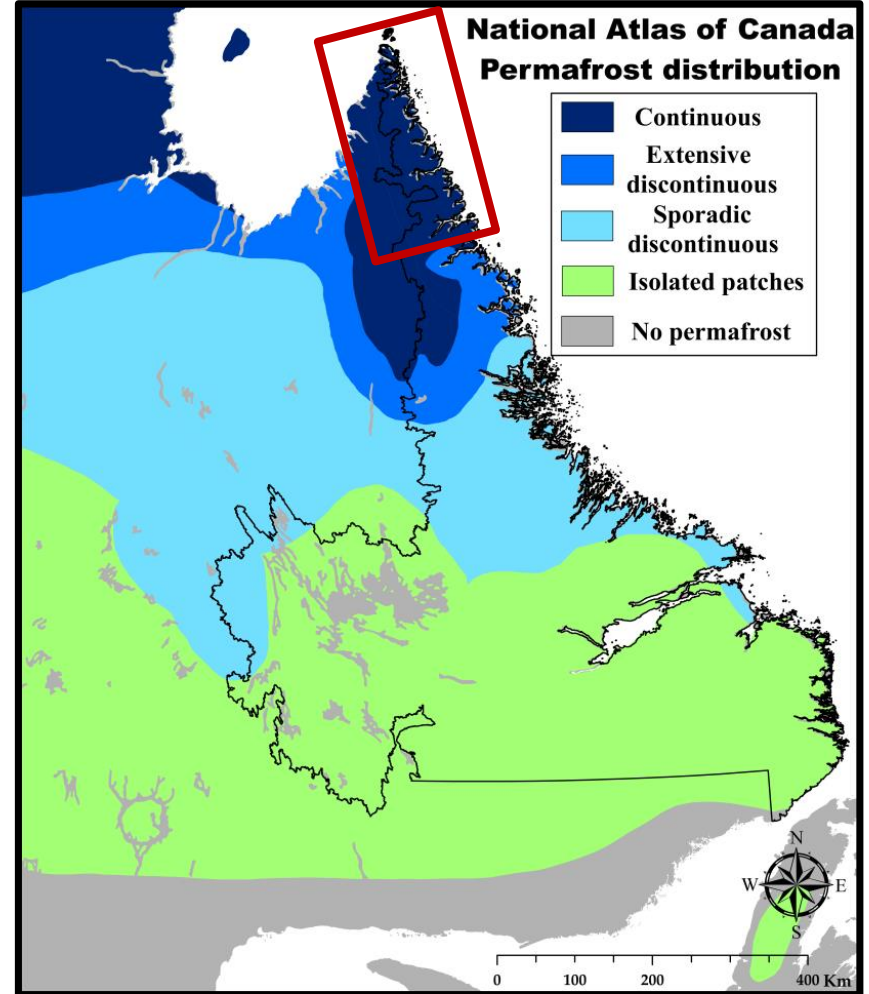
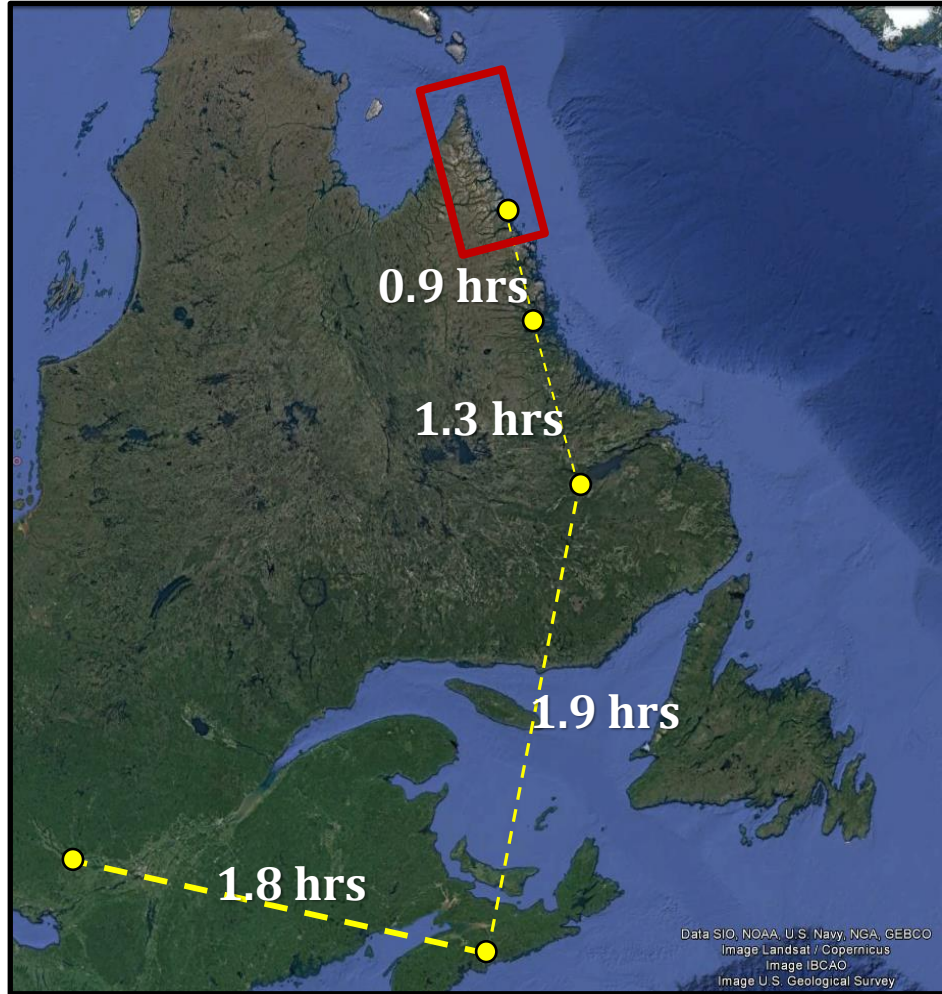
