NHP Year in Review

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

Credit: Kyle Brittain

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

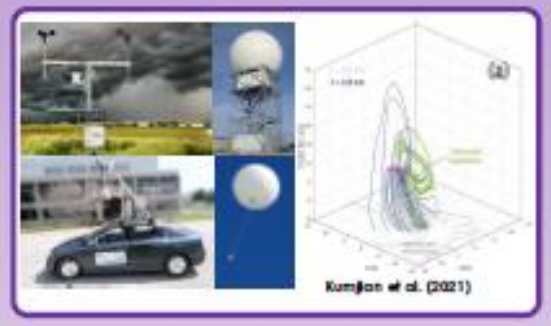
1 Hail events Size, amount, weight, swath properties. 3D scans of hail

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

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

4 National damaging hail event archive & climatology from diverse sources

5 Hailstorm environments using in-situ data. Improved model microphysics



6 Hail hazard, &vulnerability modelling. Updated hail intensity scales

Partners

Institute for Catastrophic Loss Reduction

Insurance Institute for Business & Home Safety®

Instant Weather™

WEATHERLOGICS

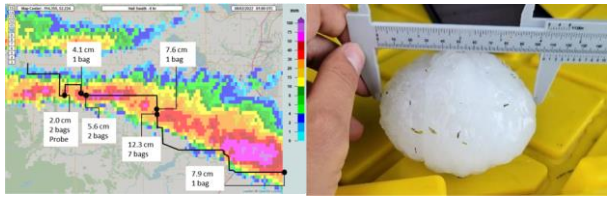
Overview

- 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

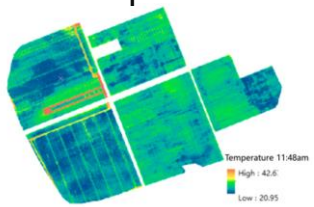
Hail Sampling Team (3)

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



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.

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.

Outreach

- Media day.
- Guest lectures.

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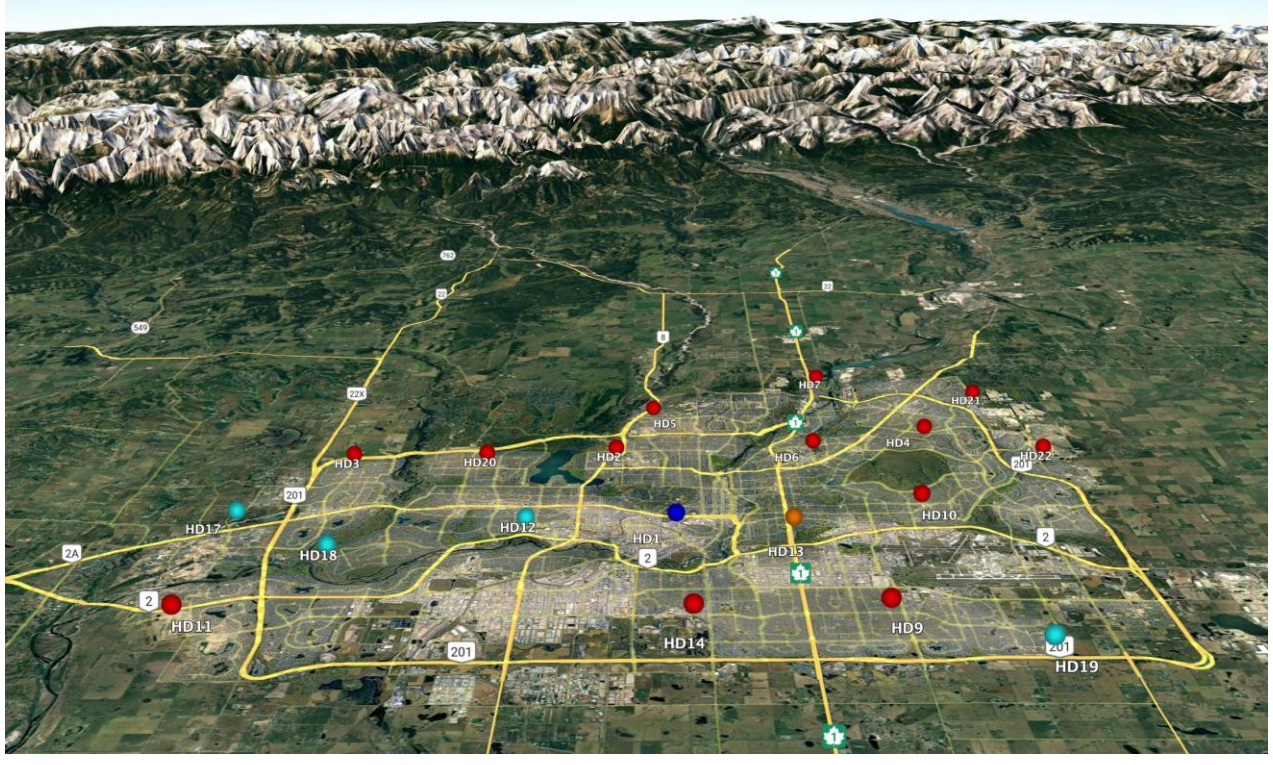
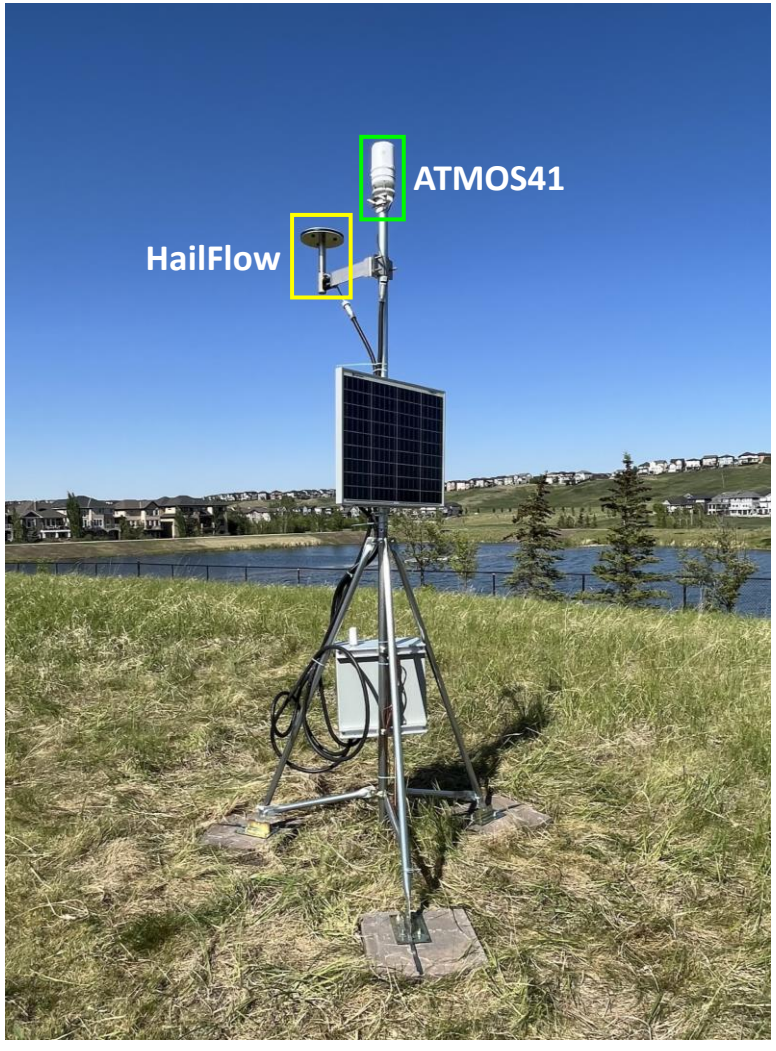
Calgary Hail Disdrometer Network

