The Northern Hail Project: A Renaissance in Hail Research in Canada

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November 3, 2022

Third Western-ICLR Multi-hazard Risk and Resilience Workshop

Credit: Kyle Brittain, TWN

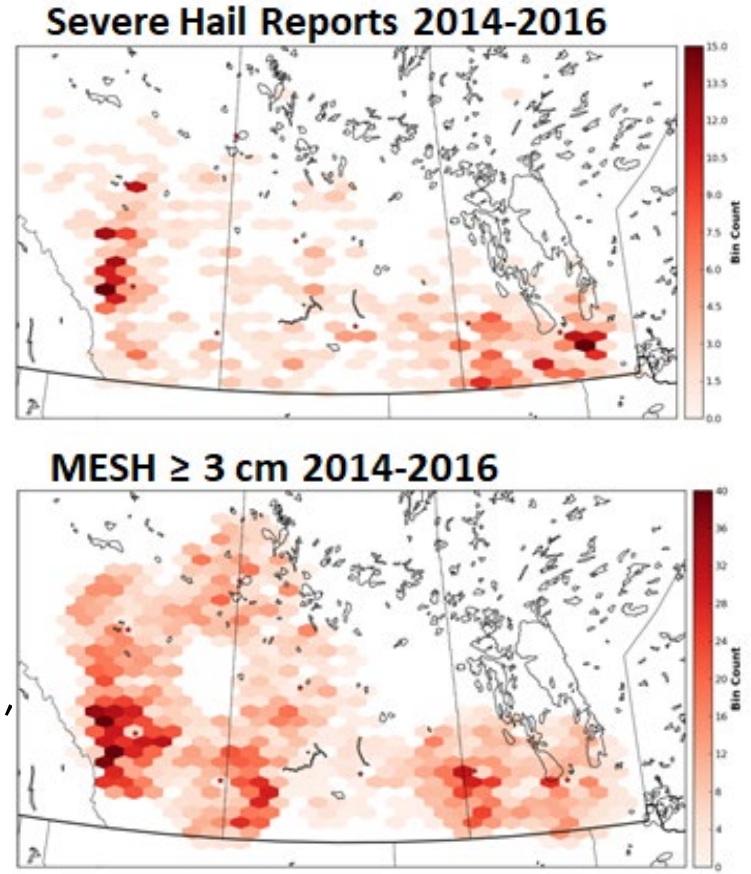
Western

Institute for Catastrophic Loss Reduction

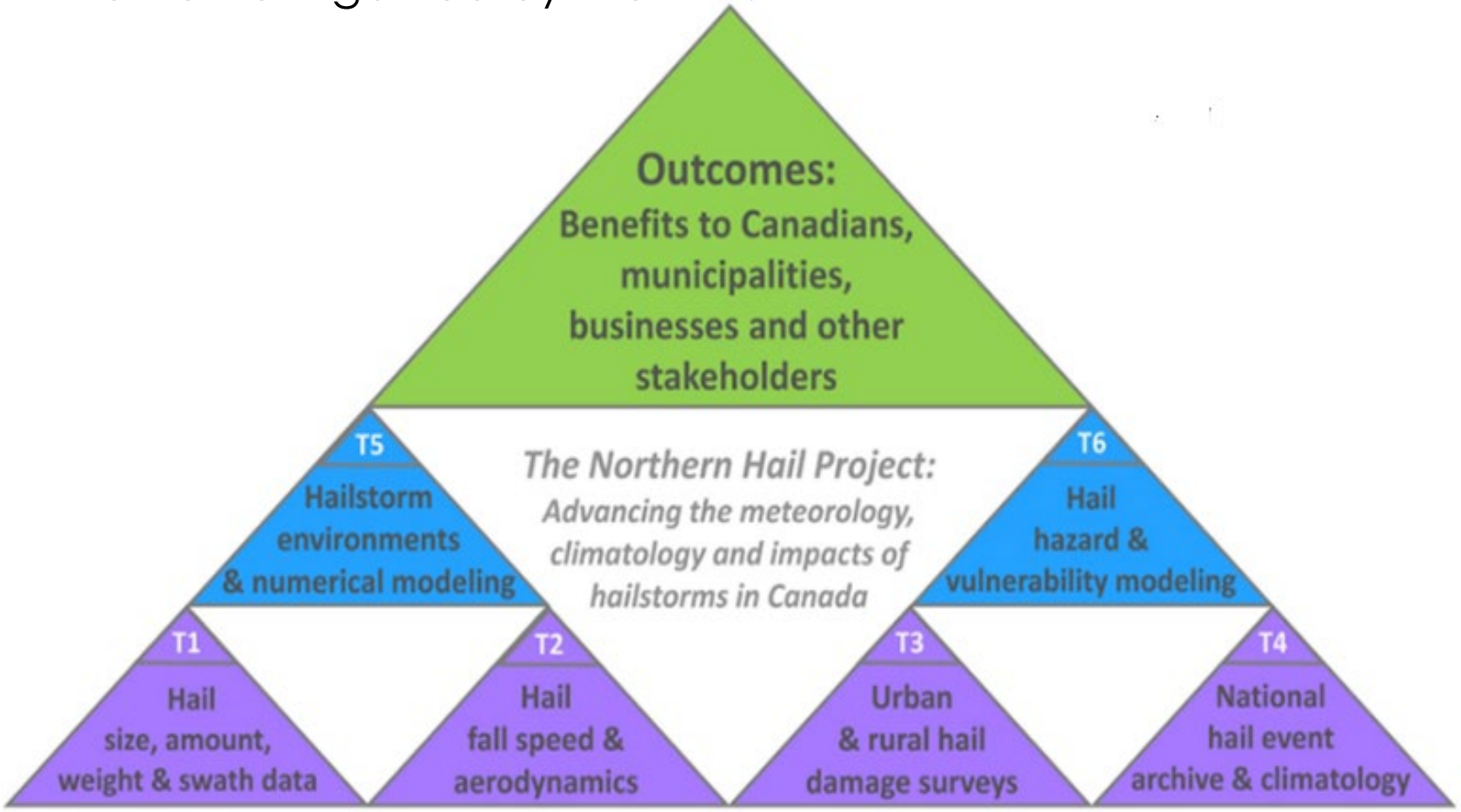
Building resilient communities

Rationale & Background

- It has been almost four decades since the last dedicated hail research program in Canada ended.
- Consequently, there is a significant gap in high-quality and high-resolution data for both hailstorms and hail.
- This data gap is a bottleneck in advancing hail research, which is critical for improving forecasts and impact assessments.
- Insured losses from hailstorms are on the increase, with research indicating an increase over Alberta from ACC/AGW.
- Additionally, there is a dearth of Canadian meteorologists, engineers and risk modelers with expertise in forecasting, assessing, and modeling storms that produce damaging hail.