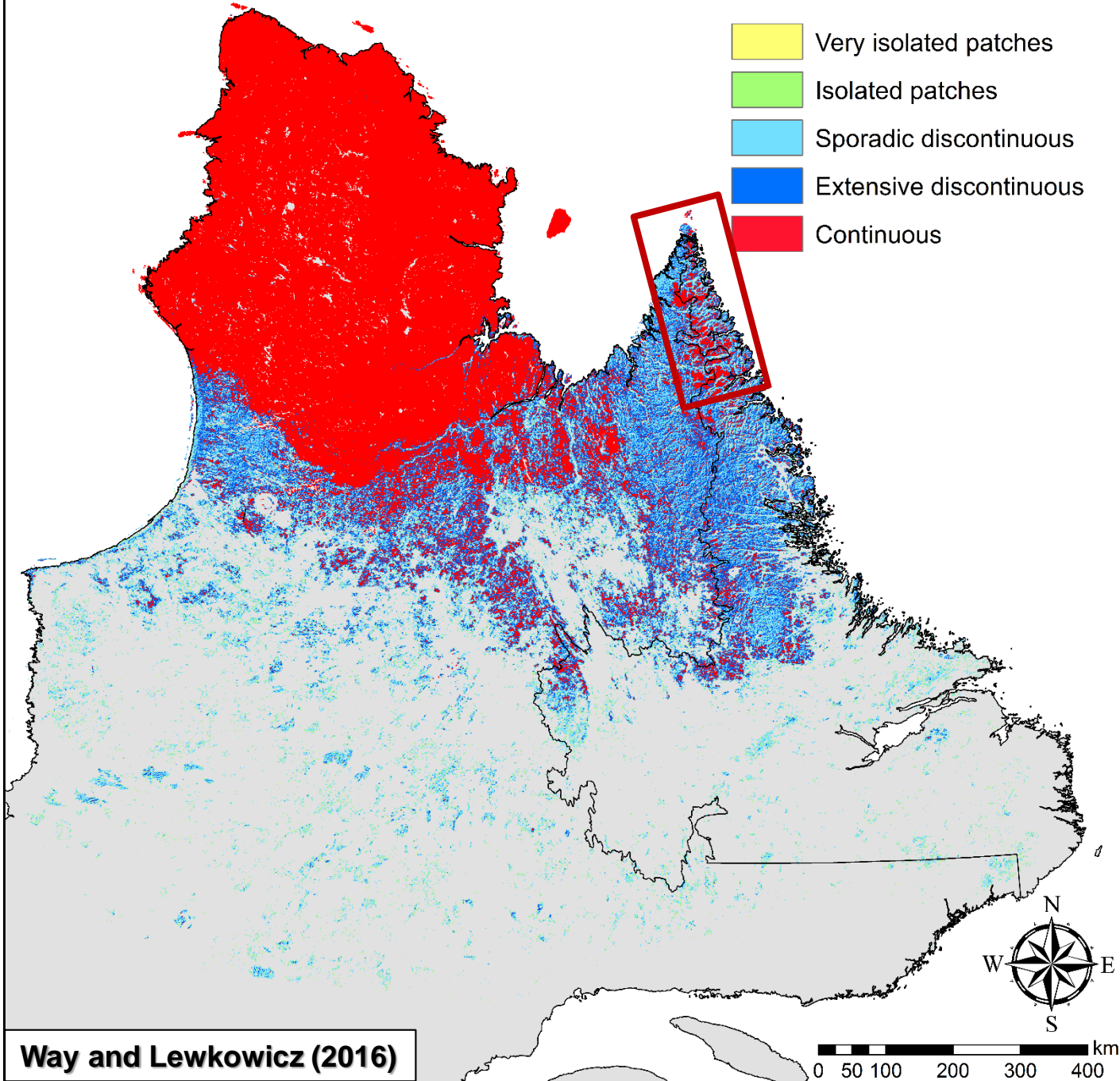


