A New Water Resource Assessment Framework for the Crown of the Continent: Castle & Waterton

Chris Hopkinson[1], Stefan Kienzle[1], Stew Rood[1], Dave Sauchyn[2], Larry Flanagan[1], Laura Chasmer[1] Brian Brisco[3], Adam Collingwood[4]

1: University of Lethbridge, Lethbridge, AB. 2: University of Regina, Regina, SK. 3: Natural Resources Canada, Ottawa, ON. 4: Parks Canada, Waterton, AB.

Outline

Program components
Monitoring examples
Kenow Fire expansion
Multispectral lidar facility

Note: summarising ~ 20 conference presentations so this is a high level overview

Westcastle WIP program components

Water resource assessment & scaling methods

Remote sensing-based snow & runoff monitoring

New vegetation monitoring procedures

Changing headwater attributes

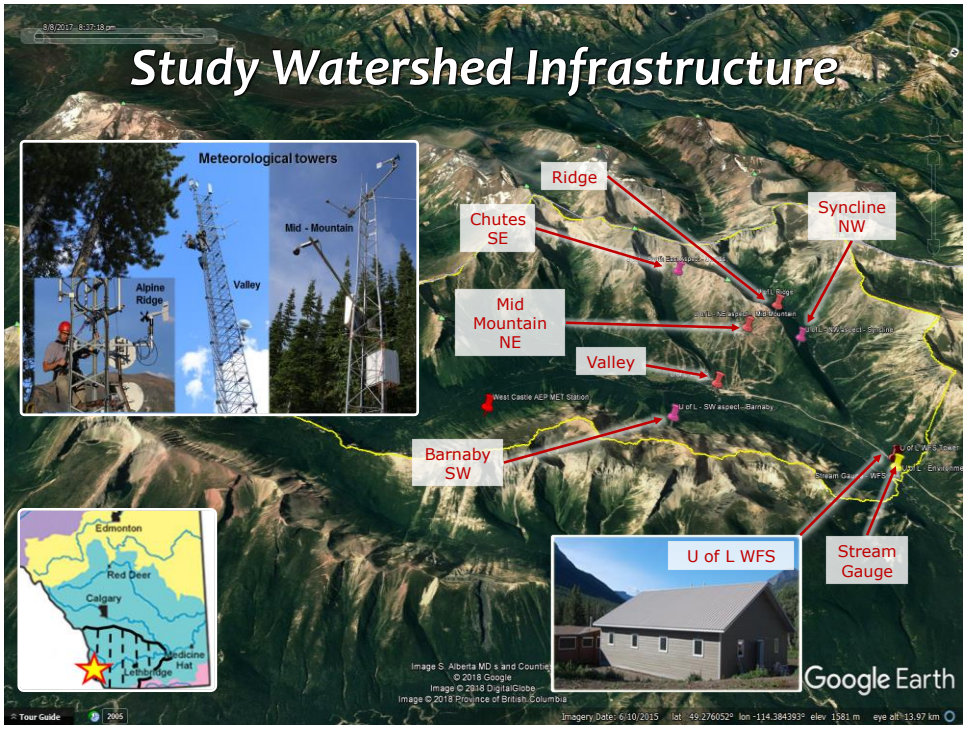
Land cover change and controls

Climate change impacts on runoff

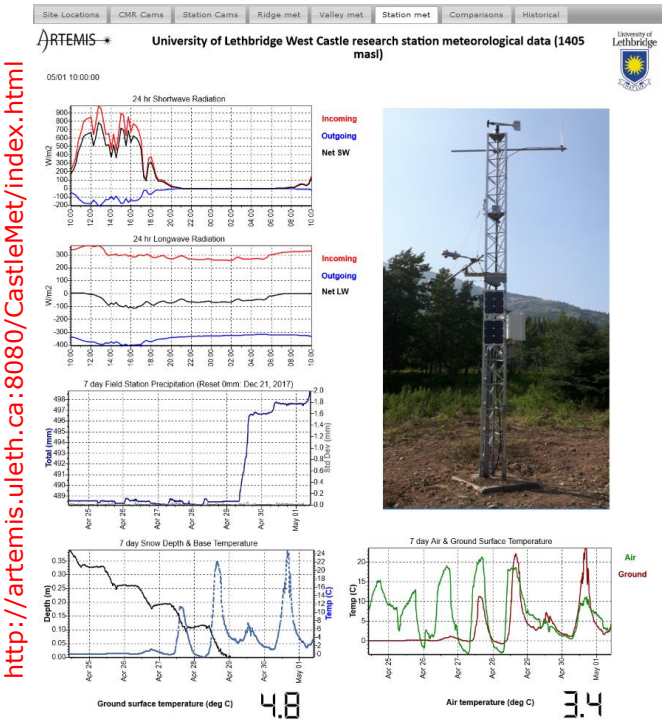
Post-Kenow fire landscape recovery

Multi-scale landcover regeneration trajectories

Spatio-temporal shifts in snowpack, ET & melt



http://artemis.uleth.ca:8080/CastleMet/index.html



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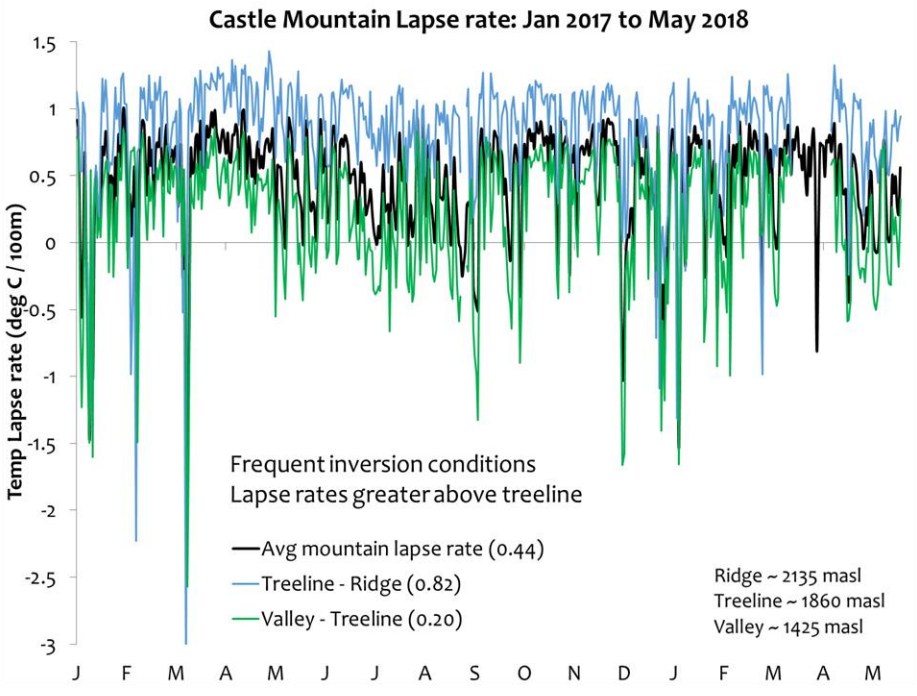

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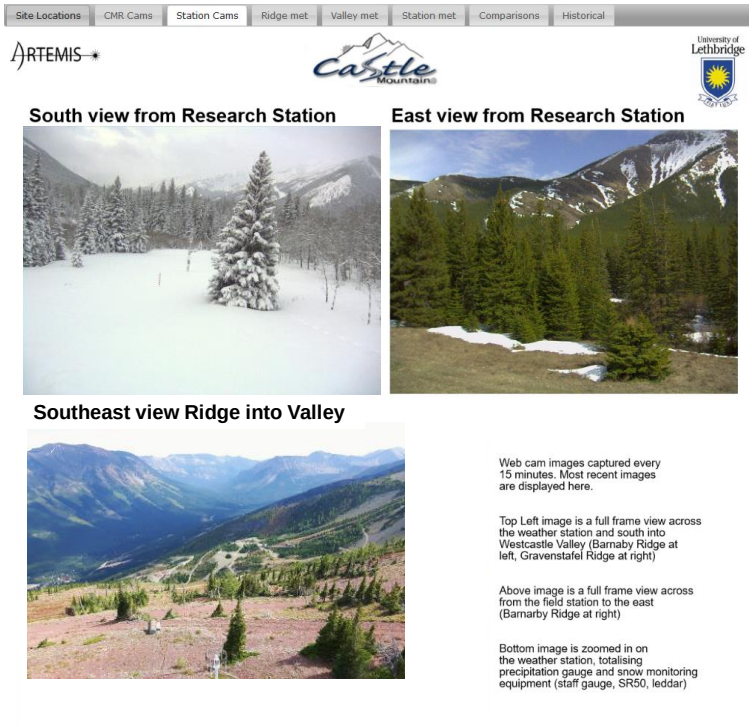

http://artemis.uleth.ca:8080/CastleMet/index.html

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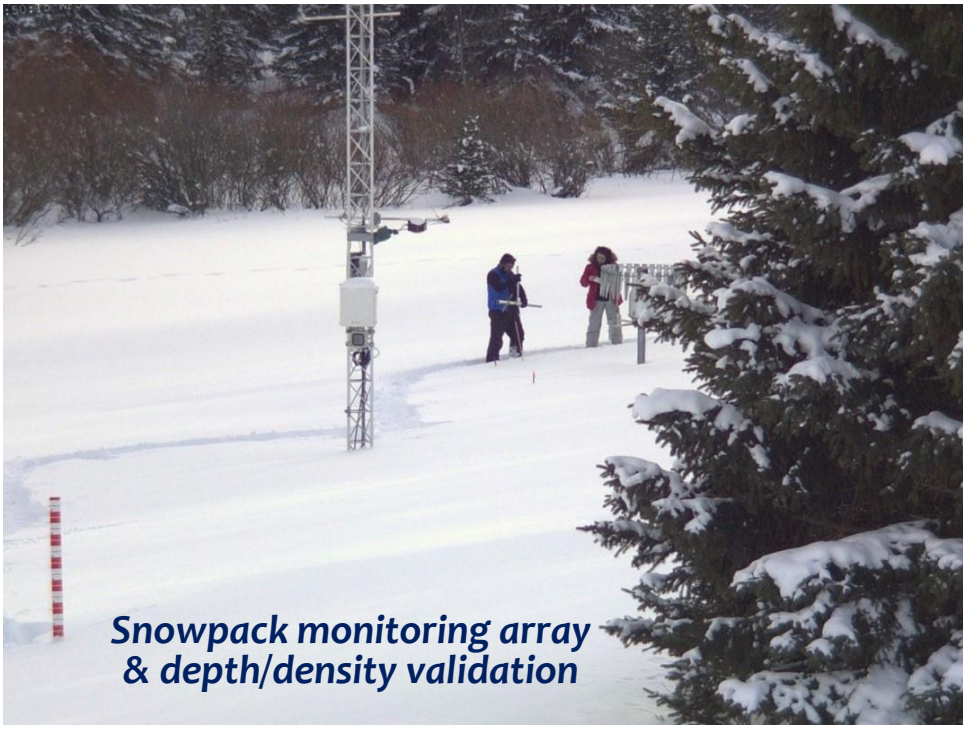

