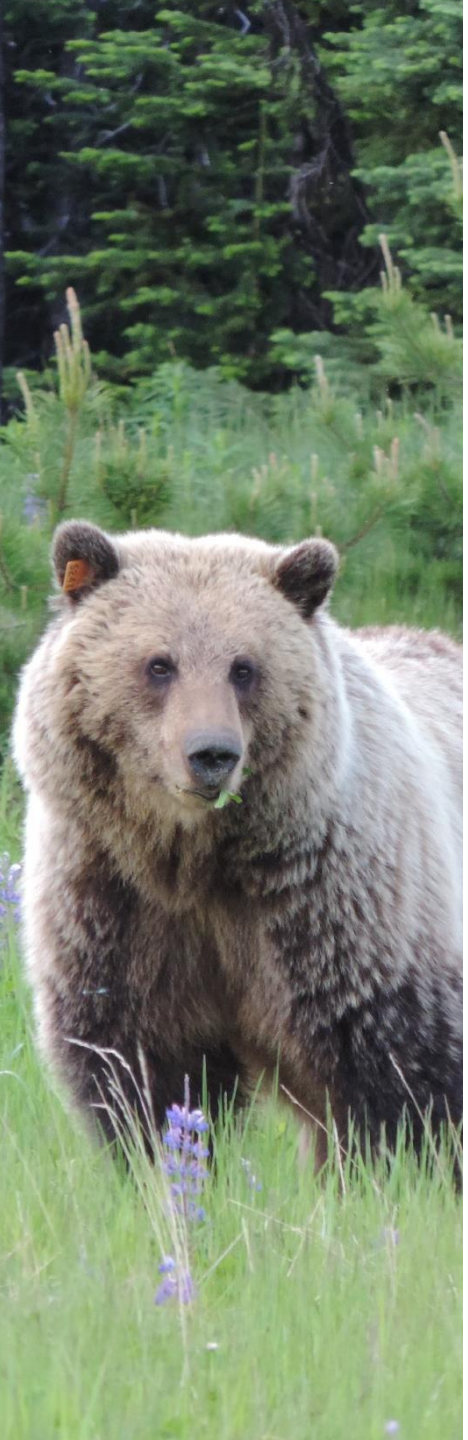


THE UNIVERSITY OF BRITISH COLUMBIA

NSERC CRSNG

# Investigating grizzly bear responses to spring snow dynamics through the generation of fine spatial and temporal scale snow cover imagery in Alberta, Canada

Annual General Meeting – 3

Ethan Berman

October 18, 2019

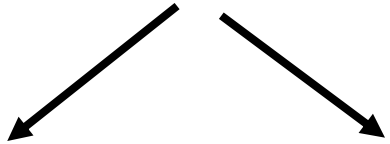
# Bears, Climate Change and Snow

Climate change has the potential to increase the pressure of top-down/bottom-up factors

*Mike Gere*

# Research Objectives

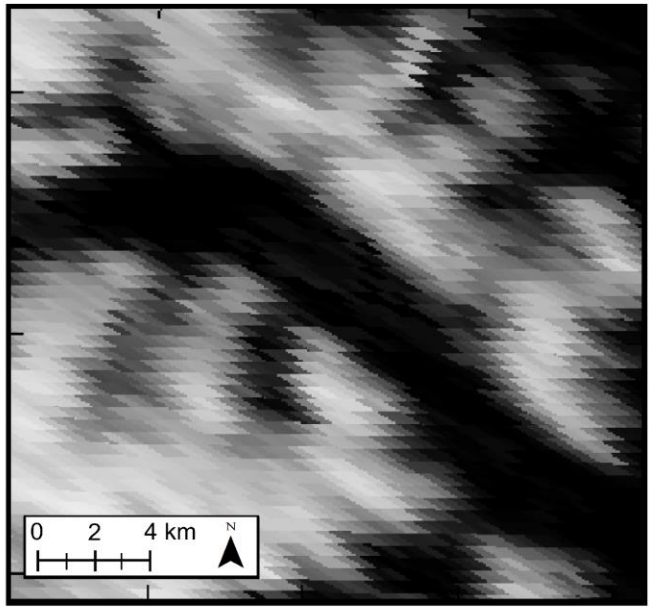
Develop a fine-scale remote sensing snow cover product and use it to explore the relationship between spring season snow dynamics and grizzly bear habitat selection and use.