Study Area



Permafrost zonation within 1 km cells

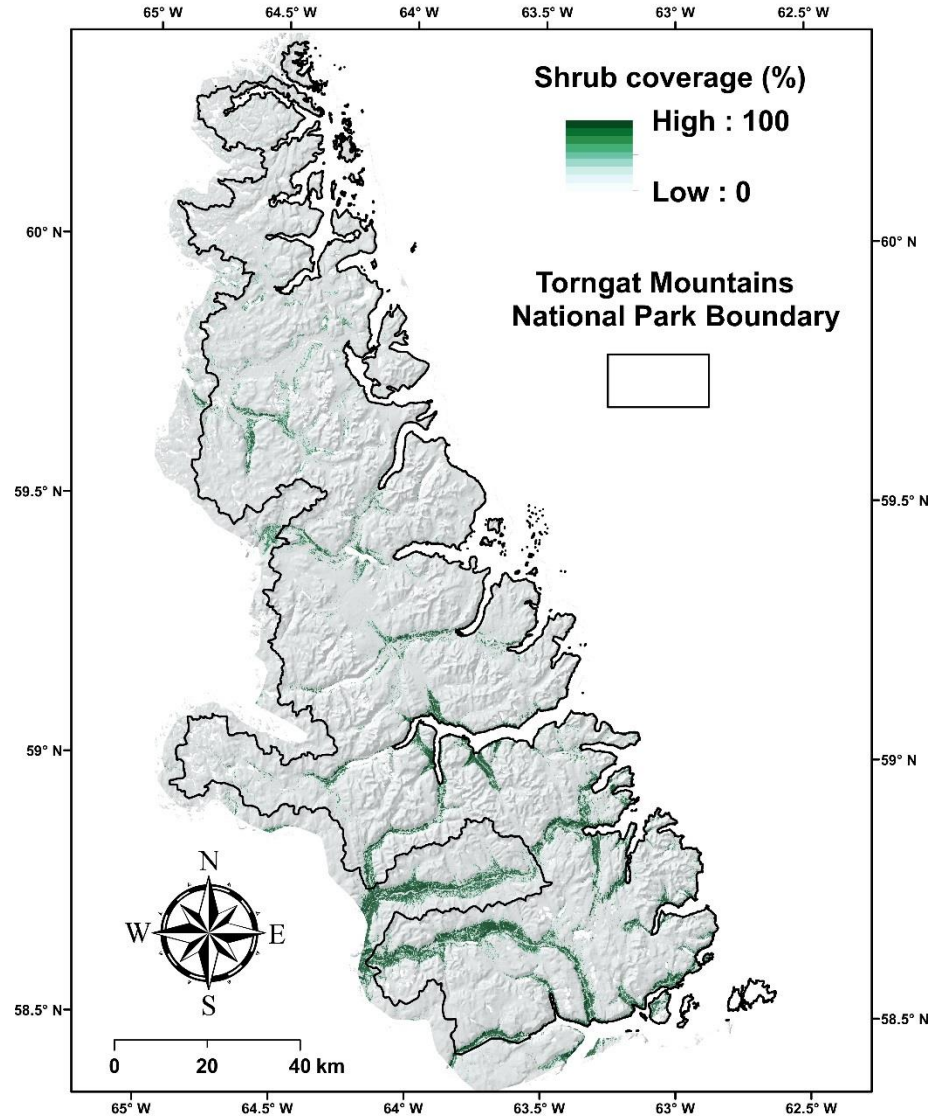
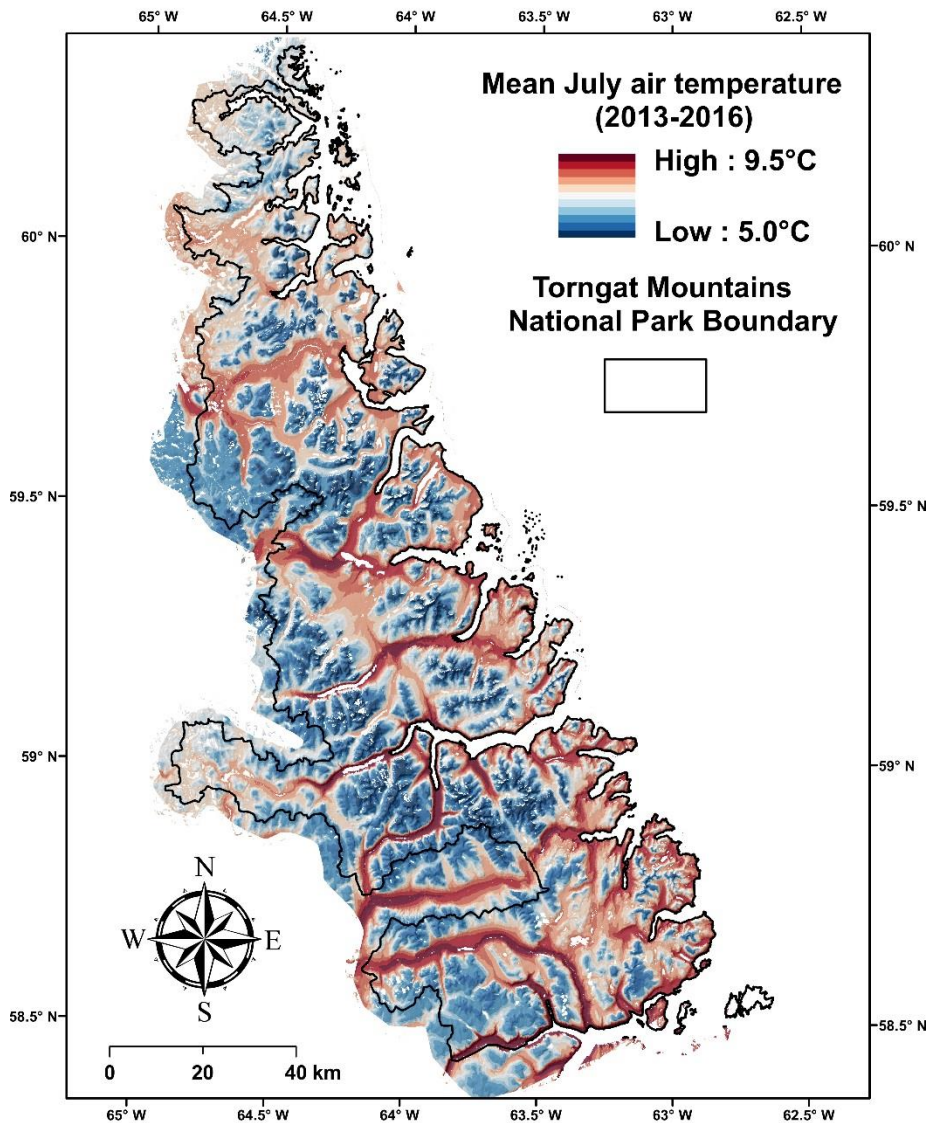
- Very isolated patches
- Isolated patches
- Sporadic discontinuous
- Extensive discontinuous
- Continuous