- The NHP will address these gaps through collaboration with our partners and drawing on multi-disciplinary science, including social science.
- The NHP will build on the expertise, knowledge and momentum gained by the NTP.



Partners

Institute for Catastrophic Loss Reduction

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WEATHERLOGICS

NHP Staff 2022

- **Dr. Julian Brimelow**, Executive Director
- **Simon Eng**, Research Meteorologist, EIT
- **Francis Lavigne-Theriault**, Field Ops Lead

Summer Interns

- Chris Rattray, MSc, U of Oklahoma
- Mark Gartner, 3rd year BSc, York U





Task 1

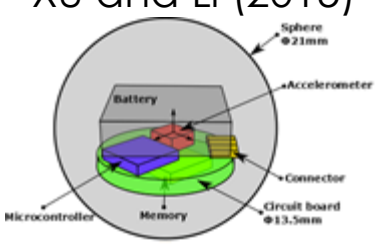
Characterization of hailstones and hailswaths using ground-based and remote-sensing techniques

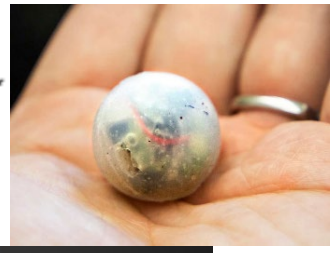
- Collect hailstones in the field for detailed analysis
- Sample hailswaths using a hailpad network.
- Characterize hailswaths using UAVs equipped with multi-spectral and thermal cameras, and LiDAR.
- Evaluate Calgary's hail disdrometer network.
- Develop/advance satellite detection methods to identify hailswaths.
- Develop/advance radar tools for the identification of hail & determination of hail size.