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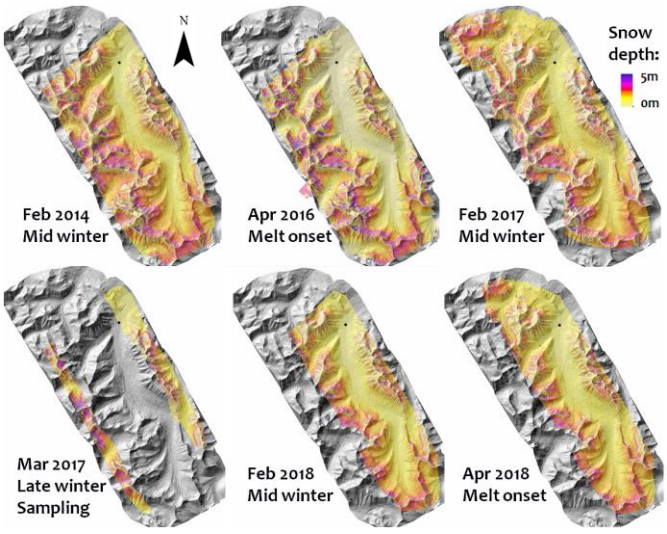
Airborne LiDAR snow depth monitoring



Objective

Better understand snowpack controls

Can snowpack depth be modeled from flight line sampling & machine learning?

Targeting mid - late winter accumulation & early ablation period

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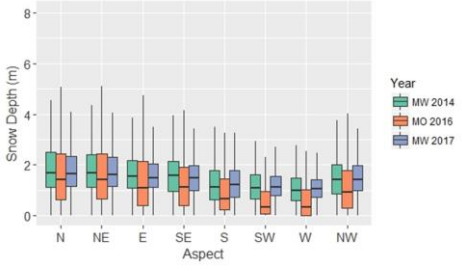
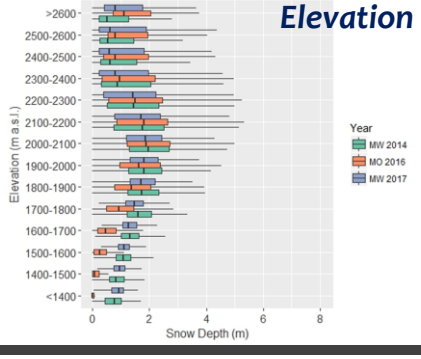
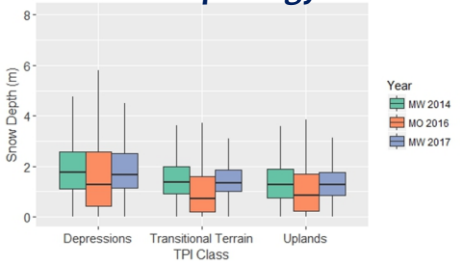
Aspect



Elevation

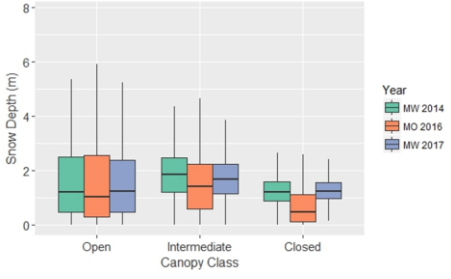


Terrain morphology



Credit: Kelsey Cartwright, MSc

Canopy cover



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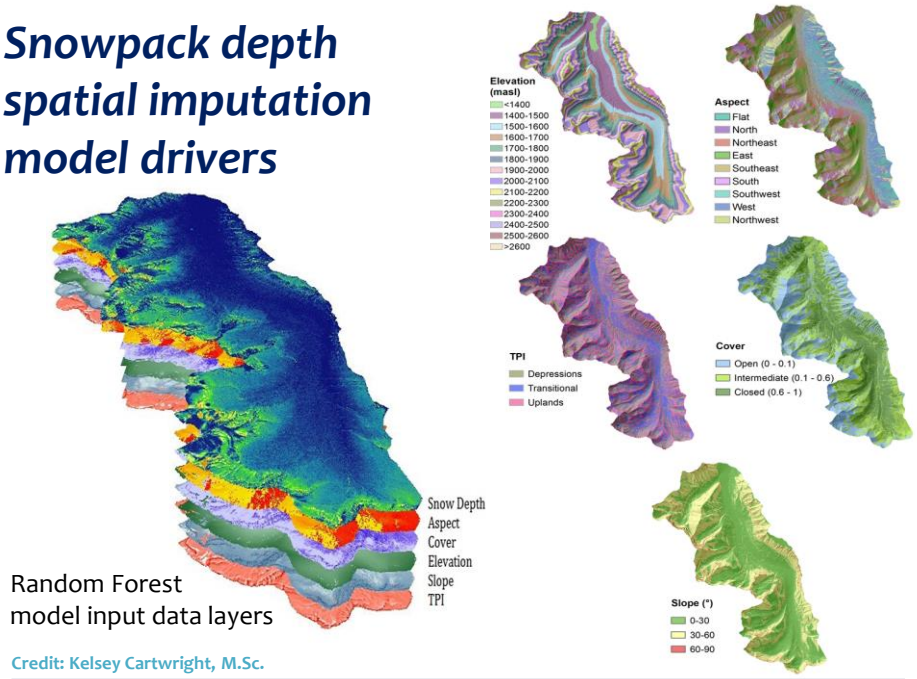
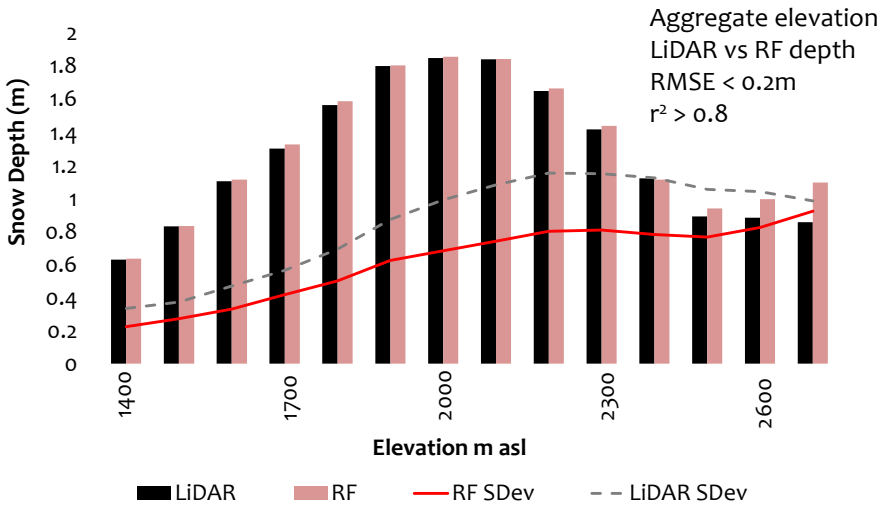
Snowpack depth spatial imputation model drivers



