Why Prairie snow?

- Prairies cover almost 1/3 of the Earth's land surface globally

  - important for agriculture, water management, flooding concerns, energy & carbon cycle interactions, ecological issues, etc.

- Low stature vegetation, wind redistribution, subtle topography, rapidly changing conditions, and shallow snow create unique snow heterogeneity

Winter 2021 planned activities: local-scale campaign at CARC, MT

  - UAV Lidar & albedo, hyperspectral, UAVSAR flights, ground meteorology, snow, & soil

Key questions to discuss (not limited)

1. What are the current gaps in remote sensing of prairie snow?

  - Impact of substrate characteristics (vegetation, soil composition & moisture, and freeze-thaw state) on remote sensing techniques
  - Characterizing spatial heterogeneity of snow (especially wind-driven redistribution, sublimation)
  - Rapidly changing conditions (metamorphism, wet snow, etc.)
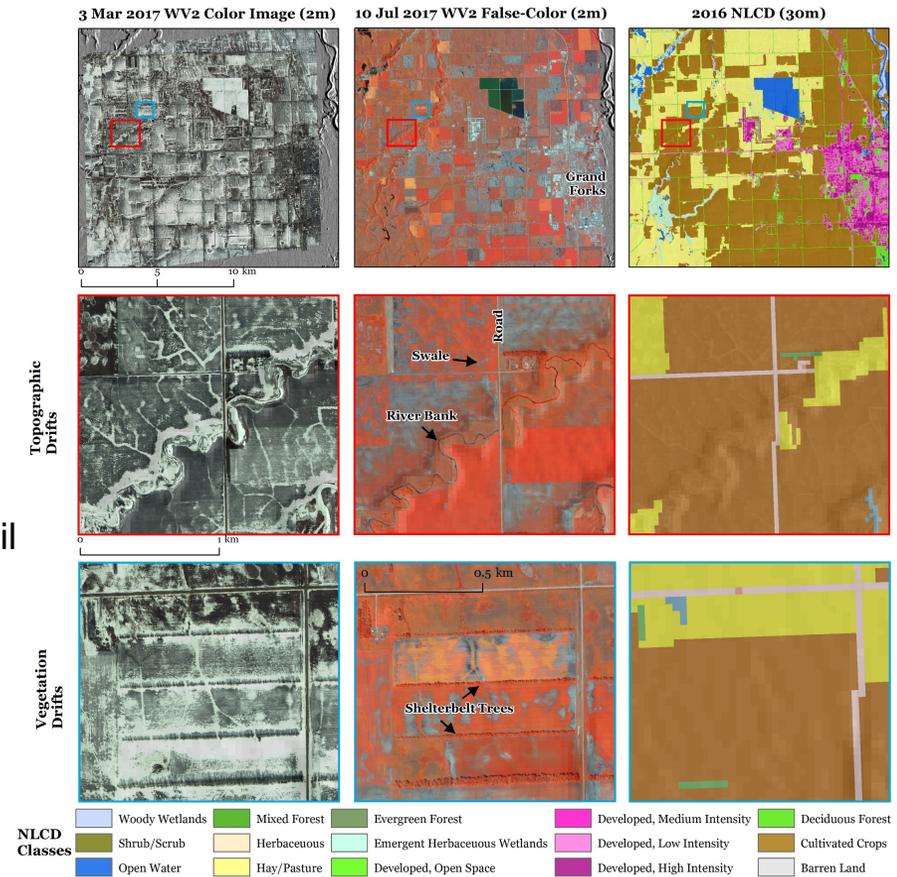
2. What sensors might be beneficial (shallow, transitional snow) – esp. path to space?

  - L-band InSAR, Lidar, multi-band SAR/radiometer, hyperspectral, Gamma radiation, SfM, others?

3. Which opportunities/collaborations should we be aware of?

  - Agricultural & ecological communities, Canadian agencies & universities, flood forecasters, others?

