

# NHP Year in Review

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30 October 2023

Joint NHP – CMRR – ICLR Multi-Hazard Risk and  
Resilience Workshop

## Rationale

- Hail is becoming an increasingly costly problem in Canada
- Almost 40 years since last hail research program concluded
- Significant gaps in our understanding and knowledge of hail remain

## Mission

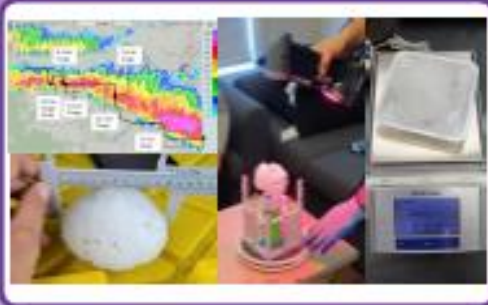
To advance our understanding of the meteorology, climatology and impacts of damaging hail across Canada

## Outcomes

- Increased resilience to hail for Canadians, municipalities, businesses and other stakeholders
- Updated and new building codes
- New scientists: 17 graduate students (10 Phd & 7 MSc), over 40 interns

1

Hail events  
Size, amount, weight, swath properties. 3D scans of hail



4

National  
damaging hail  
event archive &  
climatology from  
diverse sources



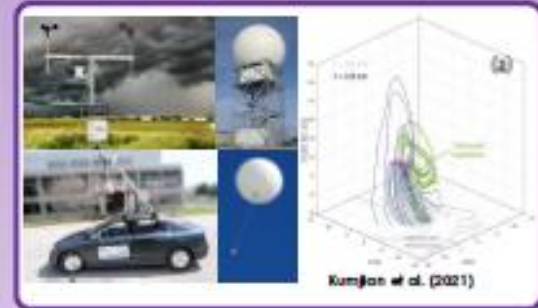
2

Hail fall speed &  
aerodynamics  
using micro  
sensors & high  
speed video



5

Hailstorm  
environments  
using in-situ data.  
Improved model  
microphysics



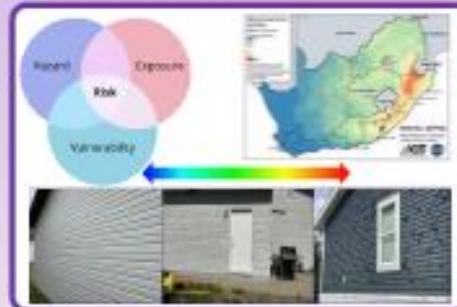
3

Urban & rural hail  
damage surveys  
by engineers  
using LiDAR &  
UAVs



6

Hail hazard,  
& vulnerability  
modelling.  
Updated hail  
intensity scales



## Partners



Instant **Weather**

**WEATHERLOGICS**

# Overview

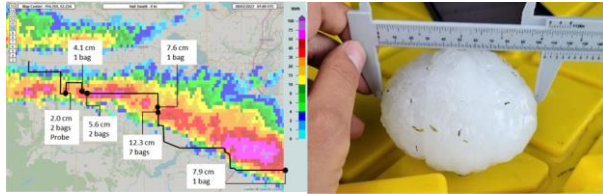
- Two very successful field seasons planned and executed in span of 15-mo
- Hailpad network expanded and modified to be safer in 2023
- Network of three supersites was planned and installed in 2023
- 13 forensic level hail damage surveys conducted in AB, SK, MB and ON
- New UAVs, instrument platforms and sampling strategies were tested
- App for tracking the maintenance of the hailpad network developed and implemented
- Data portal for disdrometer data developed, implemented
- Eight summer intern students, with diverse backgrounds, trained
- Significant interest from the media (print and radio) again this year
- Validation of the ATMOS41 weather station data was undertaken by summer high-school intern
- Field work is *tough* and we had to overcome many challenges



# Field Operations for 2023

## Hail Sampling Team (3)

Same format as last year. Improved protocols for intercepting, sampling & collecting hail samples.



## Hailpad Network

- Expand network from 55 km to 75 km in length (40 hailpads).
- Move some pads to safer locations.
- Three supersites with disdrometer stations, solar-powered cell cameras with motion sensors.

## UAV Team (3)

Flights over crops before and after hailstorm using multispectral & thermal cameras.