Random Forest model input data layers

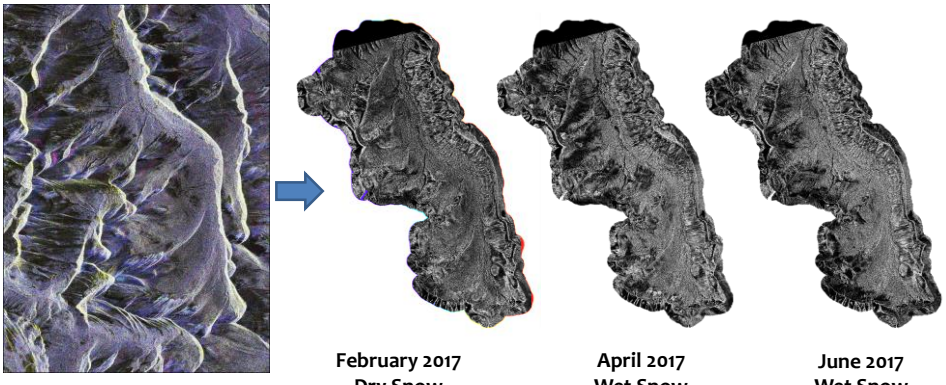
Credit: Kelsey Cartwright, M.Sc.

Snow depth models binned by elevation class



Credit: Kelsey Cartwright, M.Sc.

SAR mountain snow surface melt monitoring



Credit: Dennis Quick, M.Sc. (in progress)

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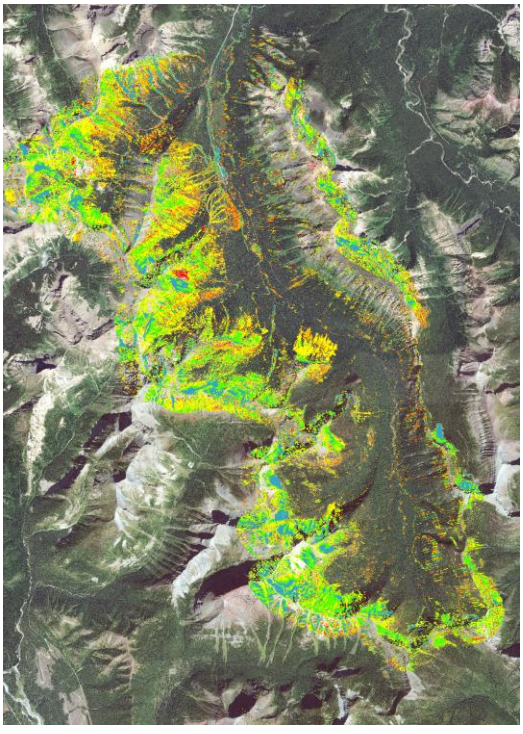

SAR-based snow wetting front mapping

Dry snow invisible to C-Band SAR

As water content increases, scattering changes from volume to surface

Last Month with snow melt

- March 22 2017
- April 15 2017
- May 9 2017
- June 2 2017
- June 26 2017

Credit: Dennis Quick, M.Sc. (in progress)

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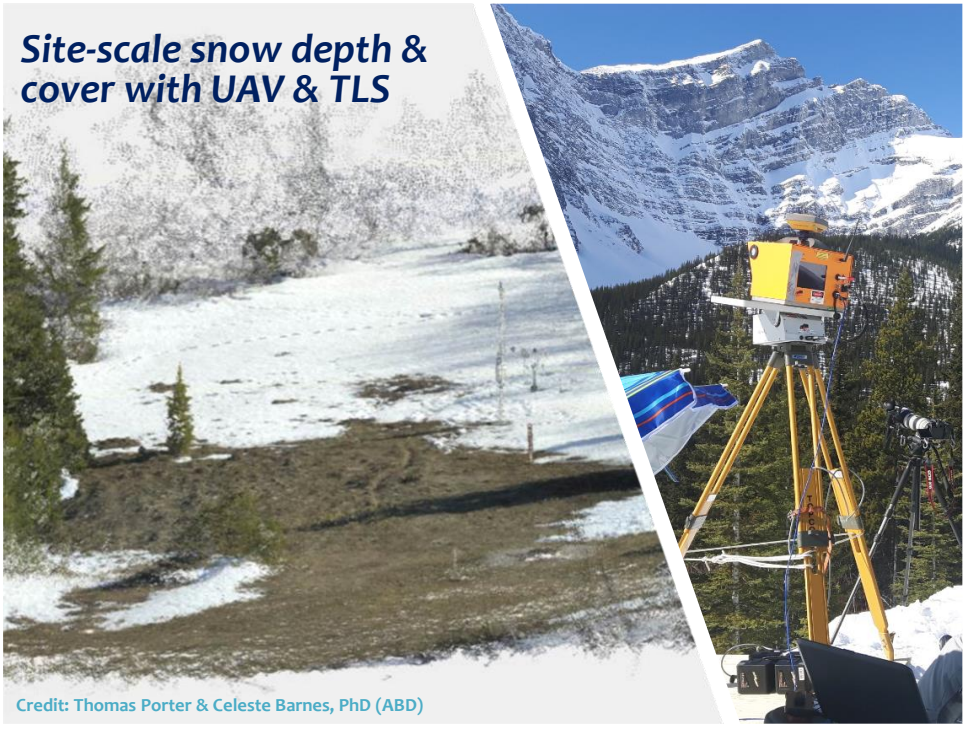
Site-scale snow depth & cover with UAV & TLS