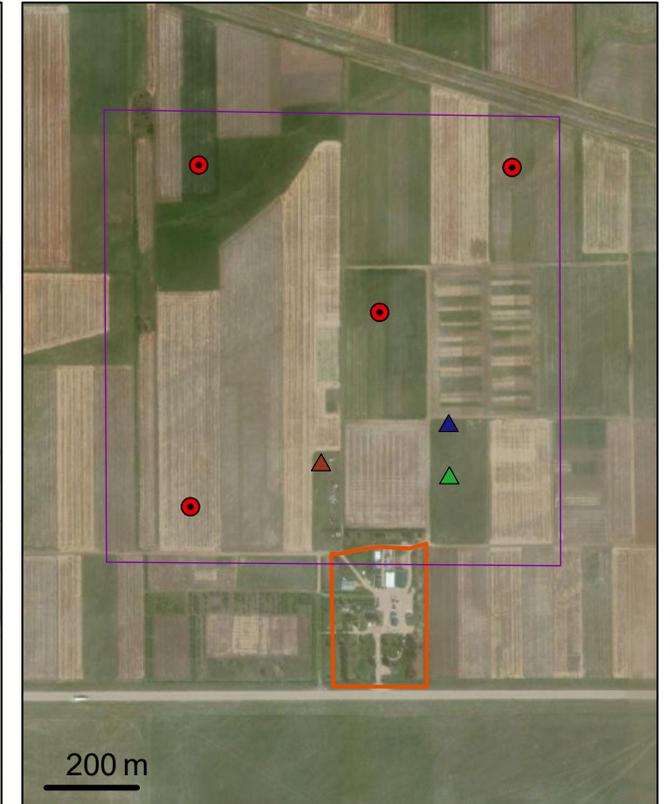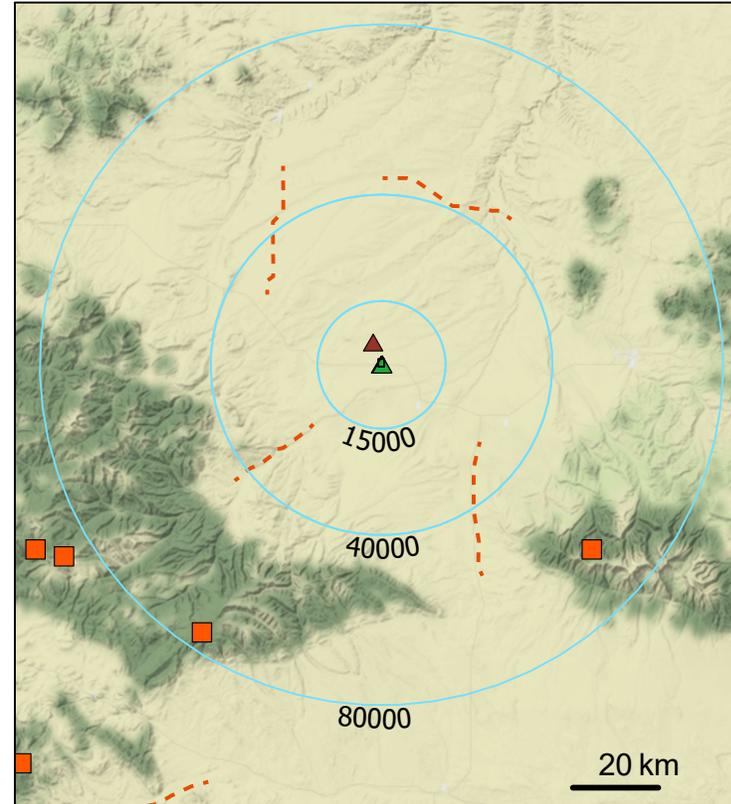4. What do we want to achieve, and when?

3 Mar 2017 WV2 Color Image (2m)   10 Jul 2017 WV2 False-Color (2m)   2016 NLCD (30m)

Topographic Drifts — Swale, Road, River Bank

Vegetation Drifts — Shelterbelt Trees

NLCD Classes: Woody Wetlands, Shrub/Scrub, Open Water, Mixed Forest, Herbaceuous, Hay/Pasture, Evergreen Forest, Emergent Herbaceuous Wetlands, Developed, Open Space, Developed, Medium Intensity, Developed, Low Intensity, Developed, High Intensity, Deciduous Forest, Cultivated Crops, Barren Land

SnowEx 2020 virtual meeting, Prairie snow group – Sam Tuttle and Eunsang Cho

2021 SnowEx Prairie Activities

Primary Objectives/Goals:

1. Characterize the **spatial heterogeneity of snow** distribution due to wind, landscape, sublimation, soil properties in a prairie environment
   - Scales at which processes dominate
   - Ability of RS techniques to characterize spatial distribution

2. Quantify the **accuracy and uncertainty in SWE retrievals from L-band InSAR** in a Prairie environment
   - Shallow snow, wet snow?
   - Quantifying & distinguishing water stored as snow vs. in soil column

3. Assess the **requirements of a prototype cal/val Prairie site** to support future aircraft and satellite missions.
   - Instrumentation/observations?