- 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

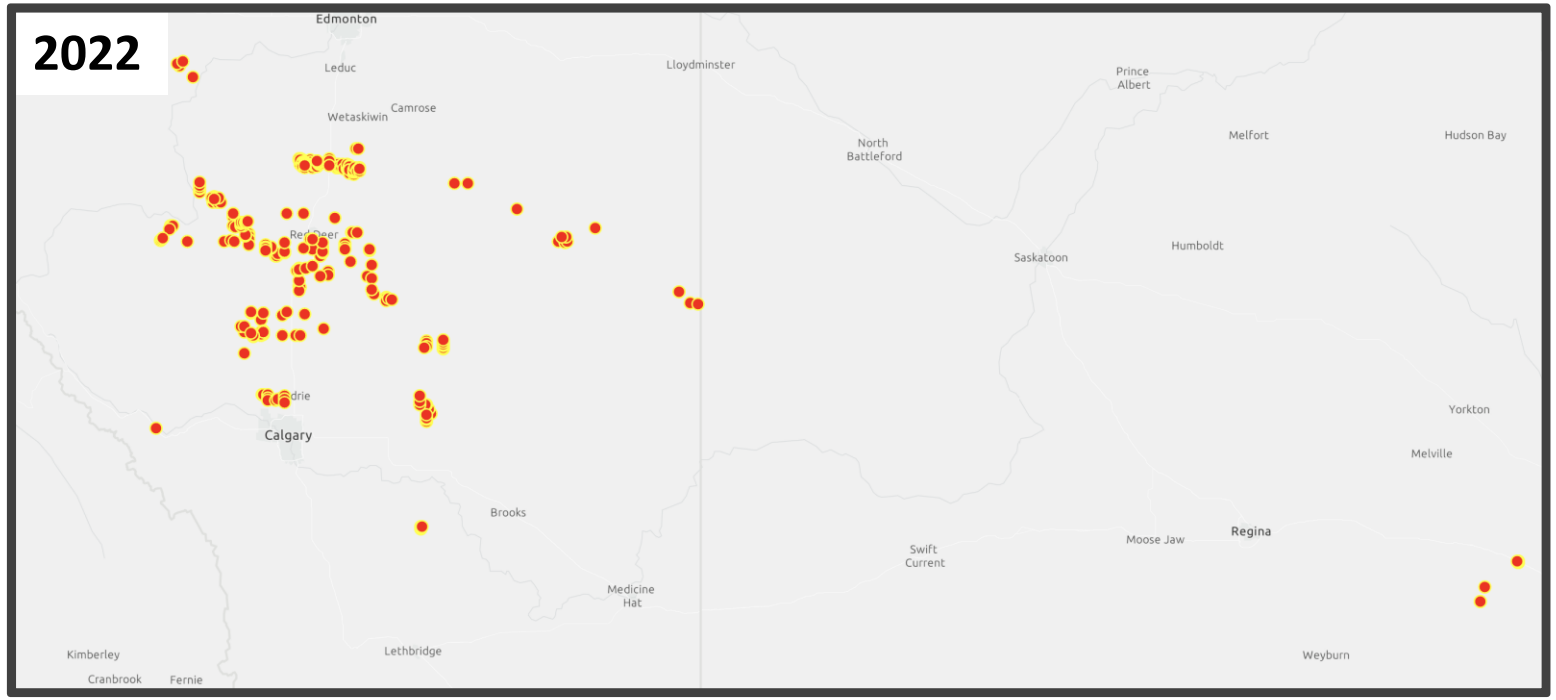


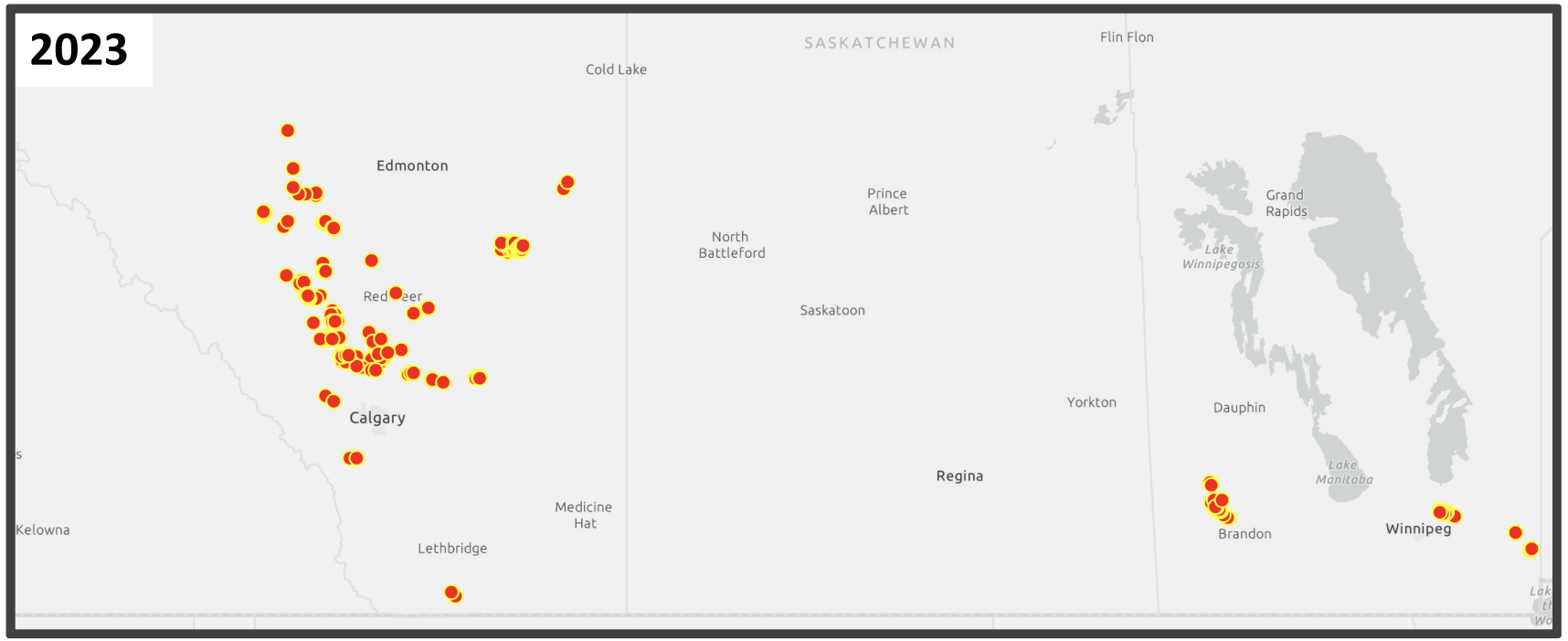


Comparison with 2022

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

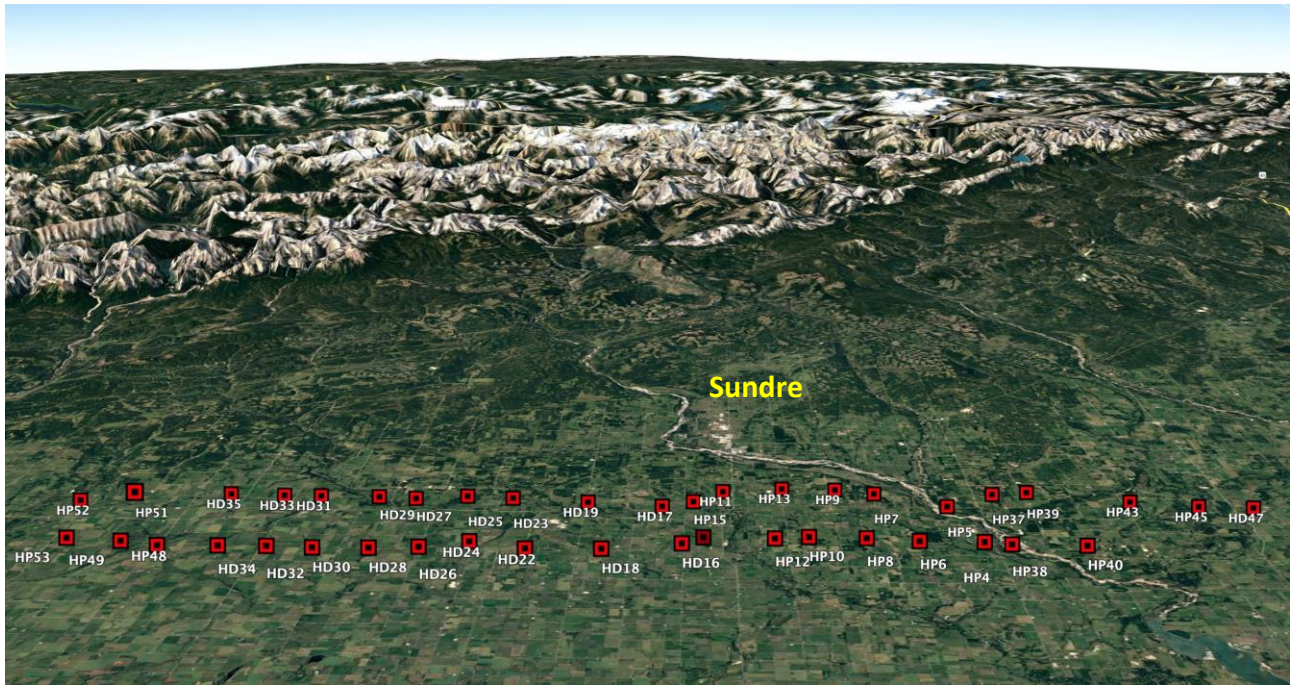
Survey Points





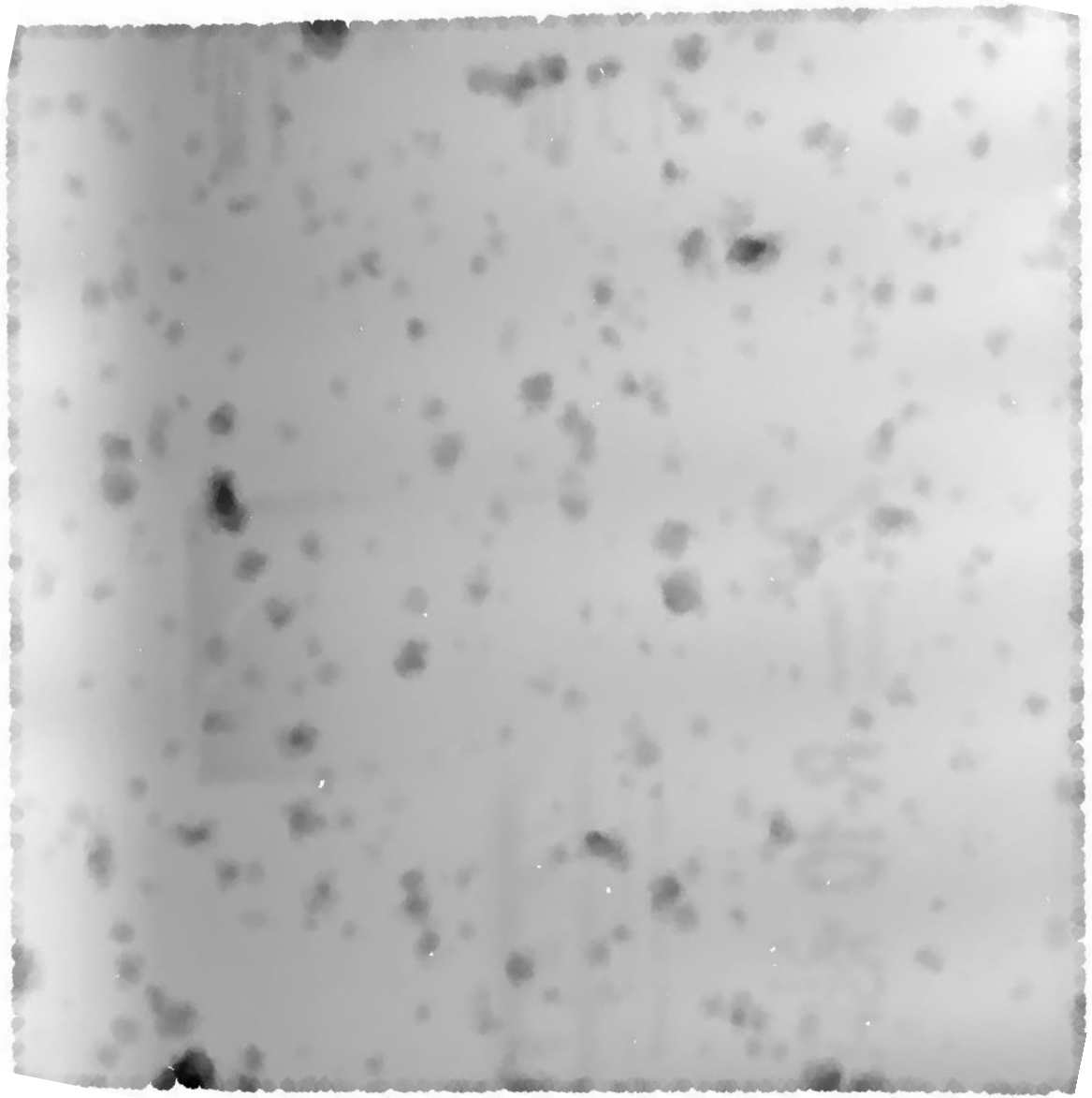