Credit: Thomas Porter & Celeste Barnes, PhD (ABD)

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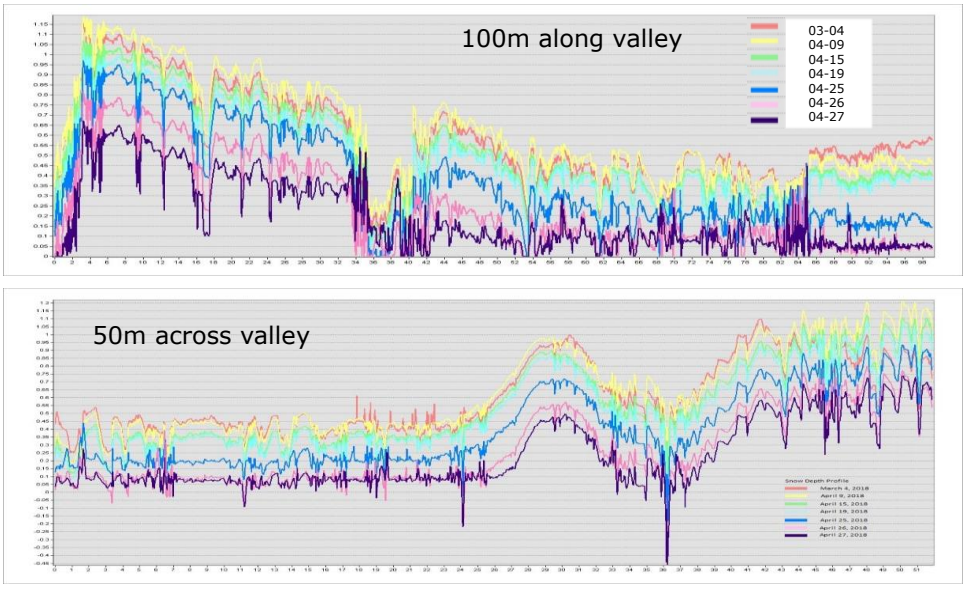
Time series terrestrial lidar snow surface profiles



Credit: Thomas Porter & Celeste Barnes, PhD (ABD)

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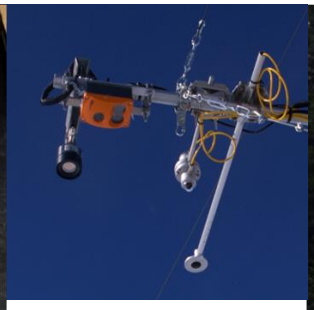
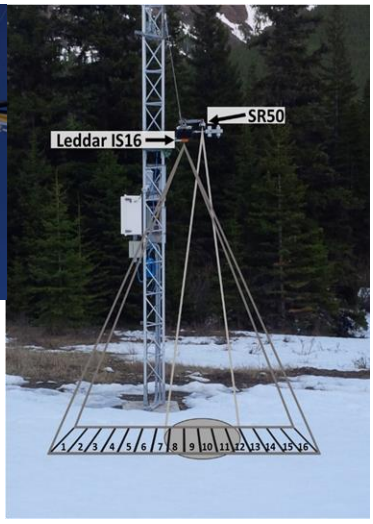
In situ snow profiling with LED ranging

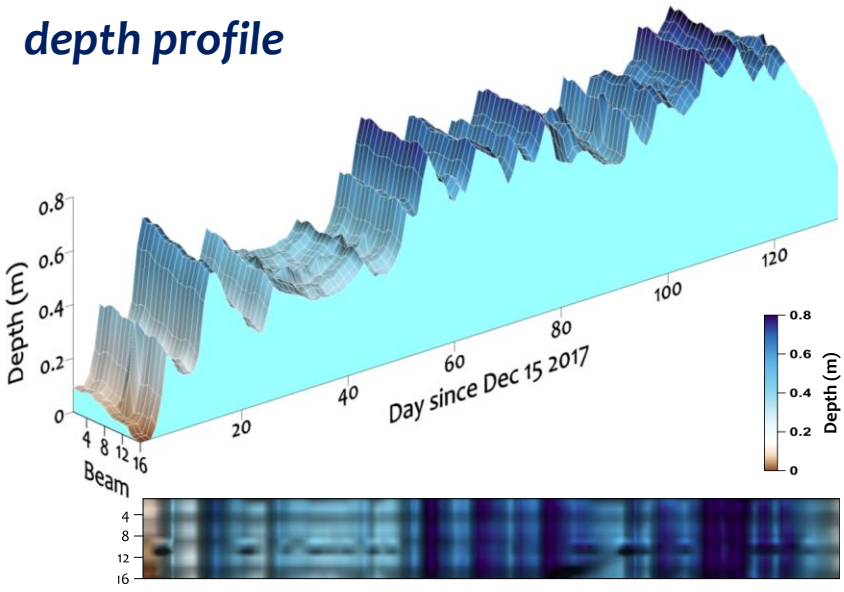


16 beams
45° field of view
940 nm wavelength
1Hz samples / 15 min
Low cost
Low power

