Overarching Research question:
• What remotely sensed terrain characteristics in permafrost terrains can be used to infer permafrost geomorphologic properties and assess vulnerability to thaw?
Variations in Permafrost Wetland Terrain Feature Conditions

Airborne LiDAR in 2014 and 2016
Airborne hyperspectral in 2016
Historical imagery to 1949
UAV testing and spectral meas.

Ground based LiDAR
Veg. spectral reflectance
Repeat thaw depths/active layer
dGPS surveying
Vegetation assessments
Vegetation manipulations

Moisture content, pH, Eh
Microbiology
Thermal measurements
Electrical resistivity tomography
Snow surveys
Coring to 15 m depth
Permafrost Tunnel- thermokarst driven hydrologic change
Gently sloping upland terrain. 10m high ice wedges covered by ~3m of silt

Initiation of thermokarst
In the last few years

June-September Precipitation:
2014: 223% above mean
2015: 156% above mean
2016: 183% above mean

Downslope sedimentation/redistribution

Advanced thermokarst hydrologic change

C. Hiemstra
Farmer’s Loop - Worldview 2 image and repeat LiDAR

2014-2016
LiDAR
(meters)

- 0.16 - 0.25
- 0.26 - 0.50
- 0.51 - 0.75
- 0.76 - 1.00
Farmer’s Loop - Worldview 2 image and galvanic electrical resistivity tomography

Birch-white Spruce forest
WC: 30-100 g/g

Treed fen
WC: 100-800 g/g

Tussocks and shrubs
WC: 100-800 g/g

Black spruce/moss forest
WC: 30-100 g/g

Electrode spacing 6 meters
RMS error: 16.4

Resistivity in ohm-meters:
100 200 400 800 1600 3200 6400 12,800
Repeat thaw depth measurements along four 500 m long dGPS surveyed transects - one summer

<table>
<thead>
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Tussock site:
60 cm <0°C in mid November

Ice cemented silt
Transition zone
Repeat thaw depth measurements along four 500 m long dGPS surveyed transects- 4 years

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Similar repeat patterns across all four transects
APEX site- snow depths in 2015 and 2016- repeated patterns of ecotype/terrain-snow relationships
-Hoping to have IceBridge fly all sites in March, 2017 coincident with a large snow campaign

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