## Damage Survey Team (3)

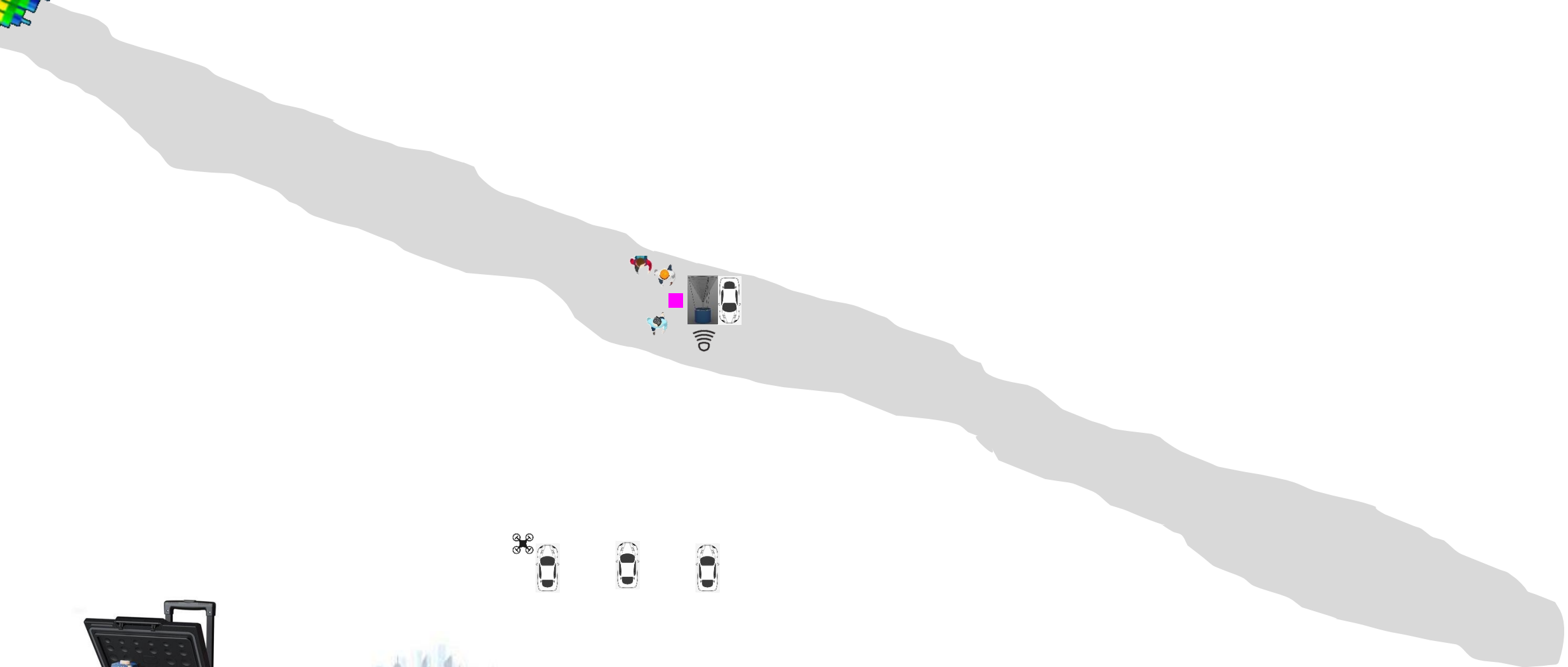
Conduct forensic damage surveys in both urban & rural settings.