Way and Lewkowicz (2016)

0 50 100 200 300 400 km

Climate & Vegetation



Rapid shrub change at Ramah Bay



1991

Rapid shrub change at Ramah Bay



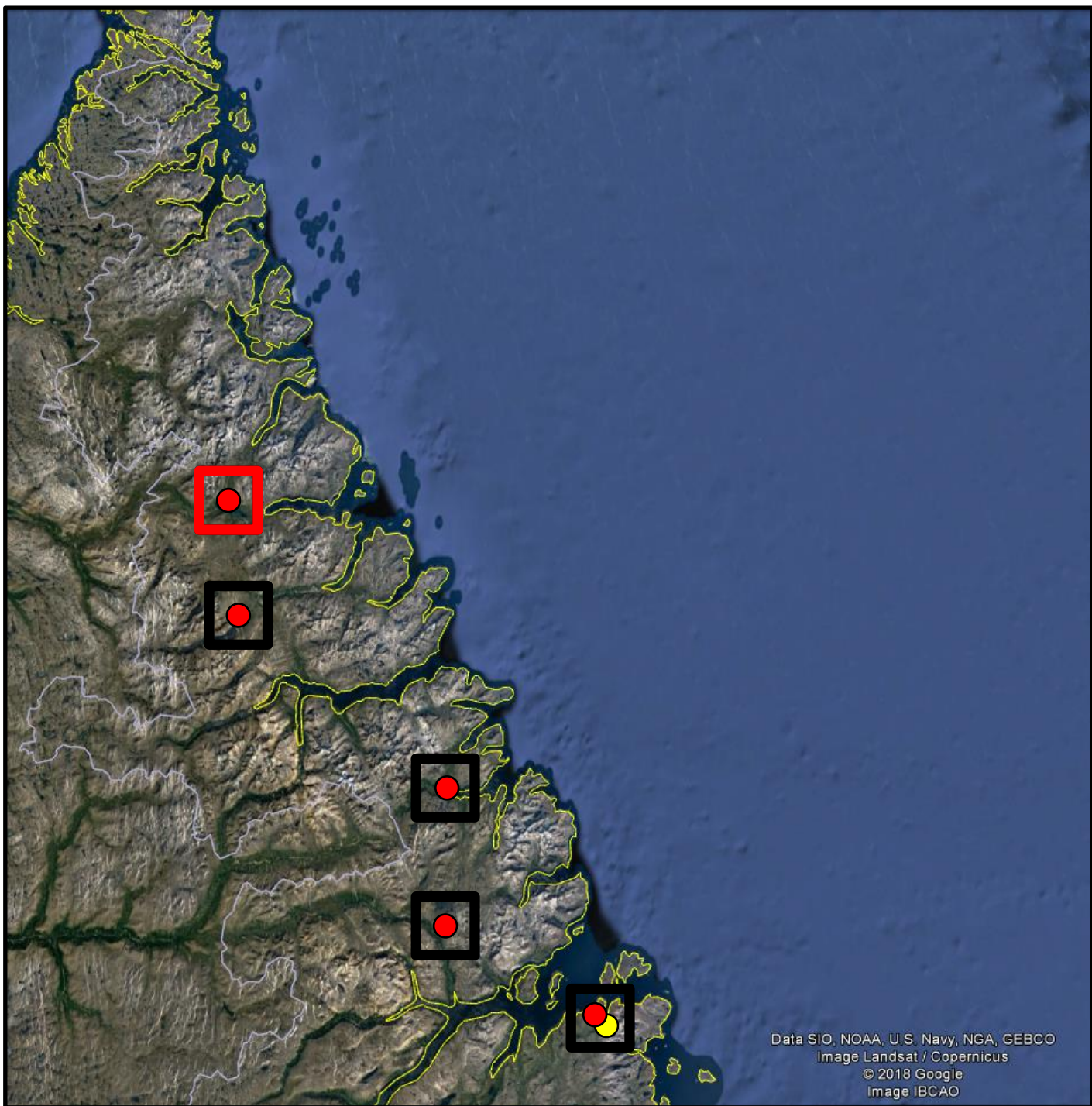