1. Develop fine-scale snow maps
2. Use new maps to explore bear habitat selection and use

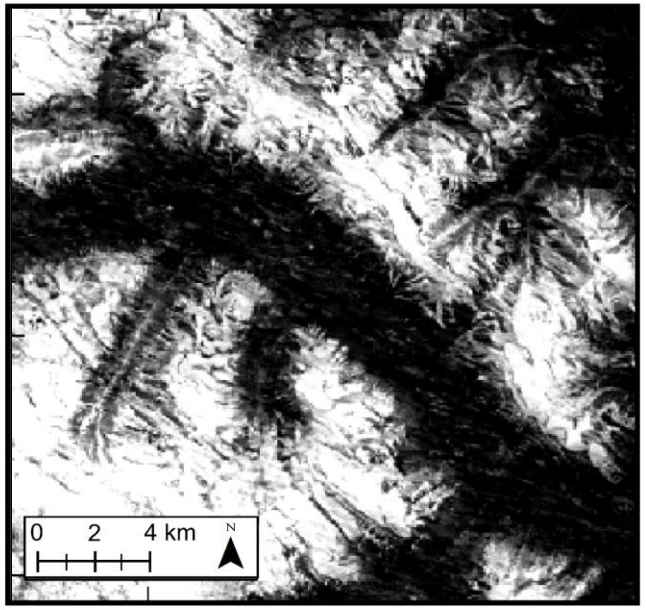
# Objective 1: Fine-Scale Snow Mapping

**Daily** MODIS NDSI snow cover (**500 m**)




MOD10A1 - 102.9 Observations/year

**16-Day** Landsat fractional snow cover (**30 m**)



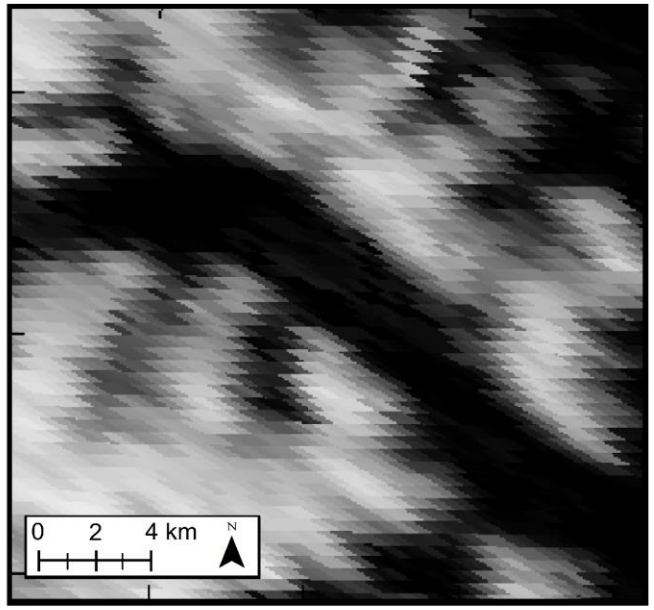

TMSCAG - 14.8 Observations/year