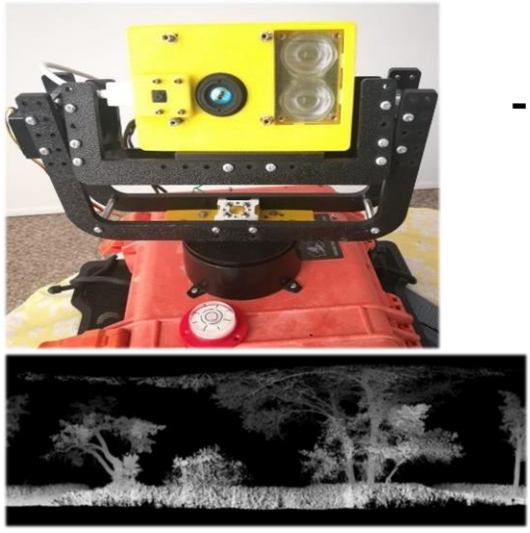


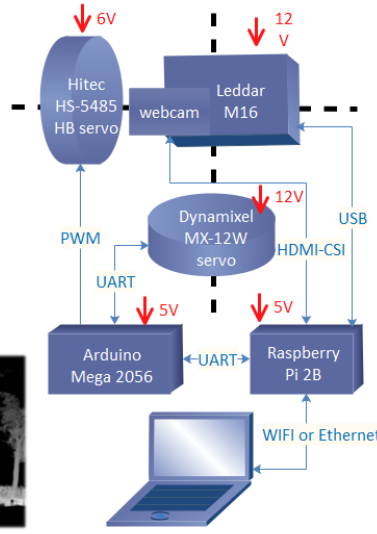
Credit: Barnes, Xi, Porter

Time-series snow depth profile



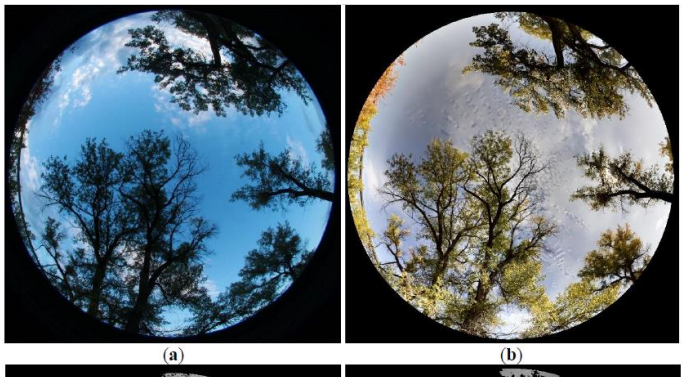
3D canopy leaf area index with Leddar & webcam – Fusion Scanning System (FSS)