2018

DC electrical resistivity tomography

- **ERT**

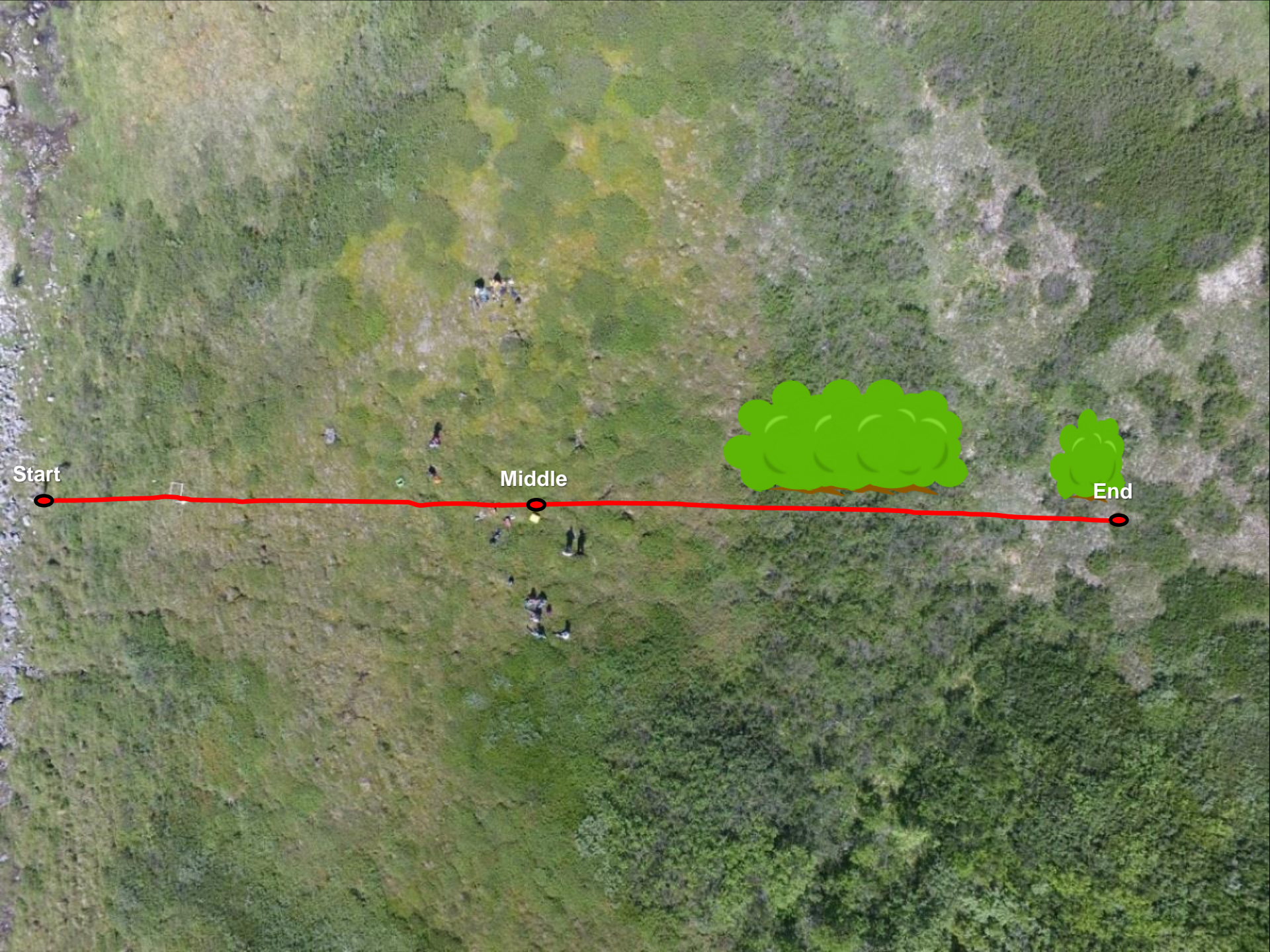
- Surveys at 17 locations in TMNP. Frost and temperature probes used as validation.