# SNOWARP: Daily 30-m Fractional Snow Covered Area (fSCA)

**Dynamic Time Warping**

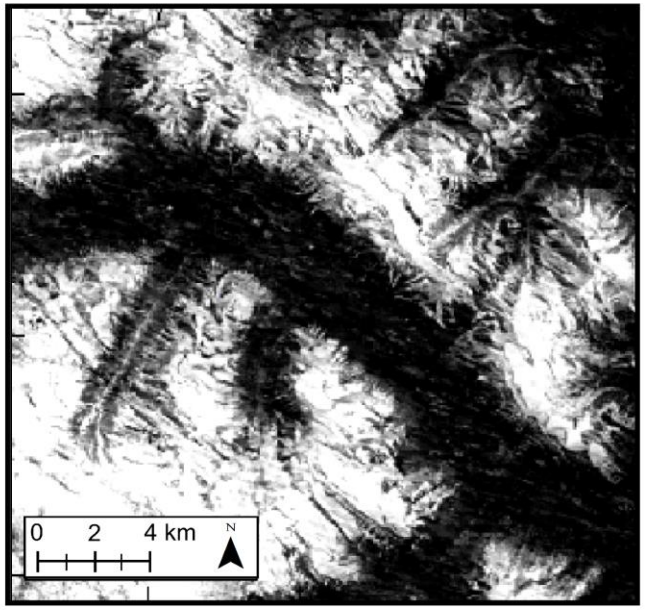
*MODIS generated rule-sets used to re-arrange historical Landsat record*

**Daily** MODIS NDSI snow cover (**500 m**)




MOD10A1 - 102.9 Observations/year

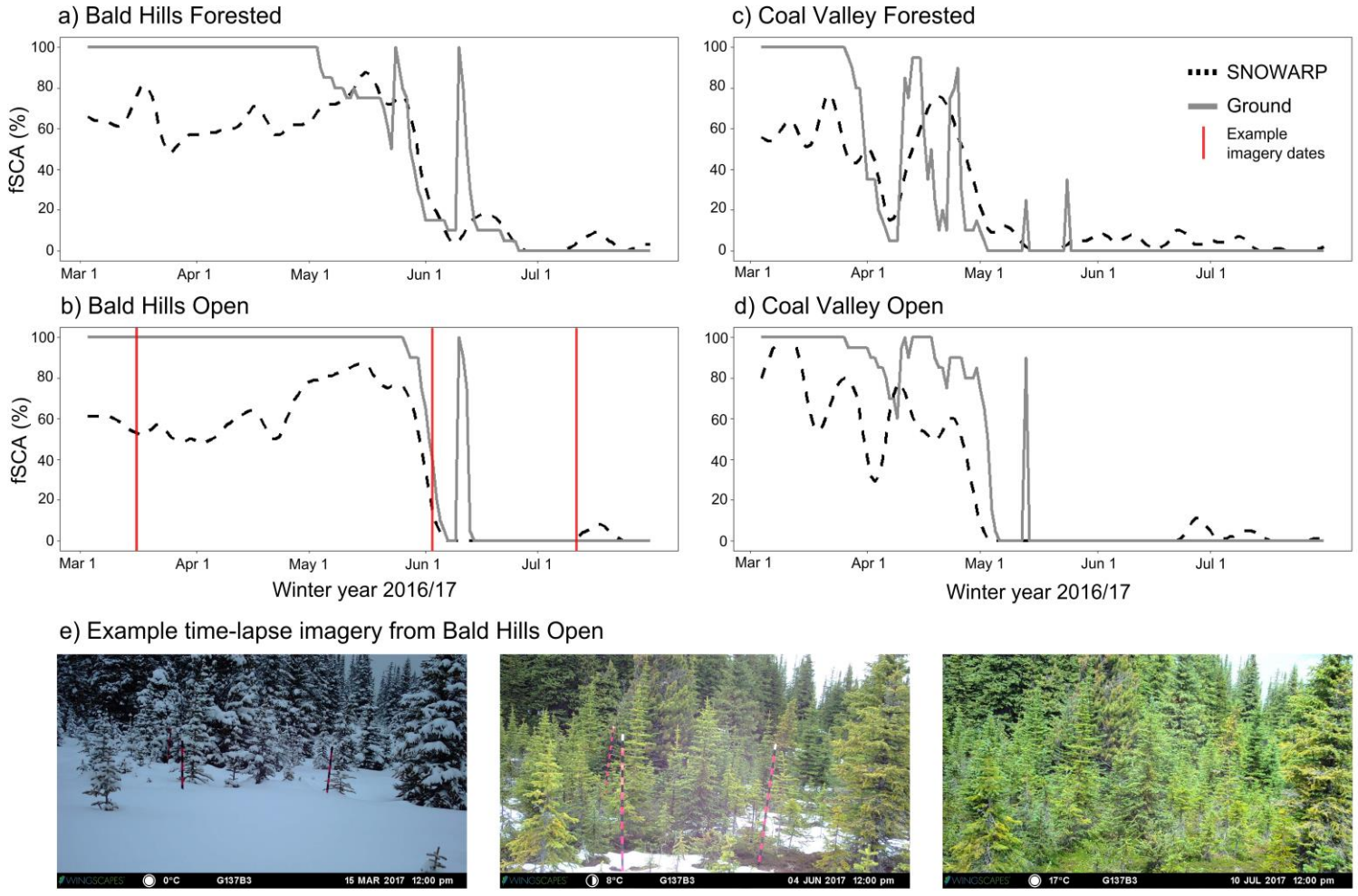
**Daily** Landsat fractional snow cover (**30 m**)