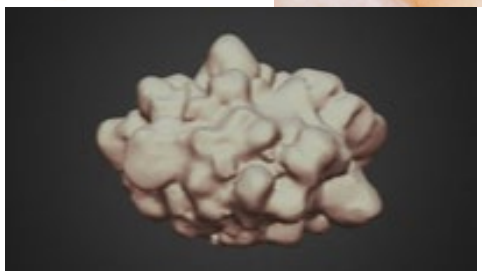
Canadian Record –
Max. Diameter 12.3 cm
Mass = 292.7 g
Bulk density 0.85 g cm^{-3}

Task 2

Xu and Li (2015)

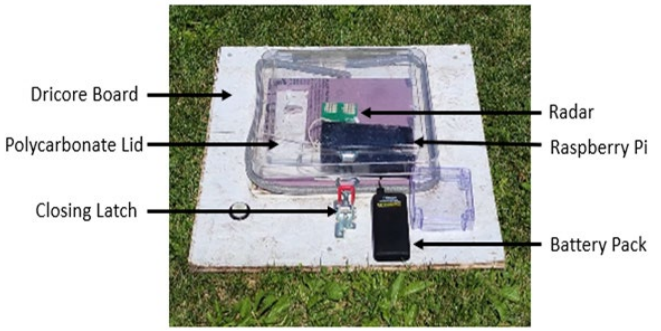






Understanding the fall speed and aerodynamics of hailstones, and their impact/damage potential

- Drop instrumented hailstone ice replicas from UAVs to measure fall speed and fall behavior.
- Use CW radar and high-speed machine cameras to directly measure the fall speed of natural hailstones.
- Study the effect of wind on the impact energy & impact angle (disdrometers, hail cubes & high-speed video).