## Outreach

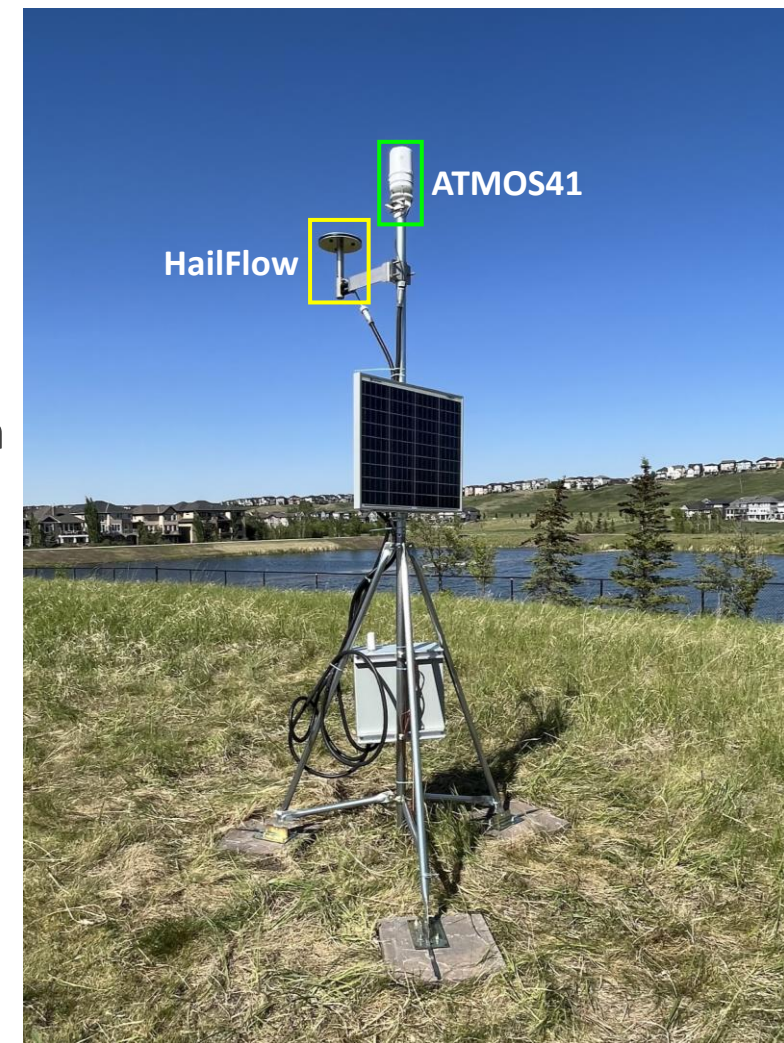
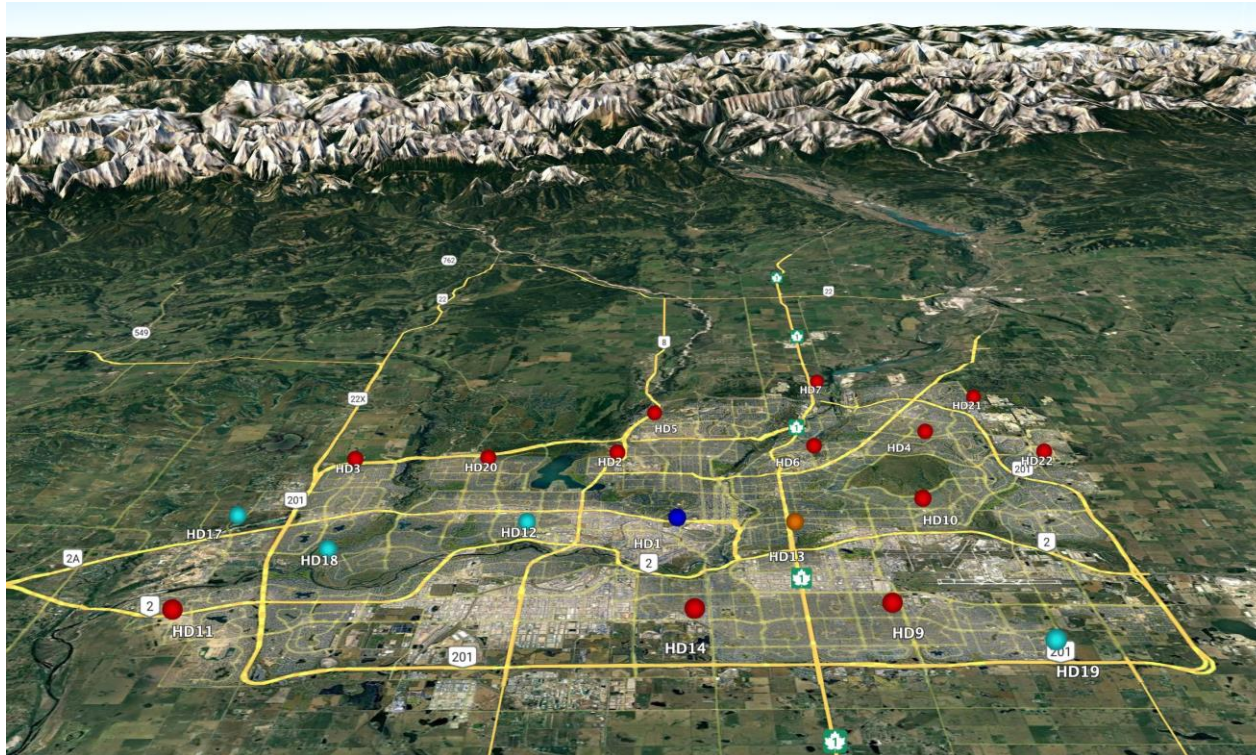
- Media day.
- Guest lectures.