Kangalaksiorvik (north side)

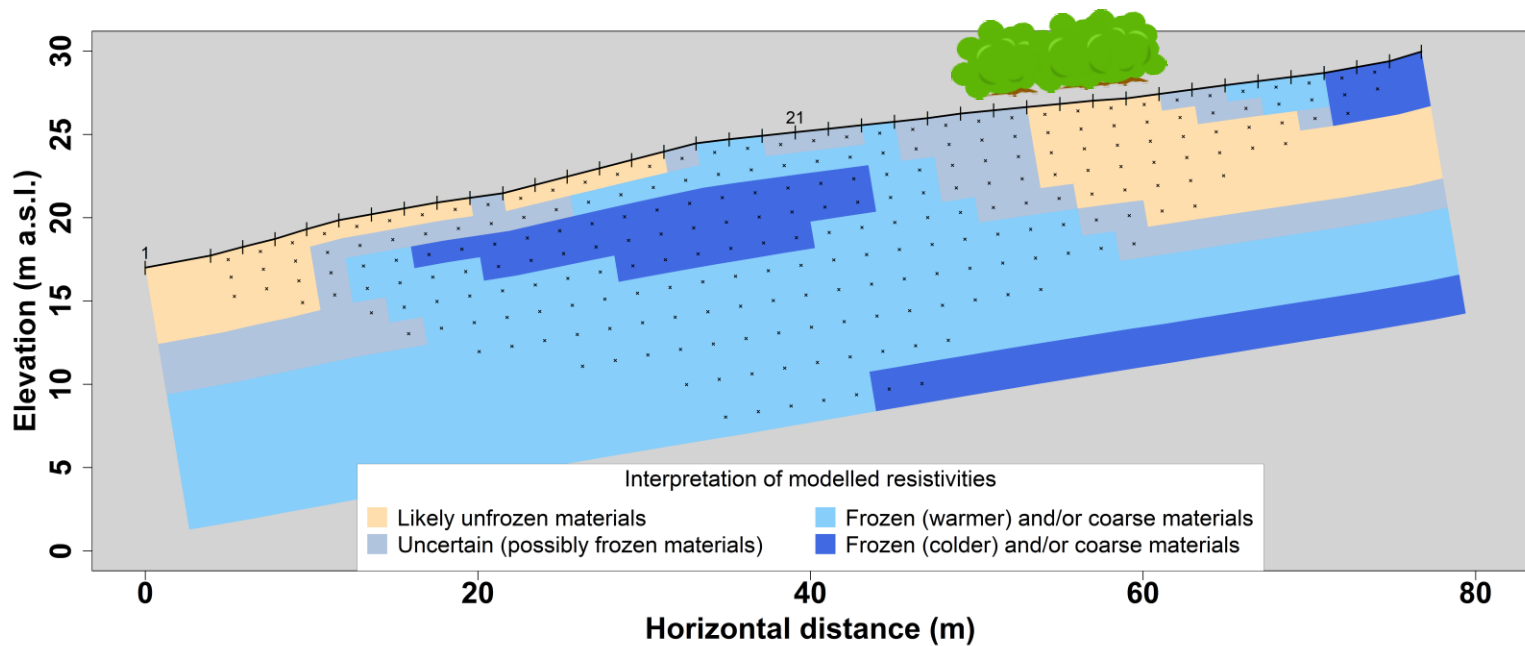