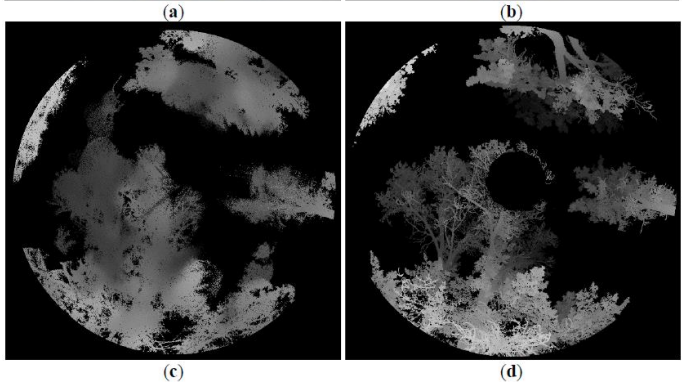
Credit: **Zhouxin Xi, Ph.D**

Standard hemi DHP



FSS generated hemi image

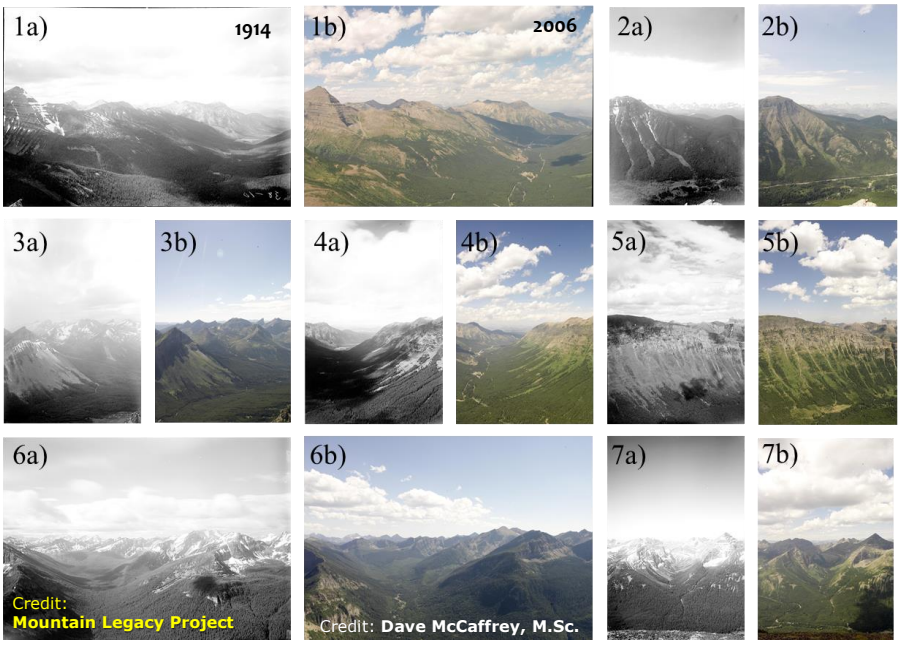
Leddar hemi range



FSS 3D hemi image

Credit: **Zhouxin Xi, Ph.D**

Oblique photography treeline change



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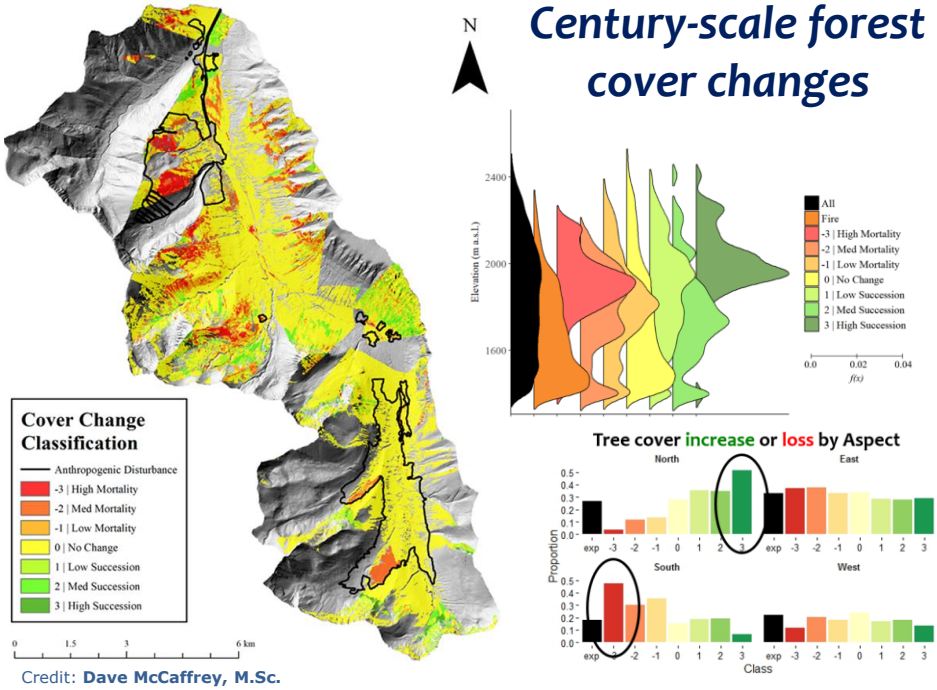
Century-scale forest cover changes



Credit: **Dave McCaffrey, M.Sc.**

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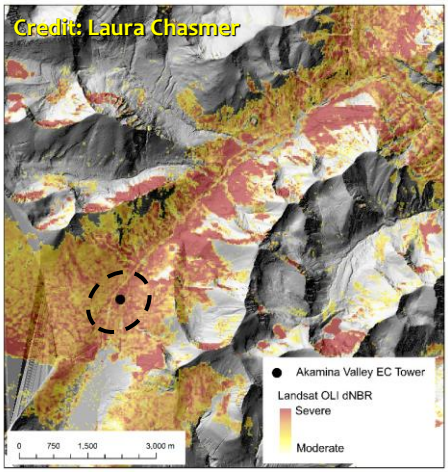
Waterton extension of Westcastle WIP program

Kenow Fire vegetation regeneration & impact on snowpack



Airborne & terrestrial Lidar, UAV, field plot, eddy flux & meteorological monitoring

Parks Canada Parcs Canada

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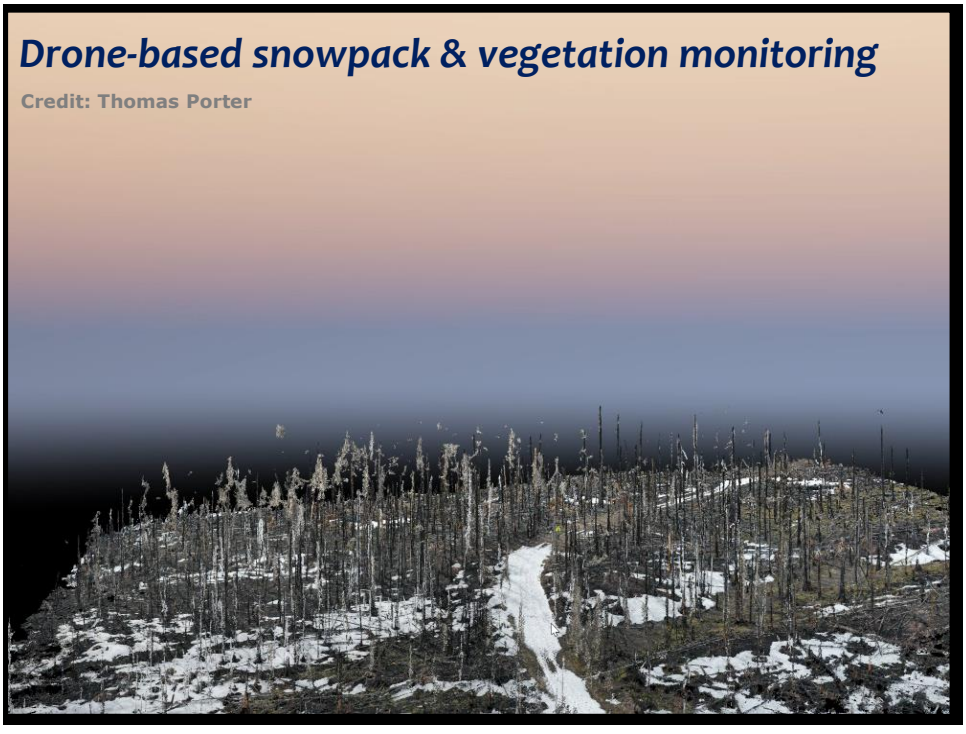
Drone-based snowpack & vegetation monitoring