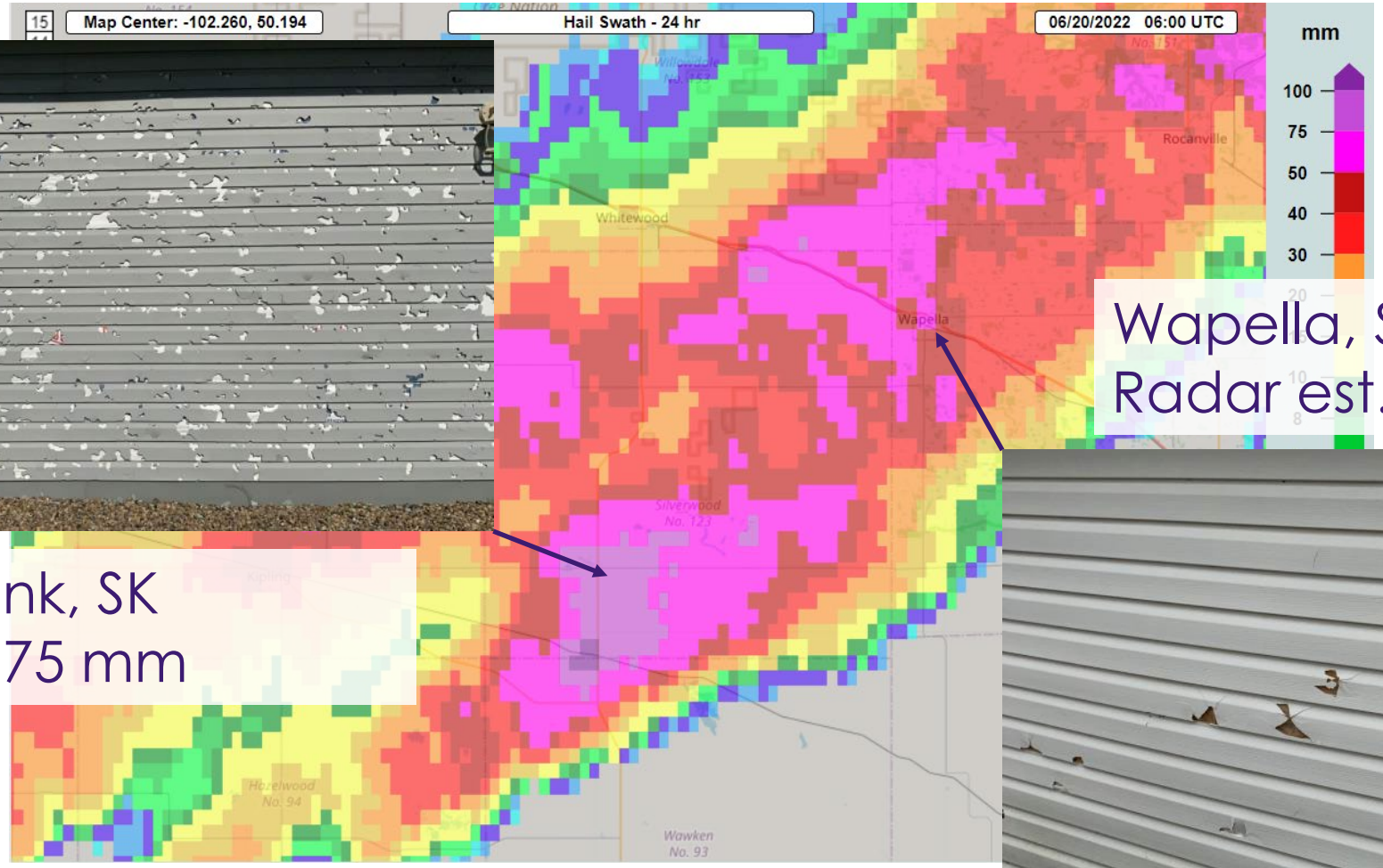
Task 3

Develop remote sensing and on-the-ground methods for advanced post-storm damage assessment and interpretation

- Develop rapid damage survey methods using mobile LiDAR and optical systems.
- Conduct damage surveys in both urban and rural settings.
- Conduct advanced interpretation of wind and hail damage to trees and forests.
- Develop hail intensity/damage scales. Similar to the EF-Scale, but tailored for N. America.
- Reflect hail intensity scales developed in Europe.