# Calgary Hail Disdrometer Network

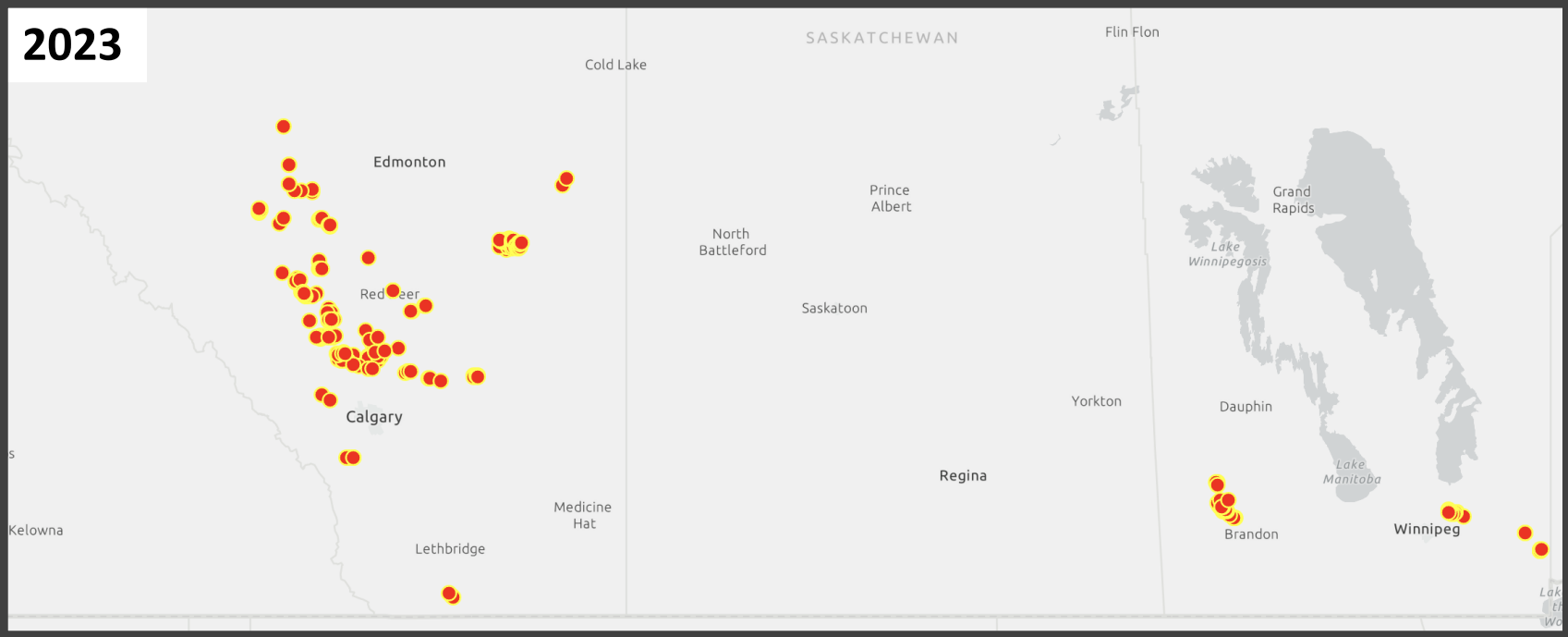
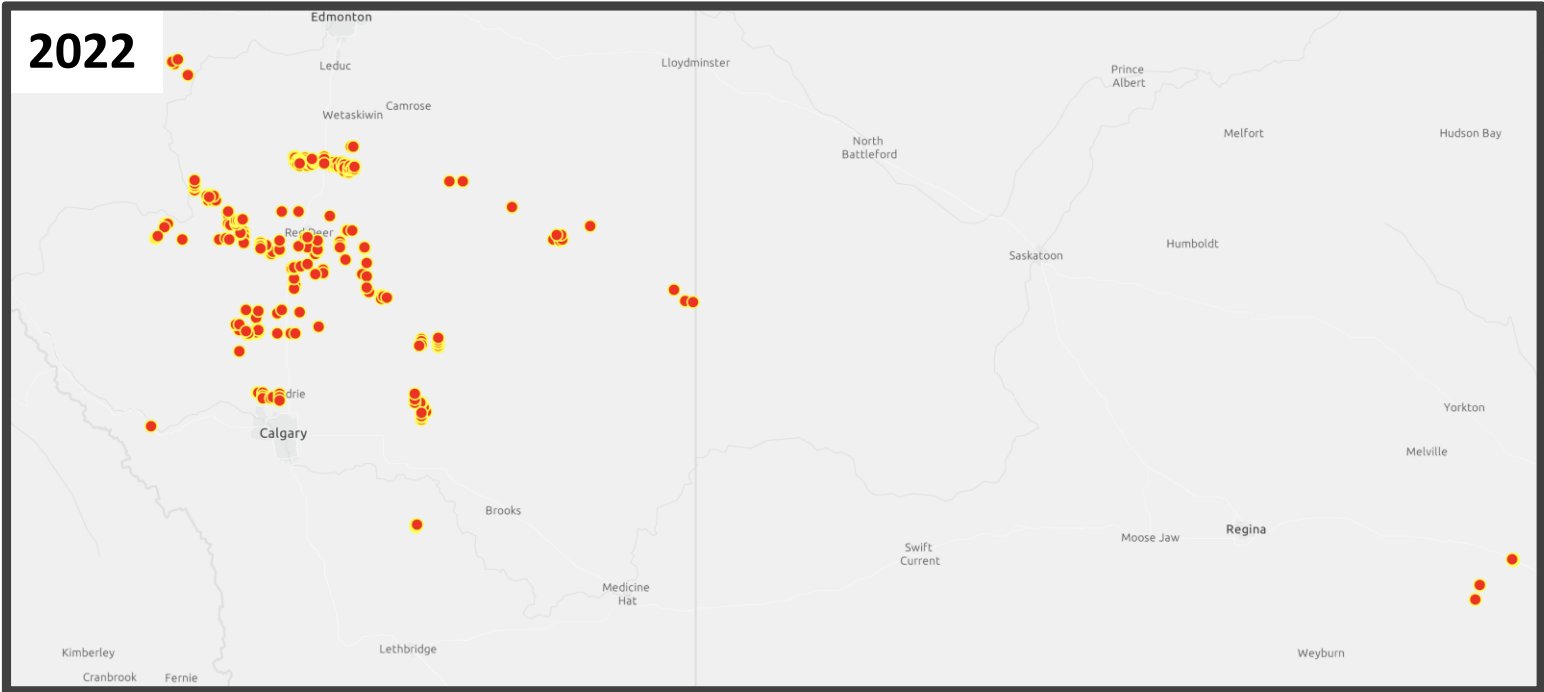
- Mammoth undertaking almost 2-y in the making
- 19 stations installed
- Located at fire stations and pond sites
- Want most residential and commercial areas to be within ~4 km of a station
- Online data viewer in development
- Data is displayed in near real-time, every 10-min
- Already captured numerous hail events