**TMSCAG - 136.2 Observations/year**

2016-08-01
0 20 40Km
0 2.5 5Km

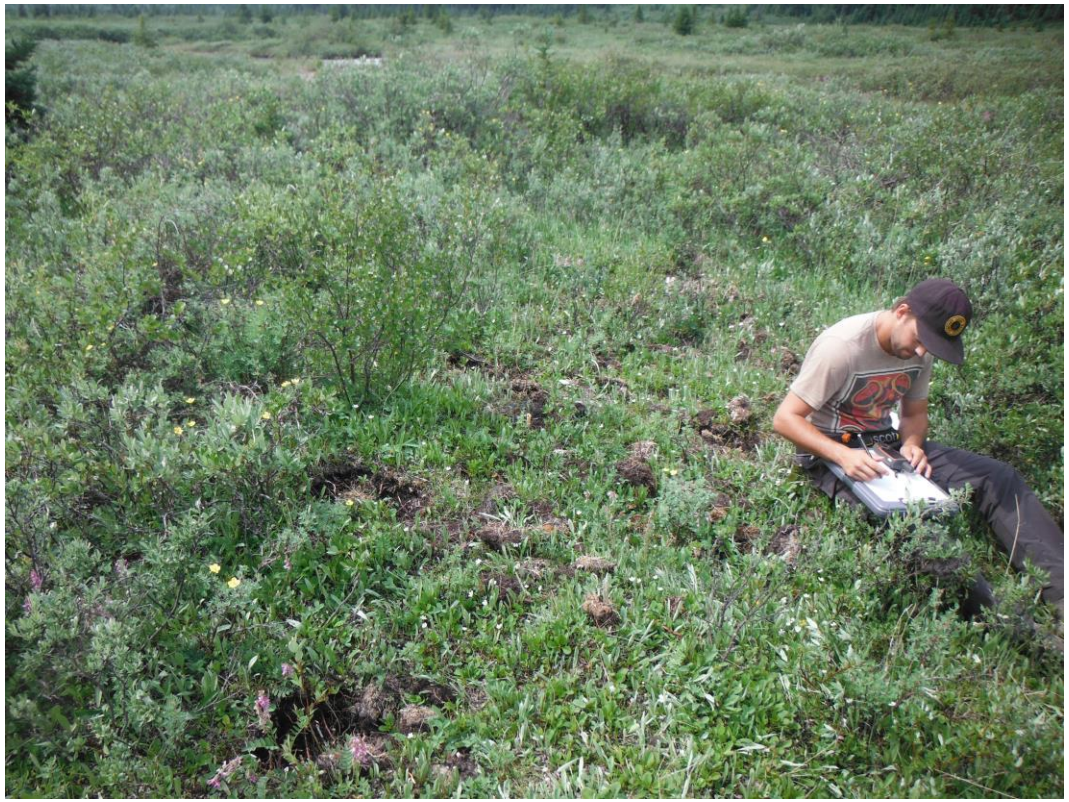
# Ground-Based Testing



# Objective 