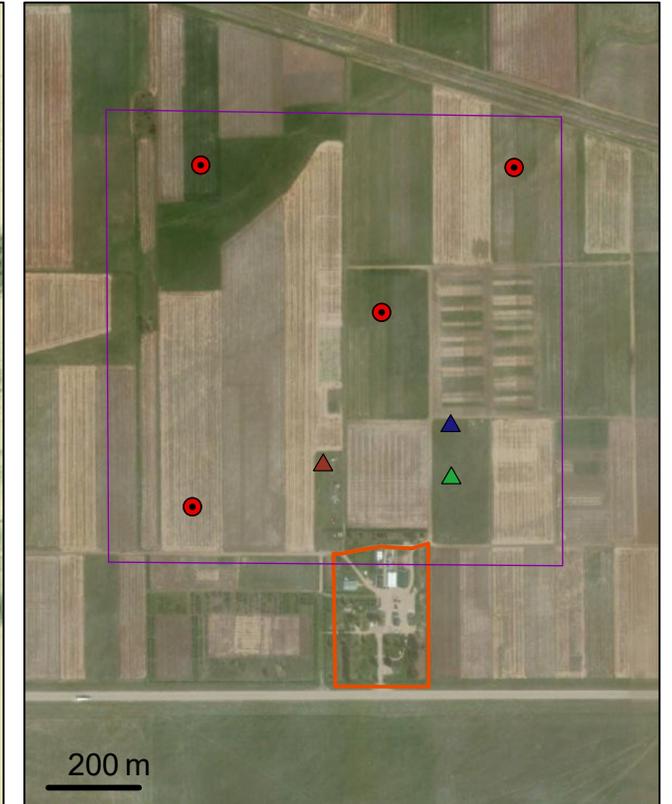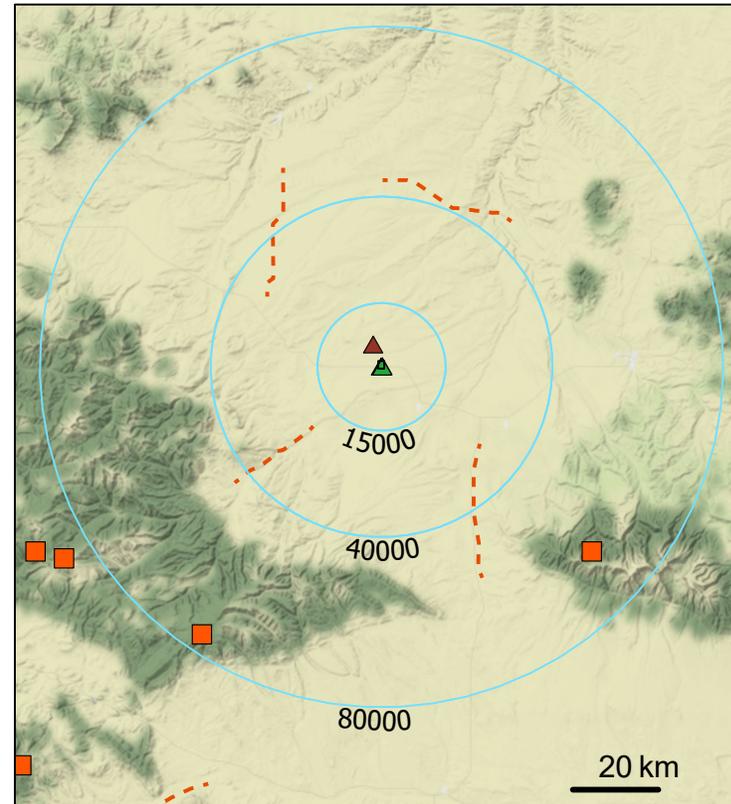

Central Agricultural Research Center (CARC)

NOHRSC Flightlines   Met Stations   Proposed Met Tower Locations
Distance from CARC (m)   MESONET   Proposed Study Area
SNOTEL Stations   NWIS -- AgriMet   Central Ag Research Station Facilities
NWS

2021 SnowEx Prairie Activities

Current plans:

- CARC in Moccasin, MT: long-term agricultural research station

- 1 km square study domain

- Periodic UAV Lidar, albedo, surface temp. flights (approx. 7 total)
  - Portable hyperspectral

- 4(?) UAVSAR airborne flights
  - Nearby gamma flights

- Ground stations (4 satellite & 1 central)
  - At all locations: Air temp., relative humidity, wind, soil moisture & temperature (3 depths), snow depth, skin temp., cameras
  - At single location: precipitation (heated, screened), SWE scale, temp. & RH (2 levels), 4-way net radiation, snow temperature profile, pressure, cosmic ray sensor

Central Agricultural Research Center (CARC)

15000
40000
80000
20 km
200 m

NOHRSC Flightlines   Met Stations   Proposed Met Tower Locations
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                            NWS

1 - Thoughts about the sampling strategy?

- Is there anything that you think is missing or should be done differently to address this year's campaign objectives?

2 - In the next few years, what do we want to achieve, and when?

- e.g. if we have a 2022 prairie campaign, …
- What objectives/activities/gaps are missing/essential?
  - Accuracy of other remote sensing techniques in prairie (e.g. multi-band SAR/radiometer)?
  - Impact of substrate characteristics (vegetation, soil composition & moisture, and freeze-thaw state) on snow depth or SWE from remote sensing techniques?
  - Impact of grain size/depth hoar, ice lenses on remote sensing techniques – how much does vertical heterogeneity matter?
  - How to measure wet snow?
  - Scaling issues?
  - Others?

3 - Is anyone already doing work in the Prairies that we should be aware of?

- Which opportunities/collaborations should we be aware of?
  - Canadian agencies & universities
  - Agricultural & ecological communities
  - Flood forecasters
  - Airports?
  - Others?

4 - What are the modeling needs that should be addressed with a Prairie campaign?