Hailpad Network

- Increased network from 34 to 40 hailpads. This is the upper limit that we can manage
- ~415 km^2, one hailpad per 10.5 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



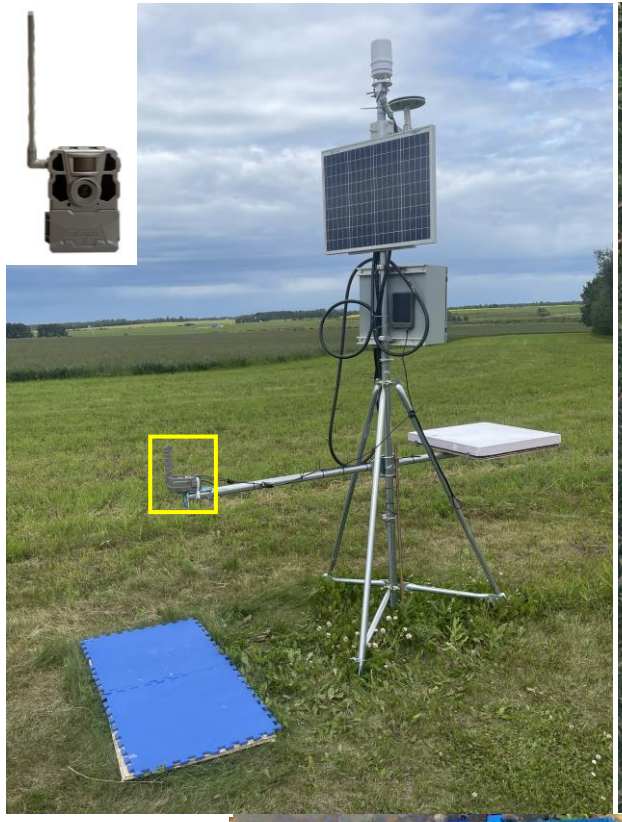
Preliminary 2023 Data

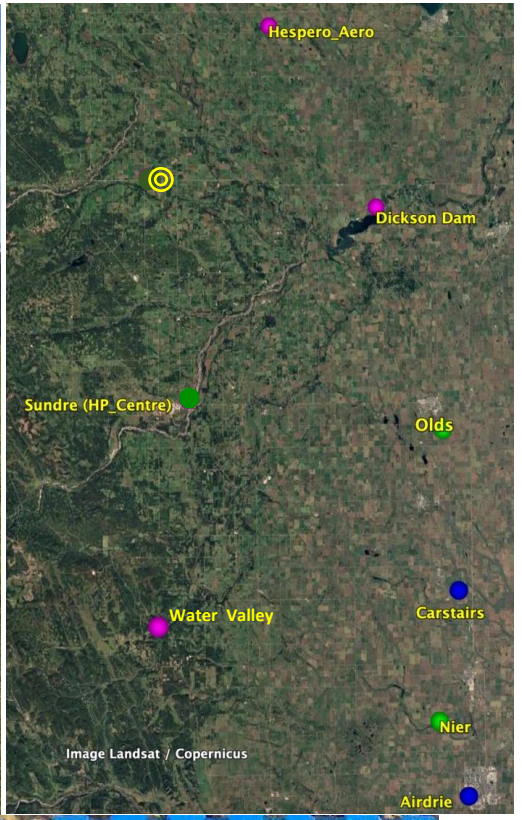
- 57 hailpads hit by hail (93 in 2022) on 18 days
- One site hit by hail four times (max. 7 times in 2022)
- Over 150 hailpads need to be analyzed
- Student going to work on automated analysis over the fall and winter (3D scanner, Lidar and ML)
- Energy-matching drop tests for new and old foams will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