2

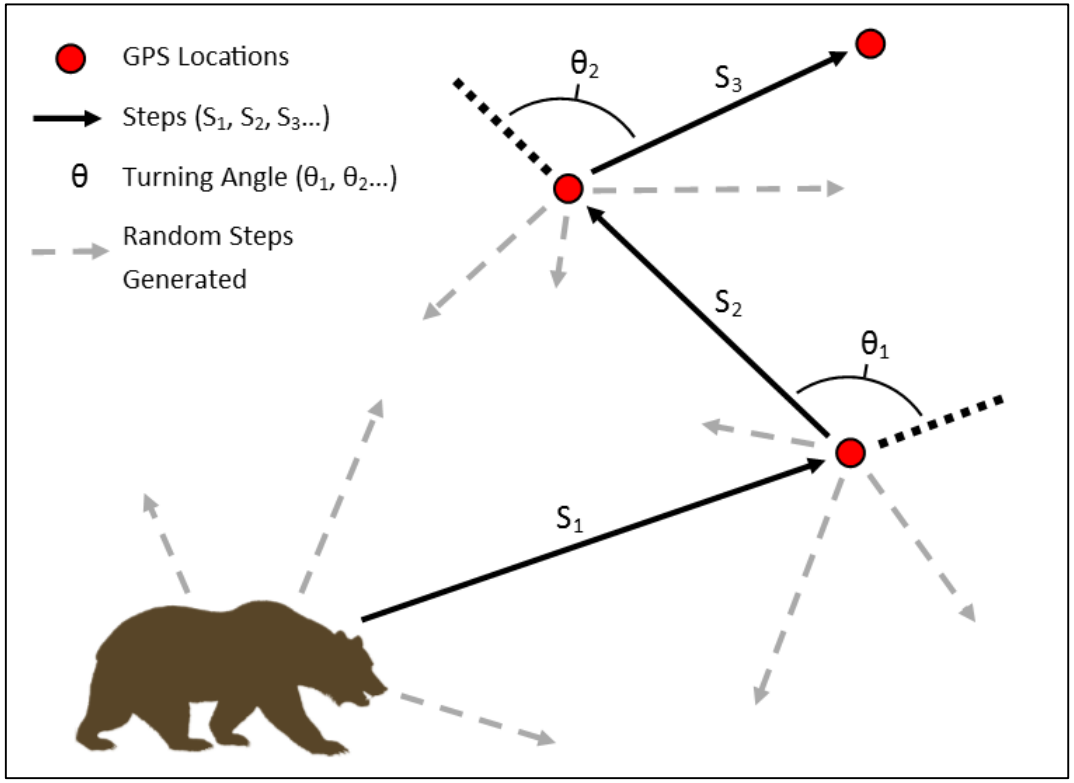
Use SNOWARP to inform our understanding of grizzly bear habitat selection and use during spring season