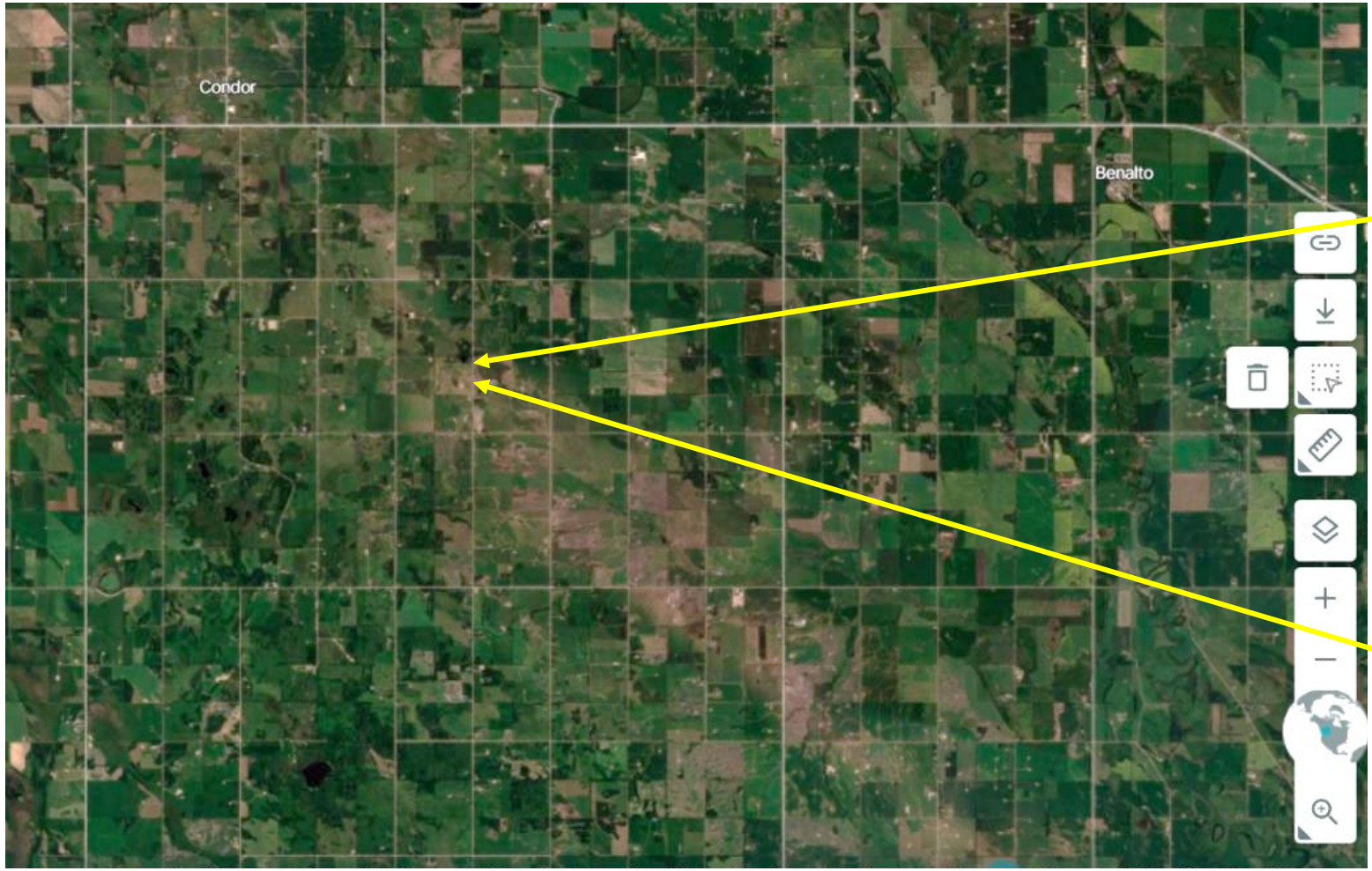
Damage/Impacts Investigations: Urban

N of Langbank, SK
Radar est. > 75 mm



Wapella, SK
Radar est. ~50 mm

Damage/Impacts Investigations: Rural



Develop Hail Damage Intensity Scales

- Clearly visible but scattered penetration damage to vinyl siding
- Particularly if brittle due to aging

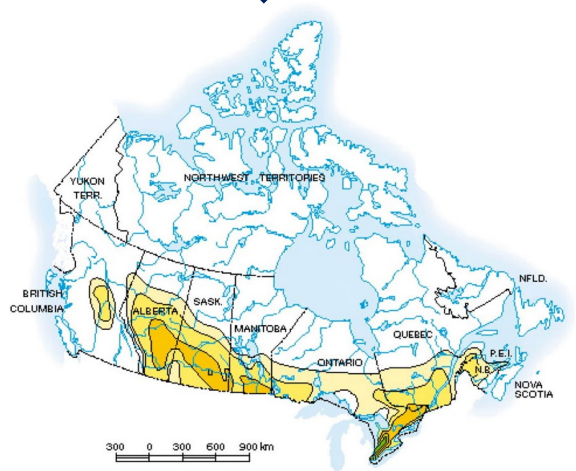
- Significant loss of vinyl siding
- Impact damage to foam insulation/backing

- Loss of windows
- Disruption of building envelope resulting in water penetration

Task 4

Strive to document all damaging hail events across Canada & develop Canada's first reliable hail climatology

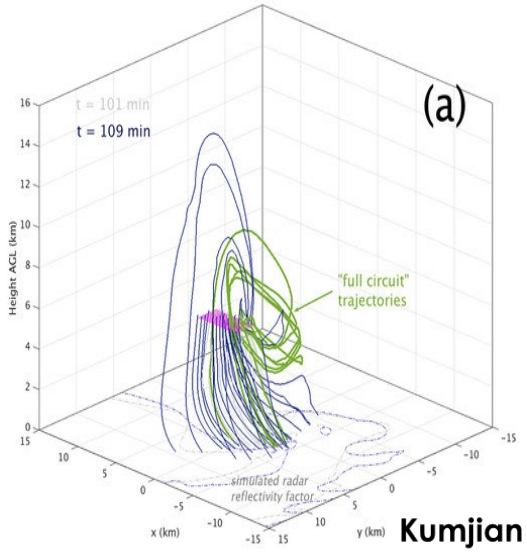
- Detect, assess & document damaging events across Canada.
- Use machine vision to leverage pictures included in social media reports.
- Develop a comprehensive new national hail climatology based on recorded hail events.
- Share data through public-facing data portal.



Task 5

Understand hailstorm & hailswath environments; improve model microphysics for forecasting hail

- Collect field data to characterize hailstorm environments and storm mode.
- Characterize hailstorm environments over hail alley in Alberta.
- Conduct sensitivity tests to identify the most suitable microphysics schemes in WRF for hail event simulations.
- Validate and improve 1-km weather model simulations of hailstorms.