# Comparison with 2022

|   | <b>2022</b>       | <b>2023</b>       |
|---|-------------------|-------------------|
| <b>Missions</b>                                       | <b>20</b>         | <b>15</b>         |
| <b>Storms sampled</b>                                 | <b>38</b>         | <b>23</b>         |
| <b>1-2-3 Survey Points<br/>(Missions only)</b>        | <b>272</b>        | <b>110</b>        |
| <b>Date of first hail<br/>collection for analysis</b> | <b>25 June</b>    | <b>27 June</b>    |
| <b>Bags Hail collected</b>                            | <b>55</b>         | <b>56</b>         |
| <b>Field vehicles</b>                                 | <b>1</b>          | <b>3</b>          |
| <b>Distance Driven</b>                                | <b>~20,000 km</b> | <b>~16,000 km</b> |

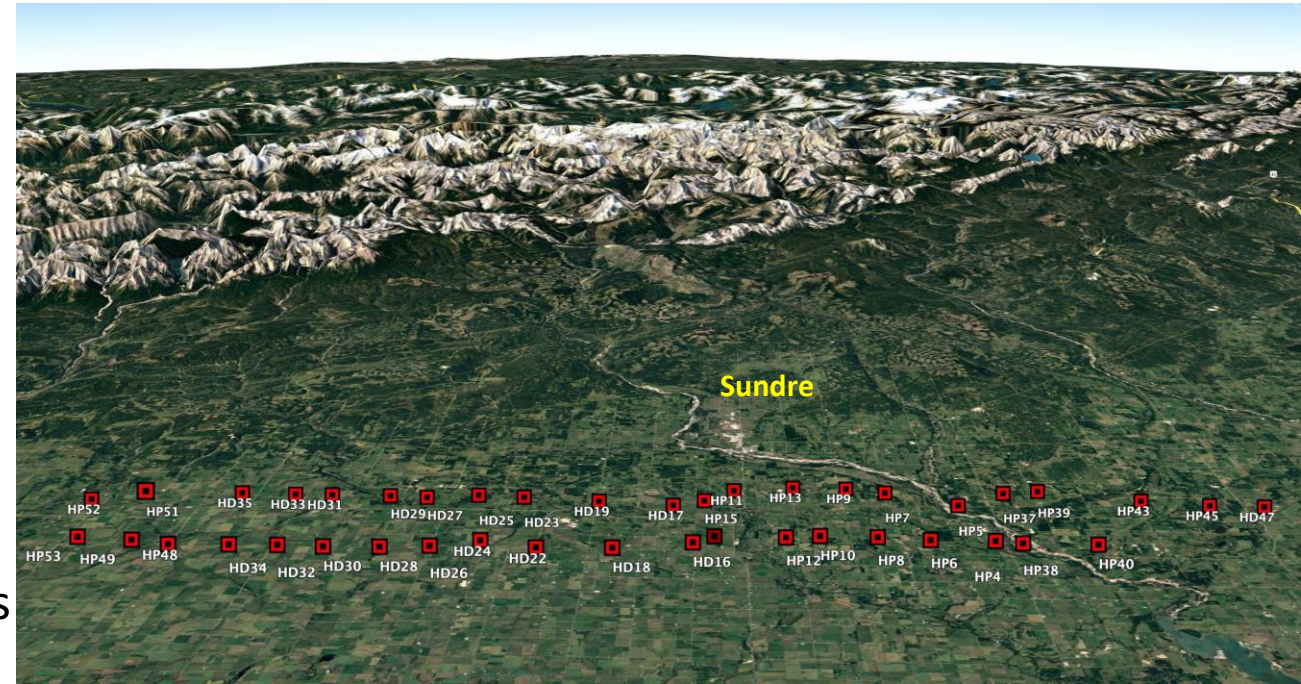