**Hypothesis:** Selecting for lower snow cover, earlier transition

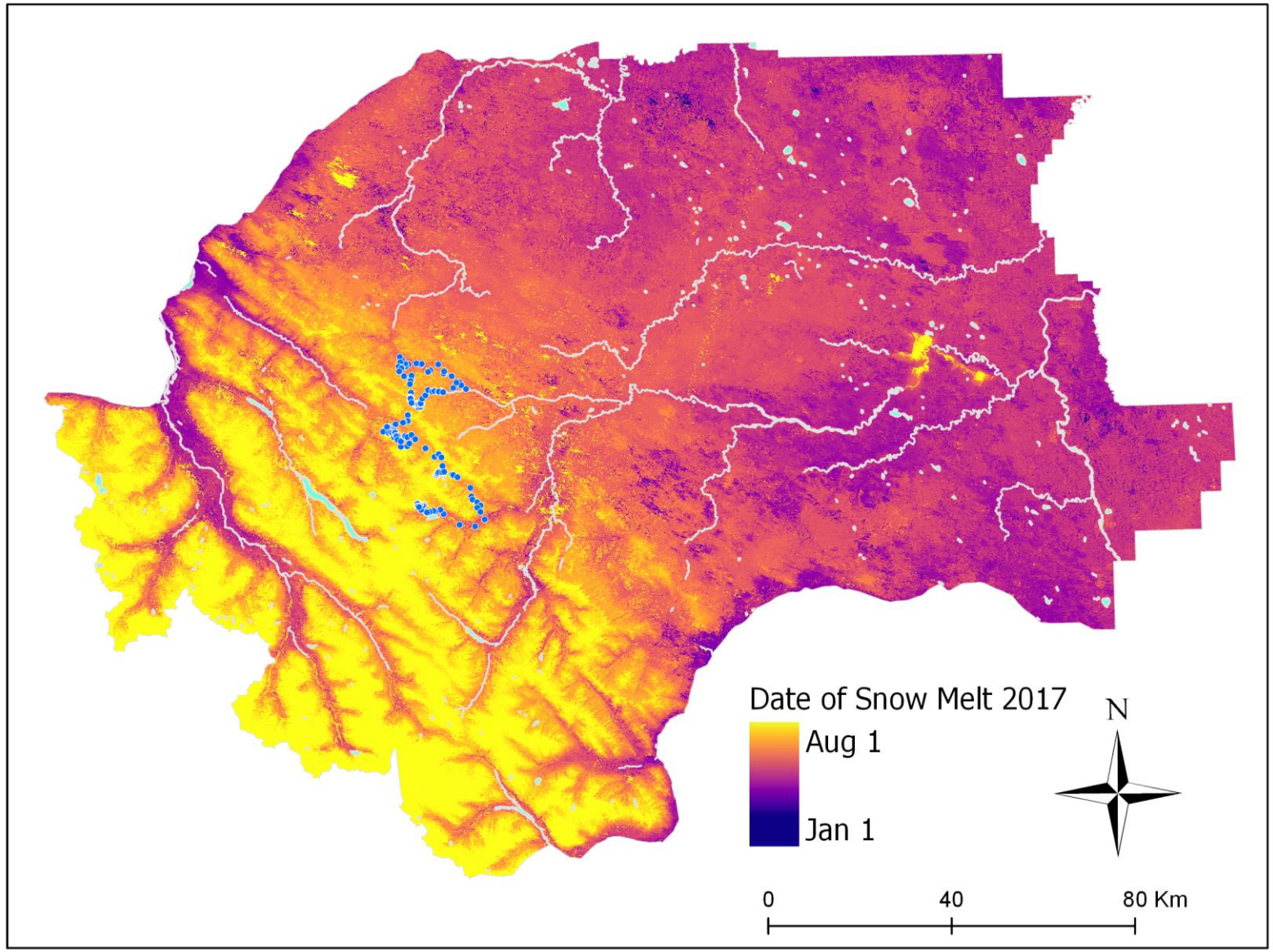


*Cam McClelland*

# Modelling Approach




- Used vs. Available steps
- Core Environmental Variables
  - Step length, time of day, elevation, distance to road, terrain wetness, distance to forest edge, landcover, solar insulation
- Snow Variables
  - Fractional snow covered area, binary snow covered area, days since snow melt

