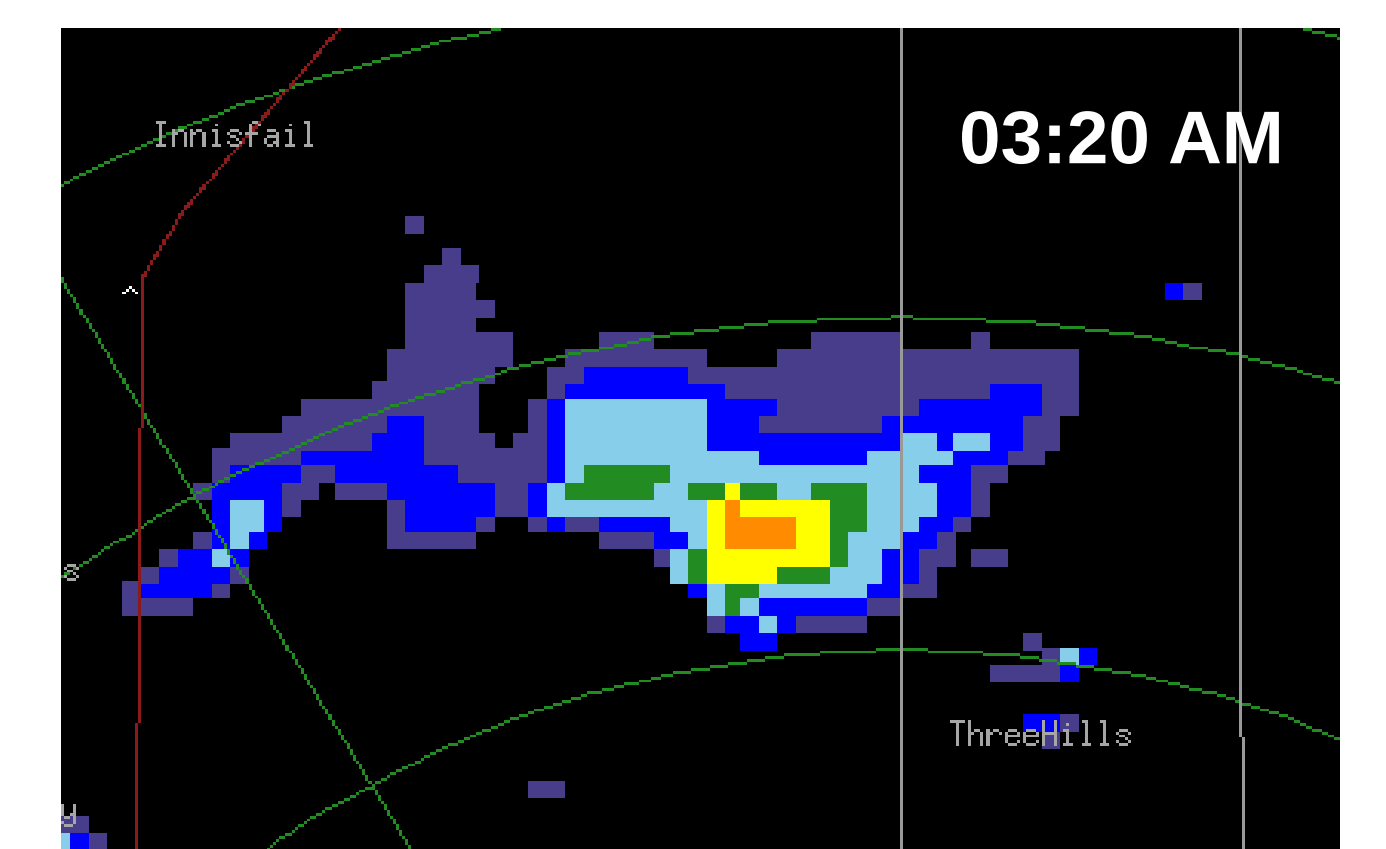
Seeding Ends



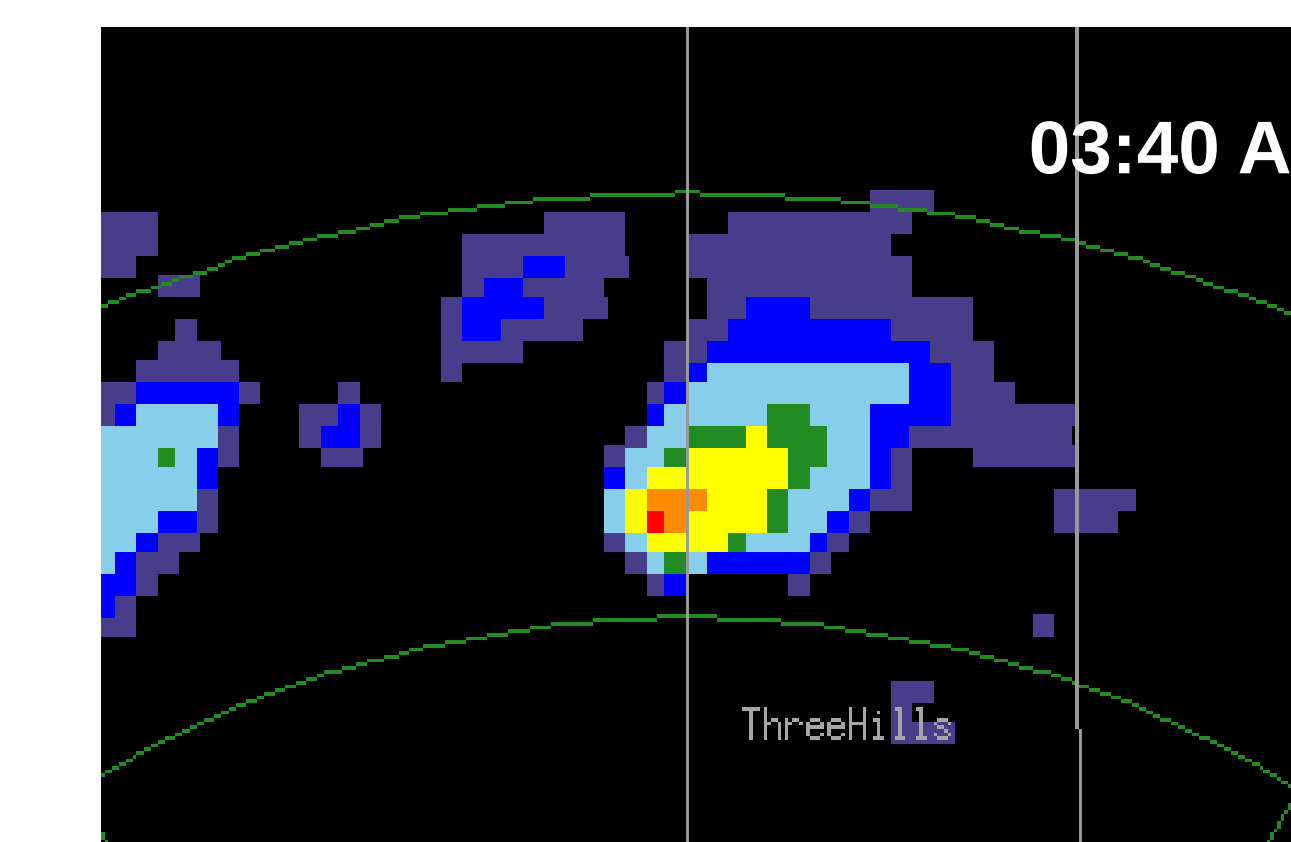
High VIL values still present



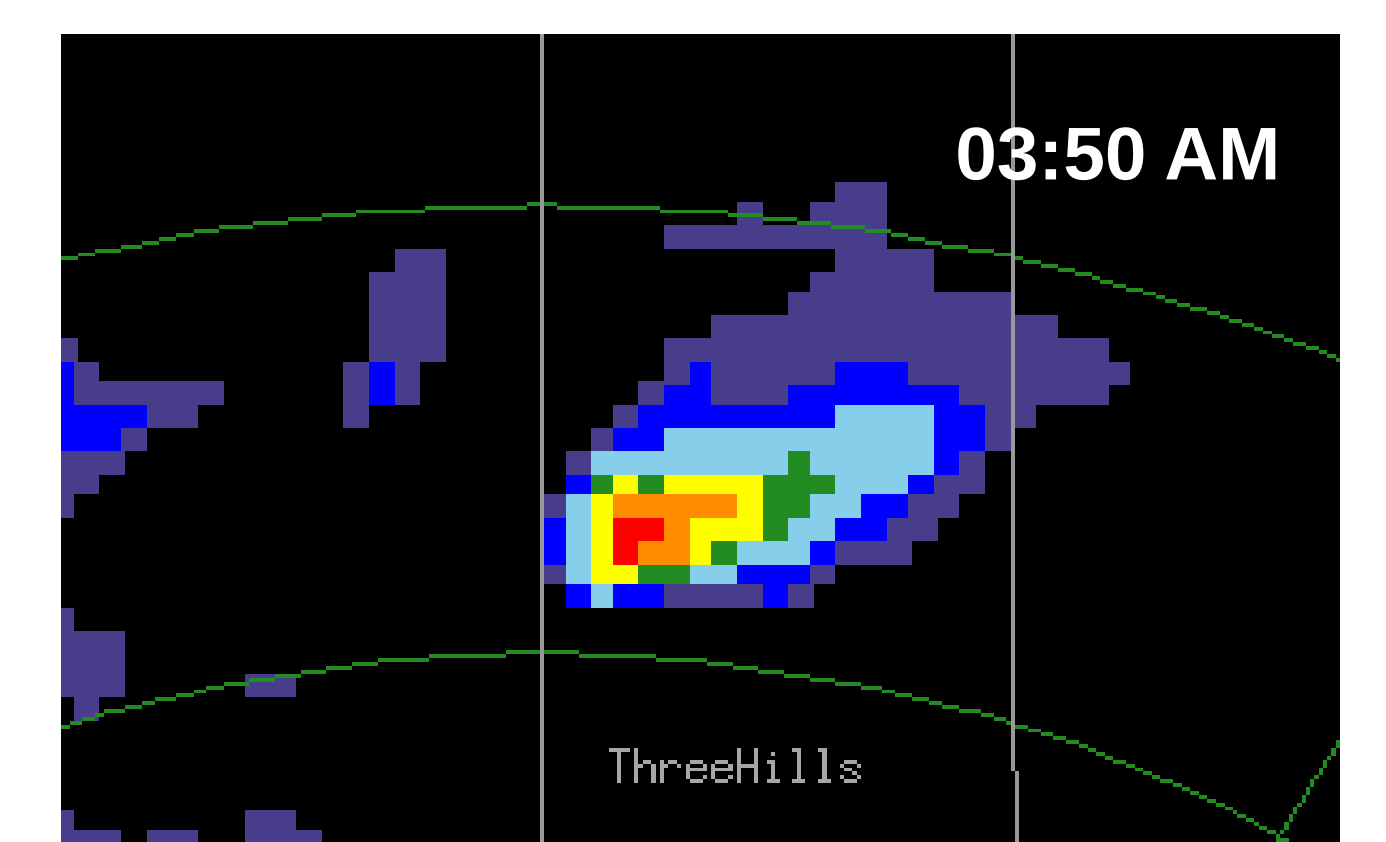
Gradual Reduction in High VIL values is observed



No further reduction in High VIL value is observed



Rise in VIL values observed in same storm cell



C-Band Radar at Strathmore, Alberta



Classification of Target Cases

- Storms that threaten the protected zone inside the radar coverage area and are treated with at least 2 kg of seeding material are categorized as treated (seeded) cases.
- Storms inside the radar coverage area but not threatening the protected area are not treated with seeding materials. These constitute the non-treated (non-seeded) cases.
- Parts of storms that re-strengthen at least 30 minutes after the termination of seeding are also classified as non-treated (non-seeded) target cases.
- Storms falling into none of the above mentioned categories are classified as non-analyzed cases and are not studied.

Results and Conclusions

- Initial observations from one day (July 10, 2017) shows a significant reduction in high VIL values about 20 minutes after the end of seeding which is consistent with the fact that it takes 20 to 30 minutes to see the effects of seeding.
- VIL values start rising about 1 hour after the end of seeding which is also consistent with the fact that the effects of seeding are practically negligible 40 or 50 minutes after the end of seeding. After this time the storm can be considered as a non-treated target case since it is not seeded anymore.
- Results from one seeded case indicate that seeding can be an effective process.

Future Work

- Analysis to be carried out using data from multiple years to obtain a more concrete and statistically significant result about the effectiveness of hail suppression processes.