Credit: Thomas Porter



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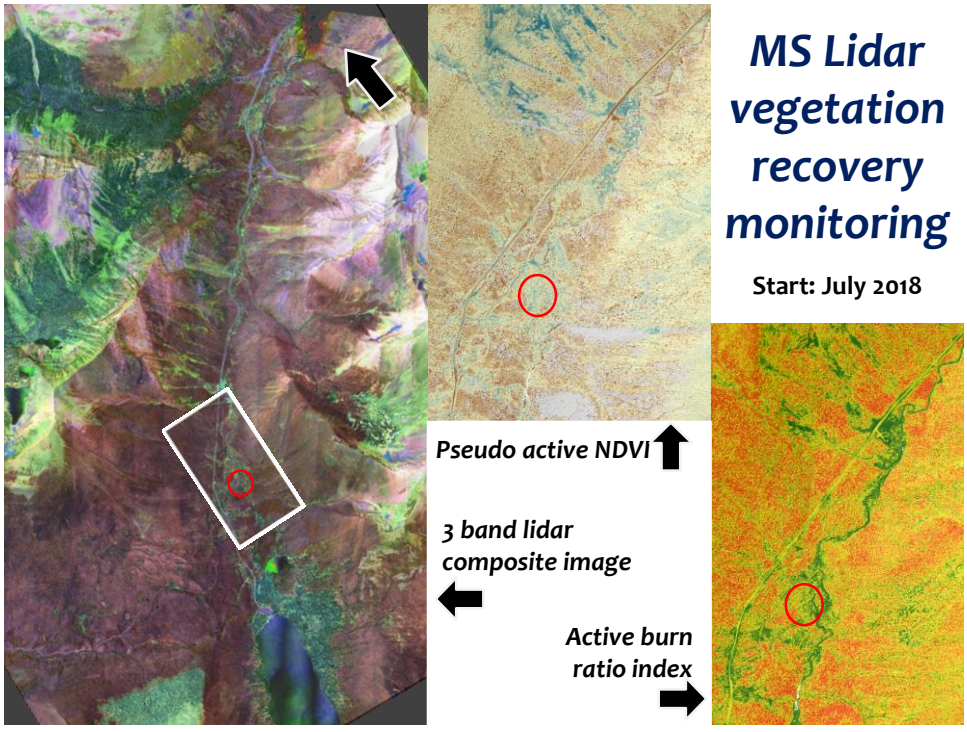
MS Lidar vegetation recovery monitoring
Start: July 2018
Pseudo active NDVI
3 band lidar composite image
Active burn ratio index

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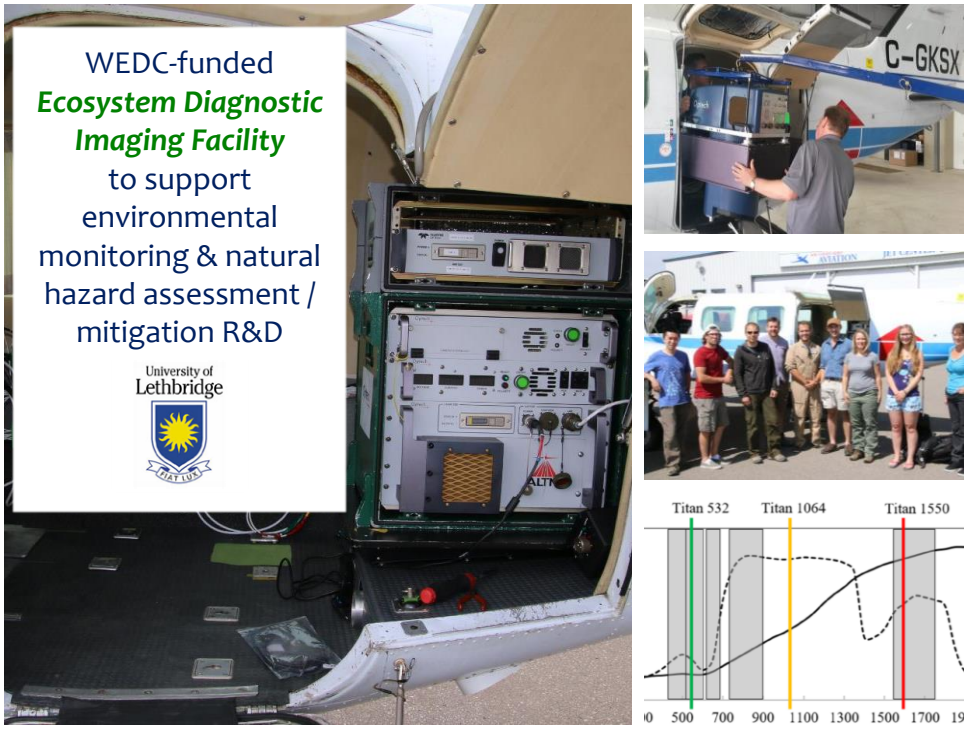
WEDC-funded
Ecosystem Diagnostic Imaging Facility
to support environmental monitoring & natural hazard assessment / mitigation R&D
University of Lethbridge
C-GKSX
Titan 532
Titan 1064
Titan 1550
500
700
900
1100
1300
1500
1700

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Thank you!
CFI
NSERC
LeddarTech
Castle Mountain Resort
Alberta Environment & Parks
Campus Alberta Innovates Program
Alberta Innovates Energy Environment Solutions
Canada Centre for Remote Sensing
Tough Country Comms
Sawback Technologies
Campbell Scientific
Airborne Imaging
Teledyne Optech
Parks Canada
ARTEMIS
HQP Trainees: Andreichuk, Aspinell, Barnes, Berry, Bexte, Cartwright, Deering, Ilich, Jones, Kerr, Kienzle, Parsons, Mahoney, McCaffrey, Montgomery, Okhrimenko, Porter, Quick, Scott, Xi

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