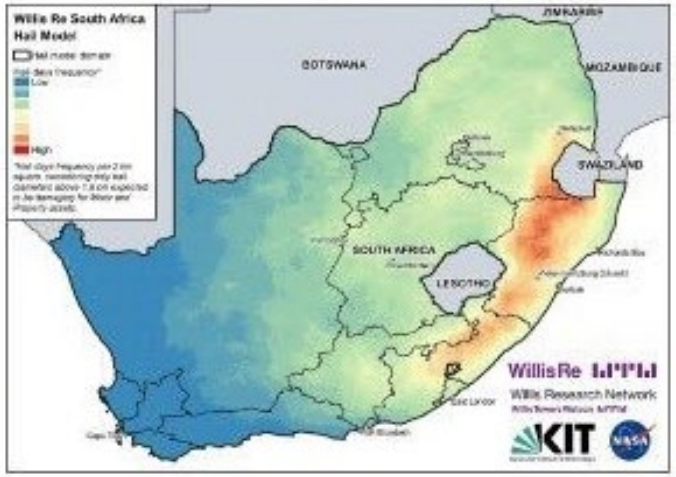
Kumjian et al. (2021)

Task 6

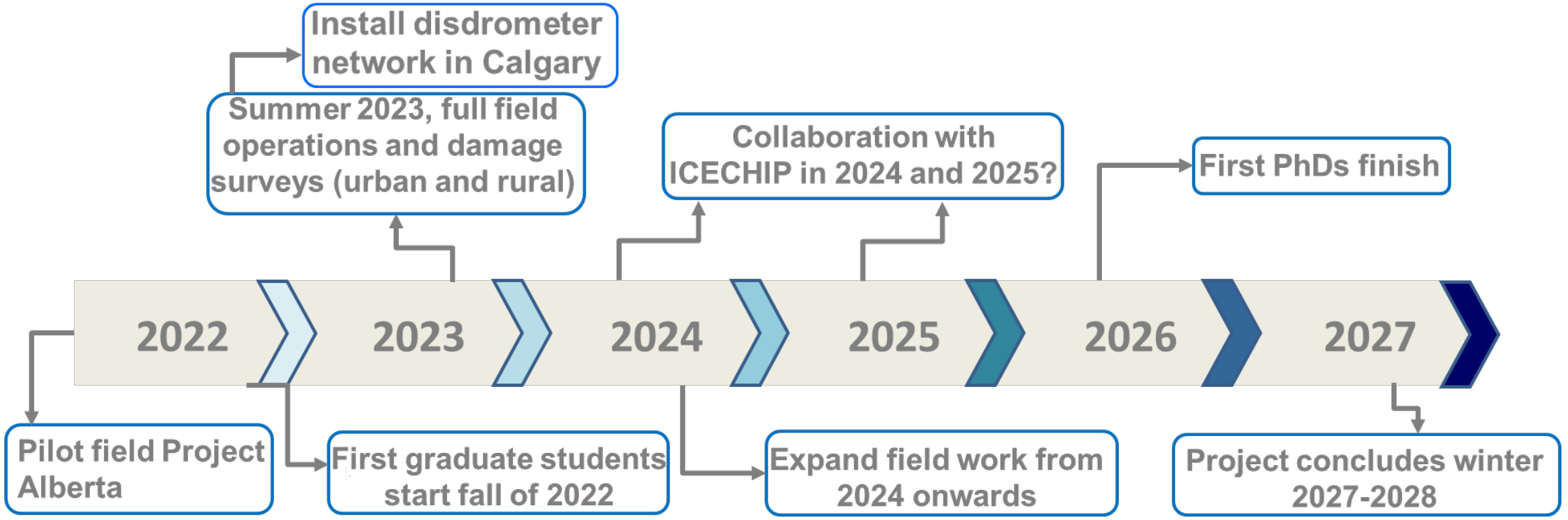
Develop new damaging hail hazard and vulnerability modelling and tools

- Undertake a hail hazard assessment using WRF simulations combined with HAILCAST.
- Complete storm and hail hazard modeling for Canada using NHP hail observations.
- Undertake storm & hail vulnerability modeling & risk assessments for Canada.

Reinsurance Hailstorm Catastrophe Models Derived From Satellite and Reanalysis Data



Timeline



Thank You!