Supersites

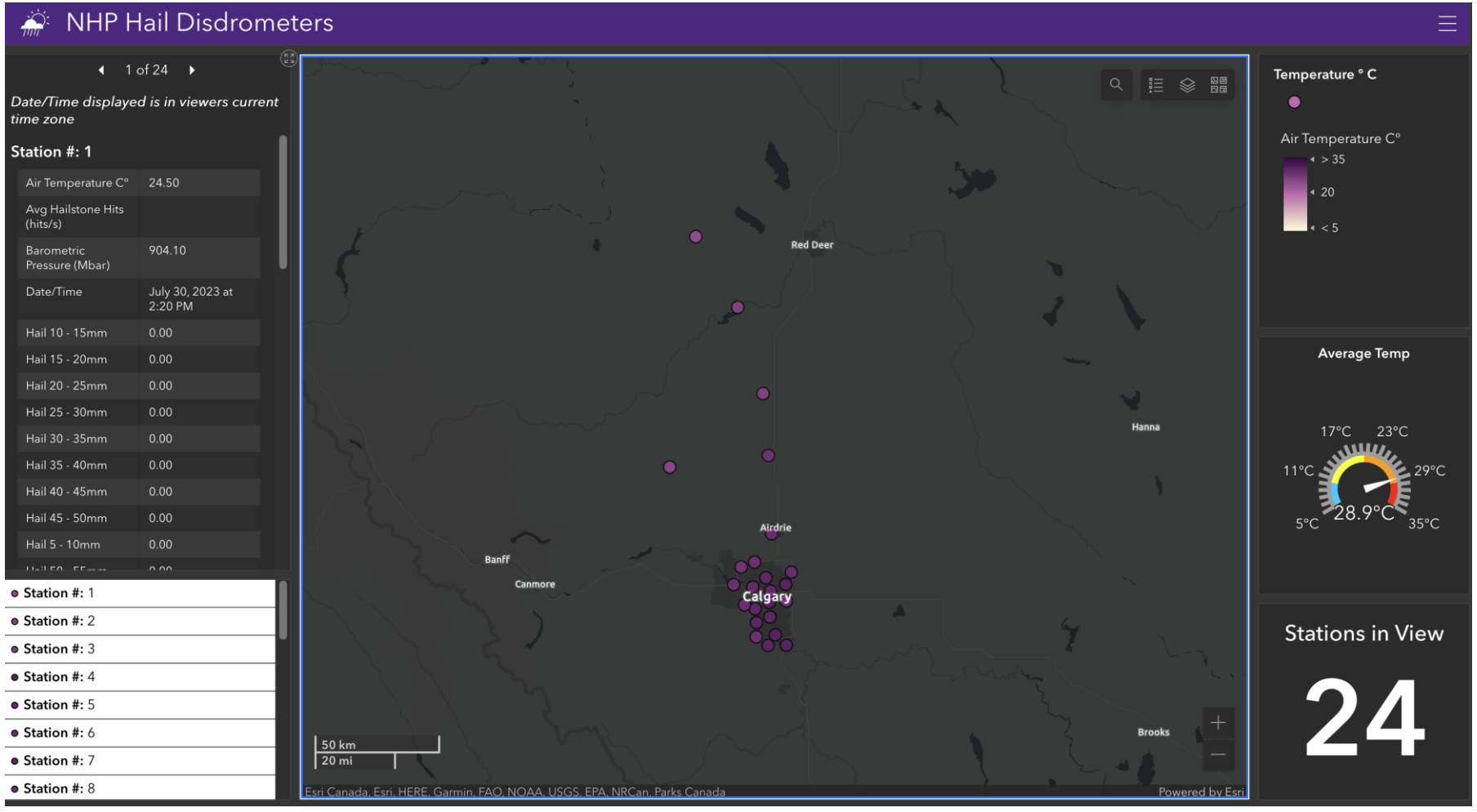
- Three supersites were installed outside of Calgary this season. Done with help of interns. They did a great job!
- Purpose of the supersites was threefold:
  i. *Validate ATMOS station*
  ii. *Test trail cameras*
  iii. *Collect hail data to validate the HailFlow sensor (against hailpad and camera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