# Survey Points





# Hailpad Network

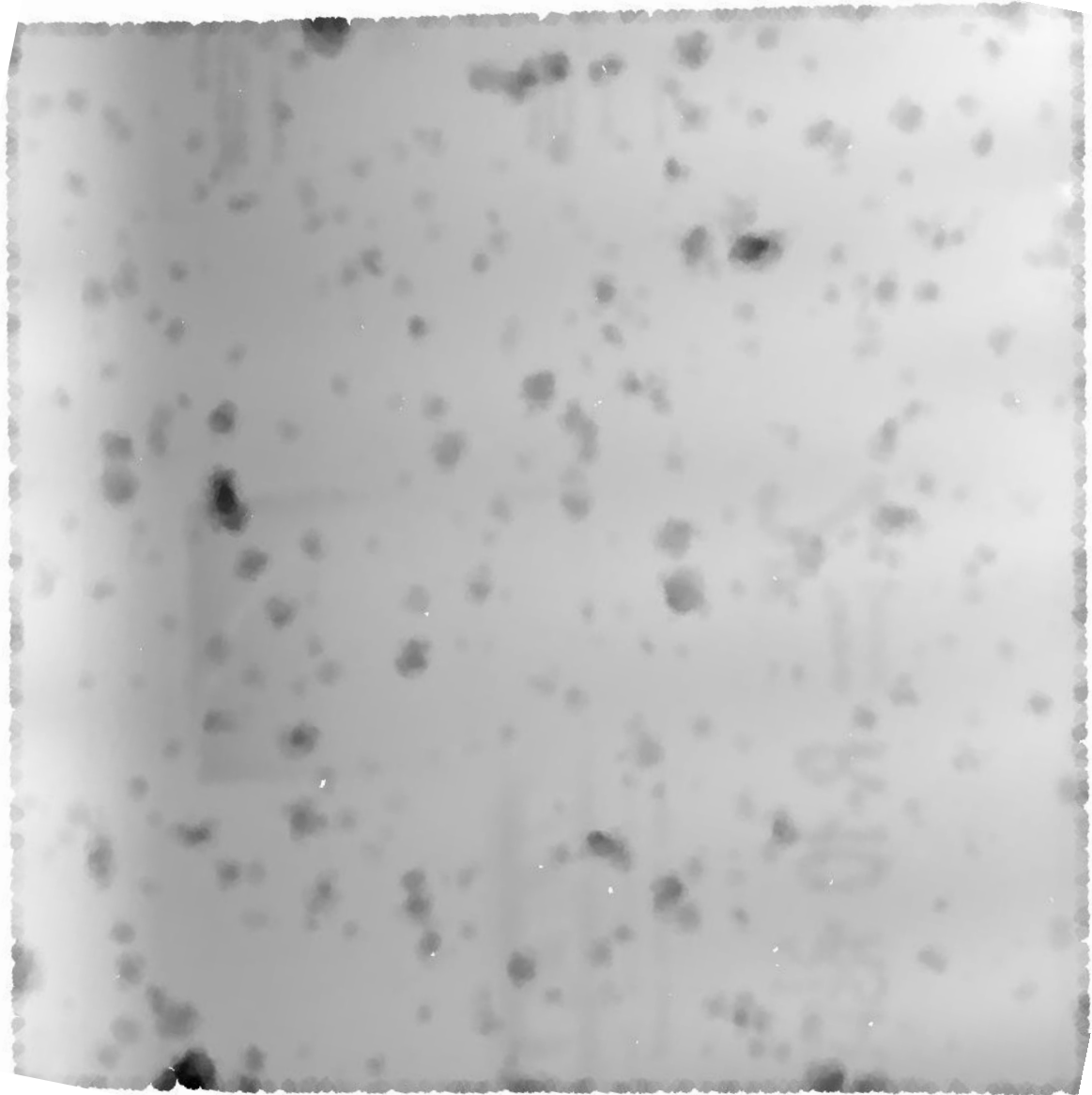
- Increased network from 34 to 40 hailpads. This is the upper limit that we can manage
- $\sim 415 \text{ km}^2$ , one hailpad per  $10.5 \text{ km}^2$
- Three hailpads at supersites and one near Bowden (next to traffic weather station) on HWY2
- Tried a new slightly softer foam this year
- Conducted side-by-side tests to identify differences



## Preliminary 2023 Data

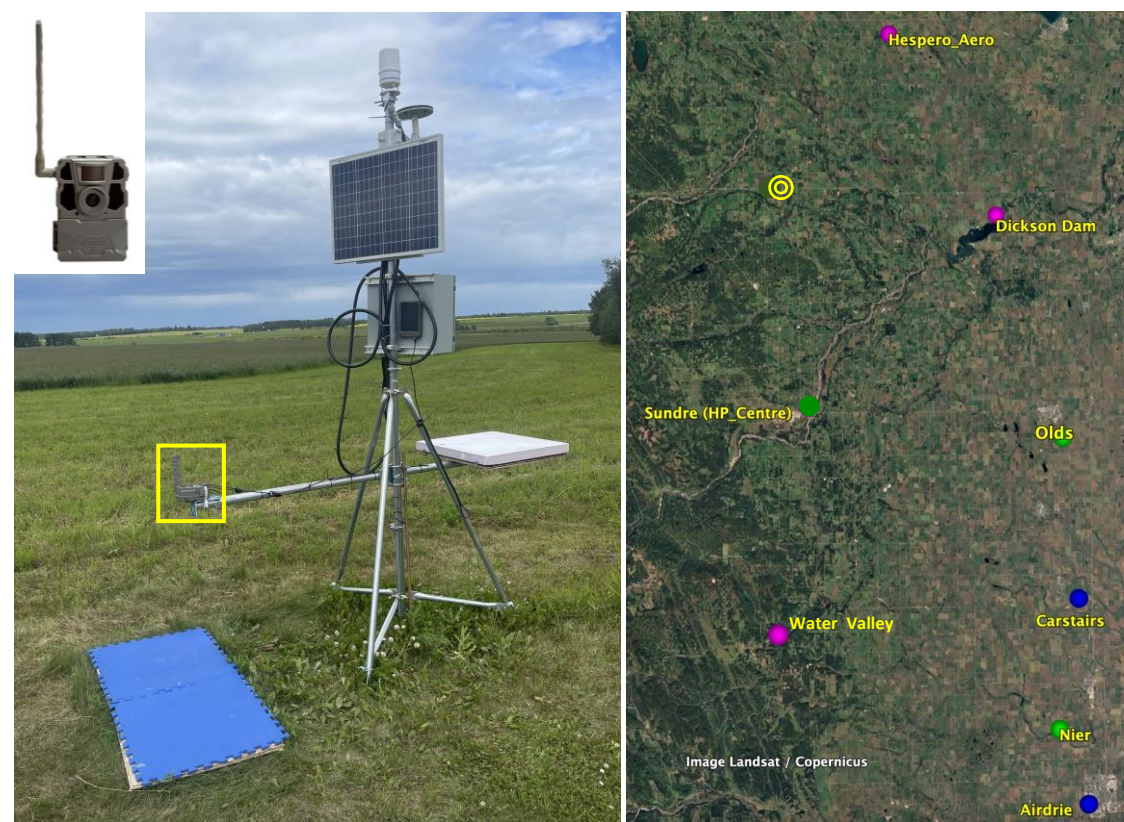
- 57 hailpads hit by hail (93 in 2022) on 18 days
- One site hit by hail four times (max. 7 times in 2022)
- Over 150 hailpads need to be analyzed
- Student going to work on automated analysis over the fall and winter (3D scanner, Lidar and ML)
- Energy-matching drop tests for new and old foams will be needed for calibration