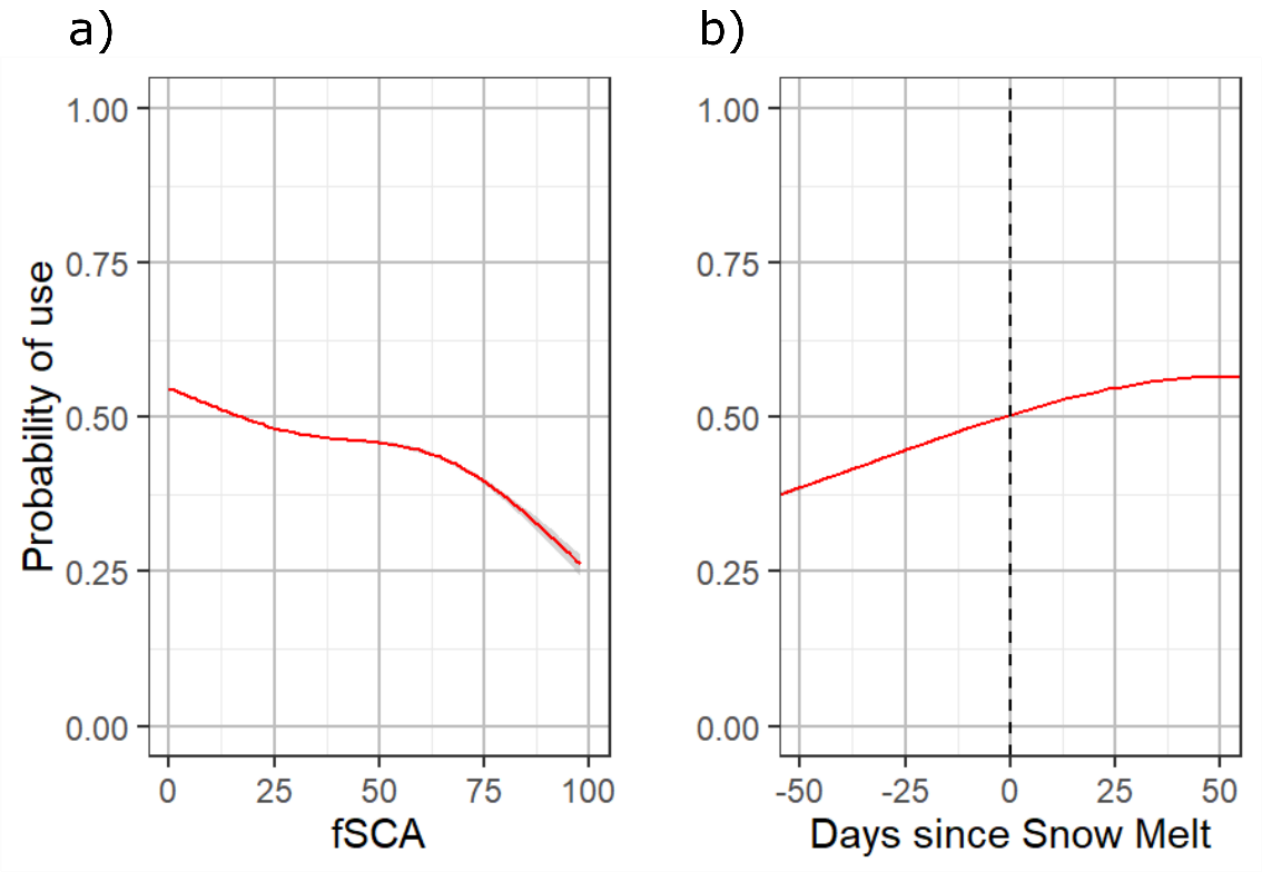

Date of Snow Melt 2017
Aug 1
Jan 1
N
0
40
80 Km

# Model Comparison

| Model | AIC Tally | Average AIC Weight |
|---|---|---|
| Core | 11 | 0.1460 |
| Days since snow melt (DSM) | 9 | 0.1508 |
| Binary snow covered area (bSCA) | 5 | 0.1357 |
| Fractional snow covered area (fSCA) | 37 | 0.5675 |