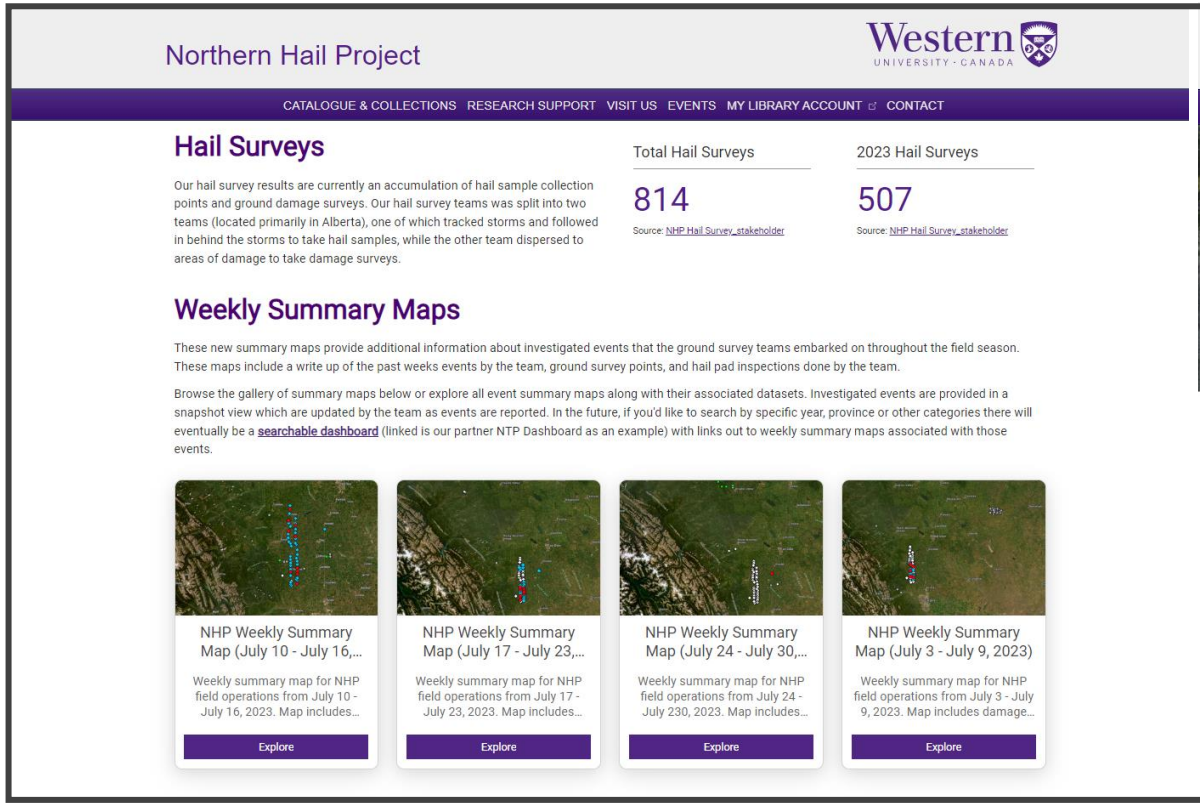
Data Sharing: Open Data Portals

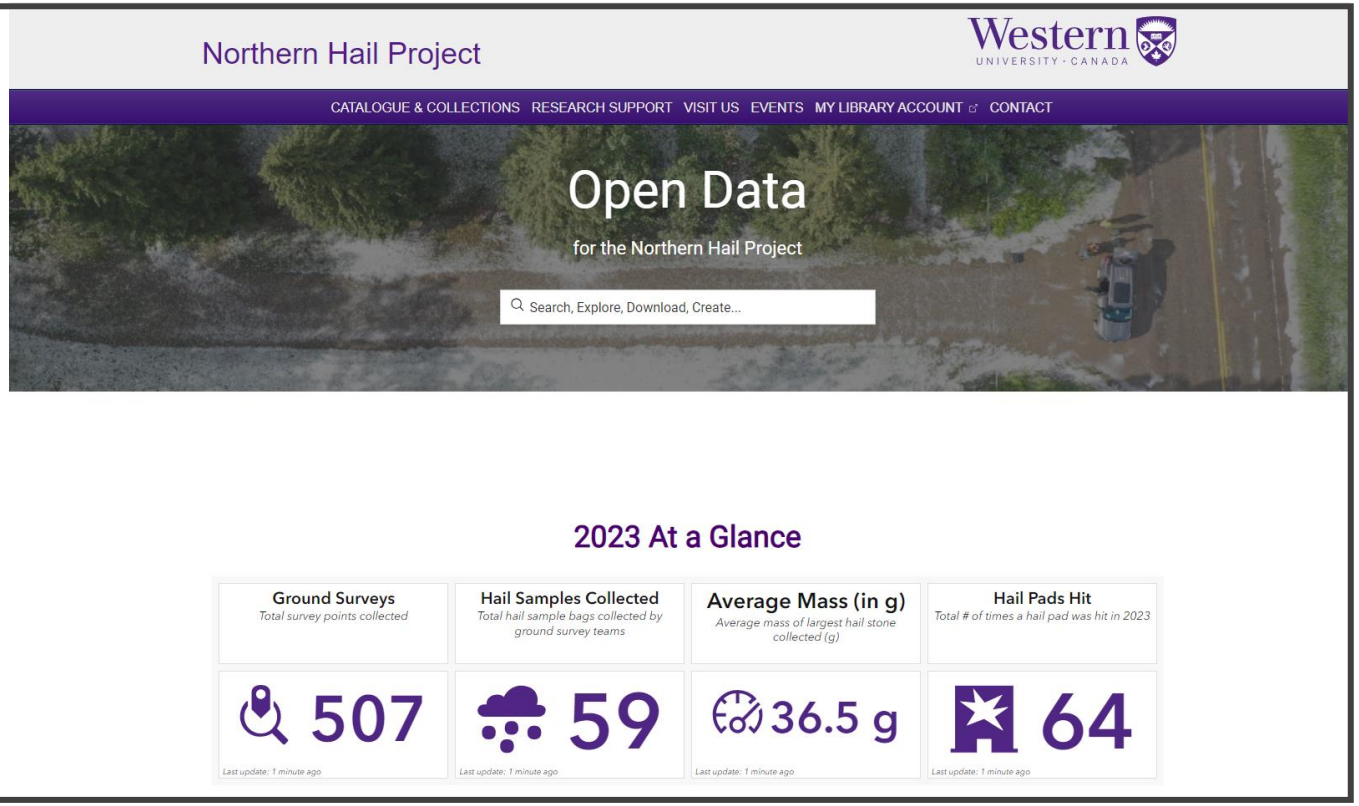
- Continue to develop the Disdrometer data portal
- Add post-processed variables (hail flag, max. hail size, accumulated rain)
- Add graphing functionality to Disdrometer data portal and, if possible, with mouse over data display