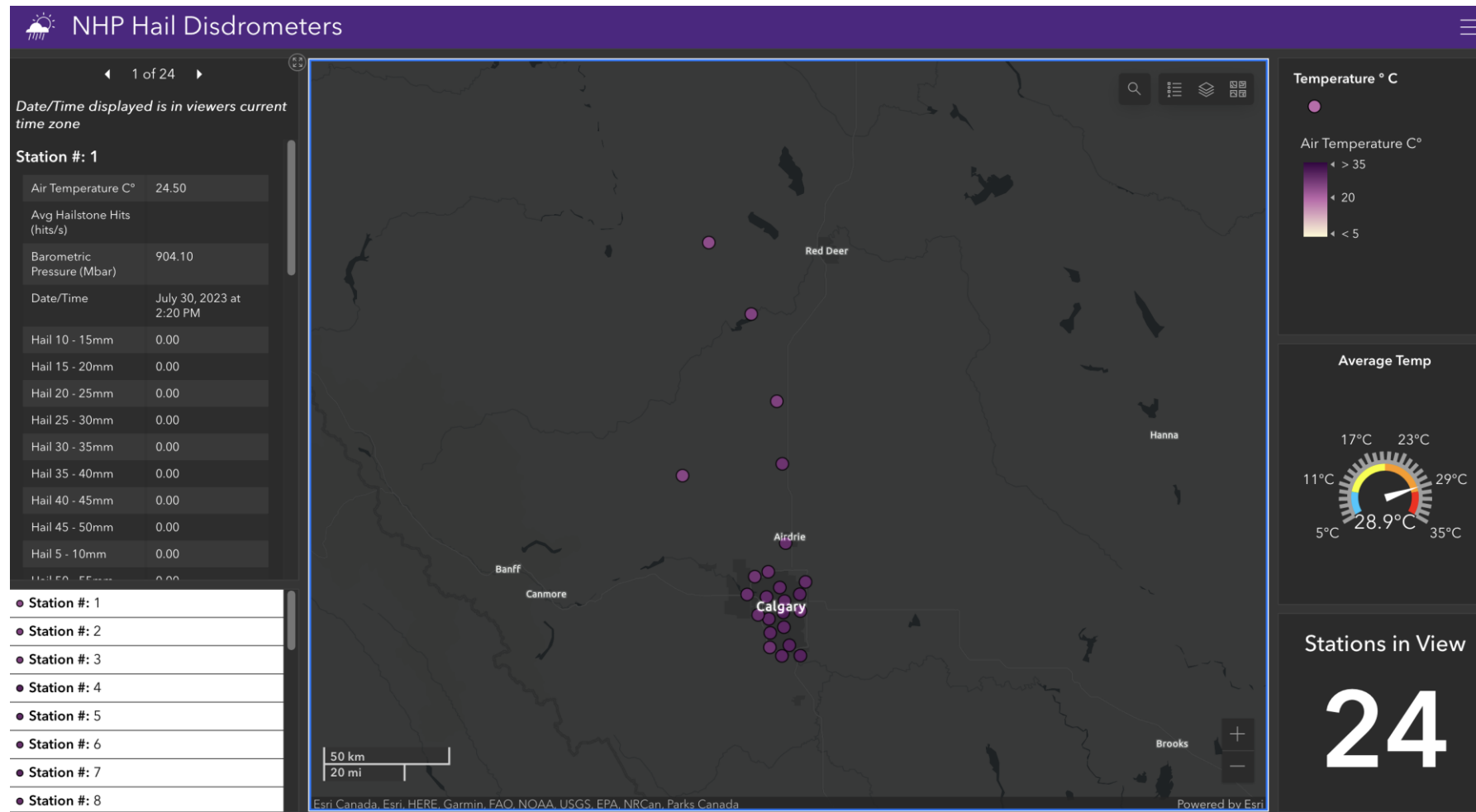
# Supersites

- Three supersites were installed outside of Calgary this season. Done with help of interns. They did a great job!
- Purpose of the supersites was threefold:
  - i. Validate ATMOS station*
  - ii. Test trail cameras*
  - iii. Collect hail data to validate the HailFlow sensor (against hailpad and camera data)*
- Two supersites were placed adjacent WMO-standard stations. A fully equipped station at Olds Farm and a weighing gauge at Dickson Dam