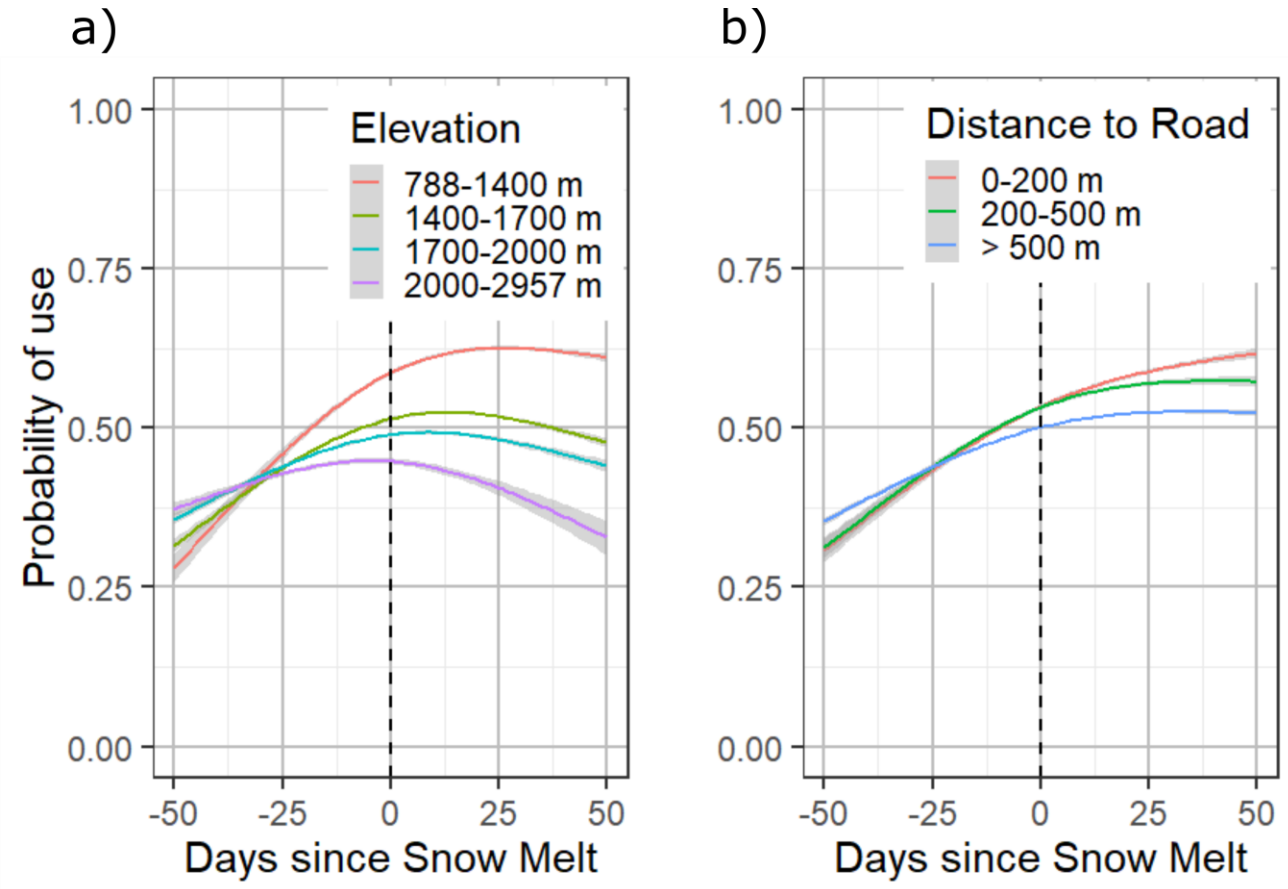
How does snow influence grizzly bear use of the landscape?

# Population Average




**More likely to use snow free areas and areas where snow melted sooner**

# By Elevation and Distance to Road




**More likely to use lower elevation locations, especially when snow free/earlier melt**

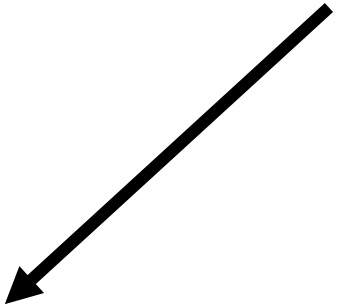
**More likely to use locations closer to roads, especially after snow melt**

# Main Outcomes and Implications

- Objective 1
  - SNOWARP and applications
- Objective 2
  - Baseline relationship
  - Climate change and bear management

Bear habitat selection and use

- Snow cover
- Periods post snow melt



Future climatic conditions

- Warmer, more uncertain winter and spring seasons
- Less days with snow cover

Management

- More bears on landscape
- Human-bear encounters
- Areas of high risk during spring

# Main Outcomes and Implications

**Outcomes**

- Objective 1
  - SNOWARP and applications
- Objective 2
  - Baseline relationship
  - Climate change and bear management

**Implications**

- Future climate:
  - Warmer, more uncertain seasons
  - Less days with snow cover
- Management
  - More bears at lower elevations
  - Risk of human-bear encounters
  - Areas of high risk during spring

# Thank You…

2 research papers published and

MSc awarded January 2019

Ethan Berman
Integrated Remote Sensing Studio
Forest Resources Management
UBC Faculty of Forestry
ethan.berman@alumni.ubc.ca