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





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]

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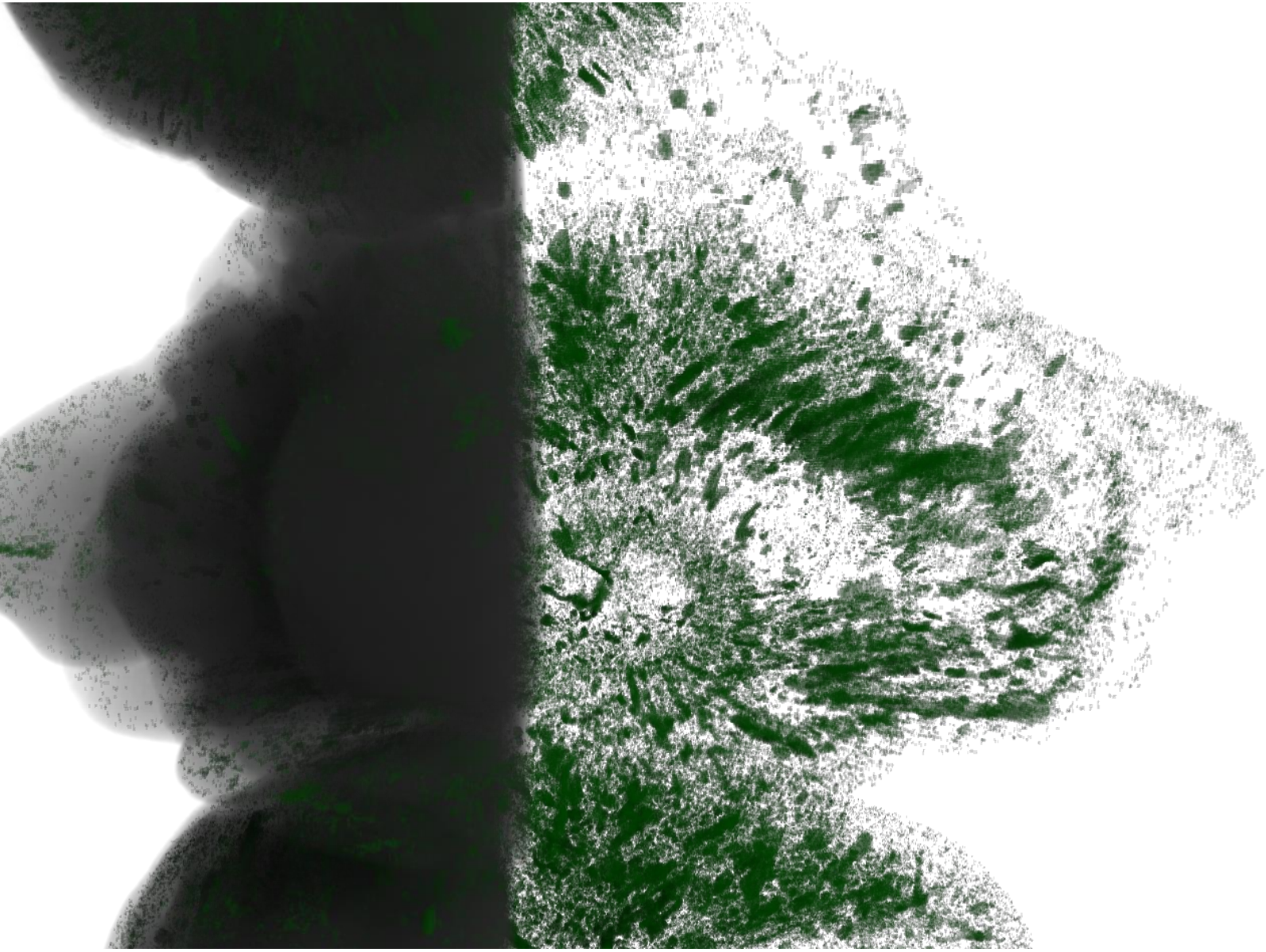

Thank You!