# Data Sharing: Open Data Portals

- Continue to develop the Disdrometer data portal
- Add post-processed variables (hail flag, max. hail size, accumulated rain)
- Add graphing functionality to Disdrometer data portal and, if possible, with mouse over data display



# Open Data Portals

- The NHP Open Data Portal is under development
- Rollout in the coming months, data will be added as they become available
- Will also develop a new app geared towards collecting hail damage survey data

## Northern Hail Project



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### Hail Surveys

Our hail survey results are currently an accumulation of hail sample collection points and ground damage surveys. Our hail survey teams were split into two teams (located primarily in Alberta), one of which tracked storms and followed in behind the storms to take hail samples, while the other team dispersed to areas of damage to take damage surveys.

Total Hail Surveys

814

Source: [NHP Hail Survey\\_stakeholder](#)

2023 Hail Surveys

507

Source: [NHP Hail Survey\\_stakeholder](#)

### Weekly Summary Maps

These new summary maps provide additional information about investigated events that the ground survey teams embarked on throughout the field season. These maps include a write up of the past weeks events by the team, ground survey points, and hail pad inspections done by the team.

Browse the gallery of summary maps below or explore all event summary maps along with their associated datasets. Investigated events are provided in a snapshot view which are updated by the team as events are reported. In the future, if you'd like to search by specific year, province or other categories there will eventually be a [searchable dashboard](#) (linked is our partner NTP Dashboard as an example) with links out to weekly summary maps associated with those events.



NHP Weekly Summary Map (July 10 - July 16, 2023)

Weekly summary map for NHP field operations from July 10 - July 16, 2023. Map includes...

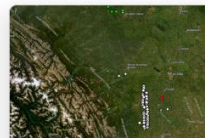
Explore



NHP Weekly Summary Map (July 17 - July 23, 2023)

Weekly summary map for NHP field operations from July 17 - July 23, 2023. Map includes...

Explore



NHP Weekly Summary Map (July 24 - July 30, 2023)

Weekly summary map for NHP field operations from July 24 - July 30, 2023. Map includes...

Explore



NHP Weekly Summary Map (July 3 - July 9, 2023)

Weekly summary map for NHP field operations from July 3 - July 9, 2023. Map includes damage...

Explore

## Northern Hail Project



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# Open Data

for the Northern Hail Project

Search, Explore, Download, Create...

### 2023 At a Glance

Ground Surveys  
Total survey points collected

507

Last update: 1 minute ago

Hail Samples Collected  
Total hail sample bags collected by ground survey teams

59

Last update: 1 minute ago

Average Mass (in g)  
Average mass of largest hail stone collected (g)

36.5 g

Last update: 1 minute ago

Hail Pads Hit  
Total # of times a hail pad was hit in 2023

64

Last update: 1 minute ago

# Data Inventory

- **MESH hailswath** database [Start, end, maximum value, maximum width]. [2022]
- **End point data** from hailswath intercept missions [Lat/Lon] [2022]
- *Event summaries for hailstorm/hailswath* [Not yet]

- **Hailswath sampling** info. [Lat/Lon, time, ground coverage, damage indicators, hail samples collected (yes/no), storm seeded (yes/no)]. [2022/2023]
- **Damage surveys** [Lots of data!] [Mostly 2023]

- **Hailstone analysis** [**O(1000)**, 3 axes, mass] [2022, 2023]
- **3D scans**: 35 hailstones, Dimensions, bulk density. [.STL files] [2022,2023]
- Embryo analysis, porosity analysis and isotopes [Not yet]

- **Hailpad data** [Hit (yes/no), number of impacts, HSD, Max. D, estimated accumulated kinetic energy and hail mass, divot depth and volume(?)] [None yet, hit yes/no only]

*All of the above in the process of being quality controlled. They will be published on Open Data Portal once completed.*

# Data Inventory Cont.

- **Disdrometer** data [number of impacts per 10-min, HSD in 5 mm increments] [2023]
- **Weather station** data [T, RH, P, e, lightning, pressure, rainfall, solar radiation, wind speed and direction and gusts] [2023]

- Hail scars from satellite images [Not yet]

- **Trail camera** imagery [Static images when movement detected, not many with hail] [2023]

- **UAV** imagery [Static images, orthomosaics] [2023]

- **Videos** from probe cameras [2023]
- **Route data** for vehicles during missions [2022, 2023]
- **Dashcam** footage vehicles [2022, 2023]

*All of the above in the process of being quality controlled. They will be published on Open Data Portal once completed.*

**Thank You!**