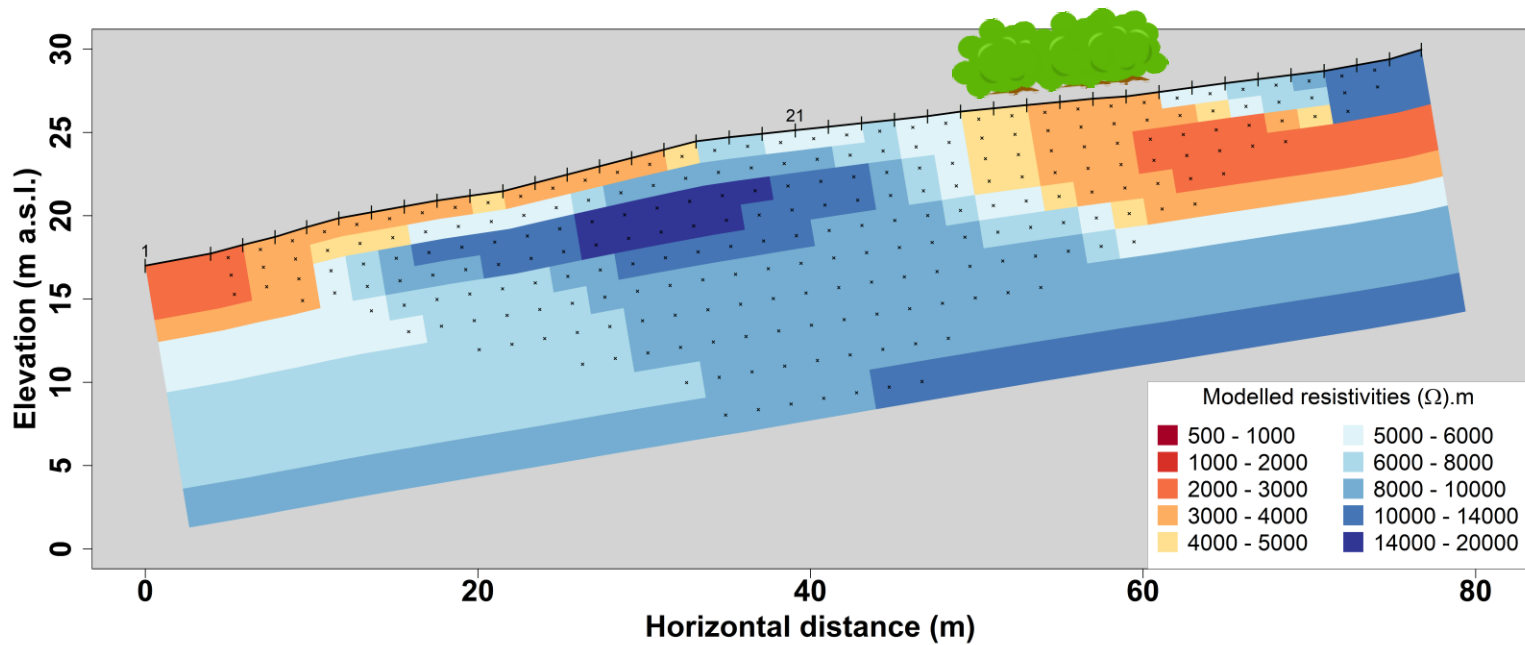




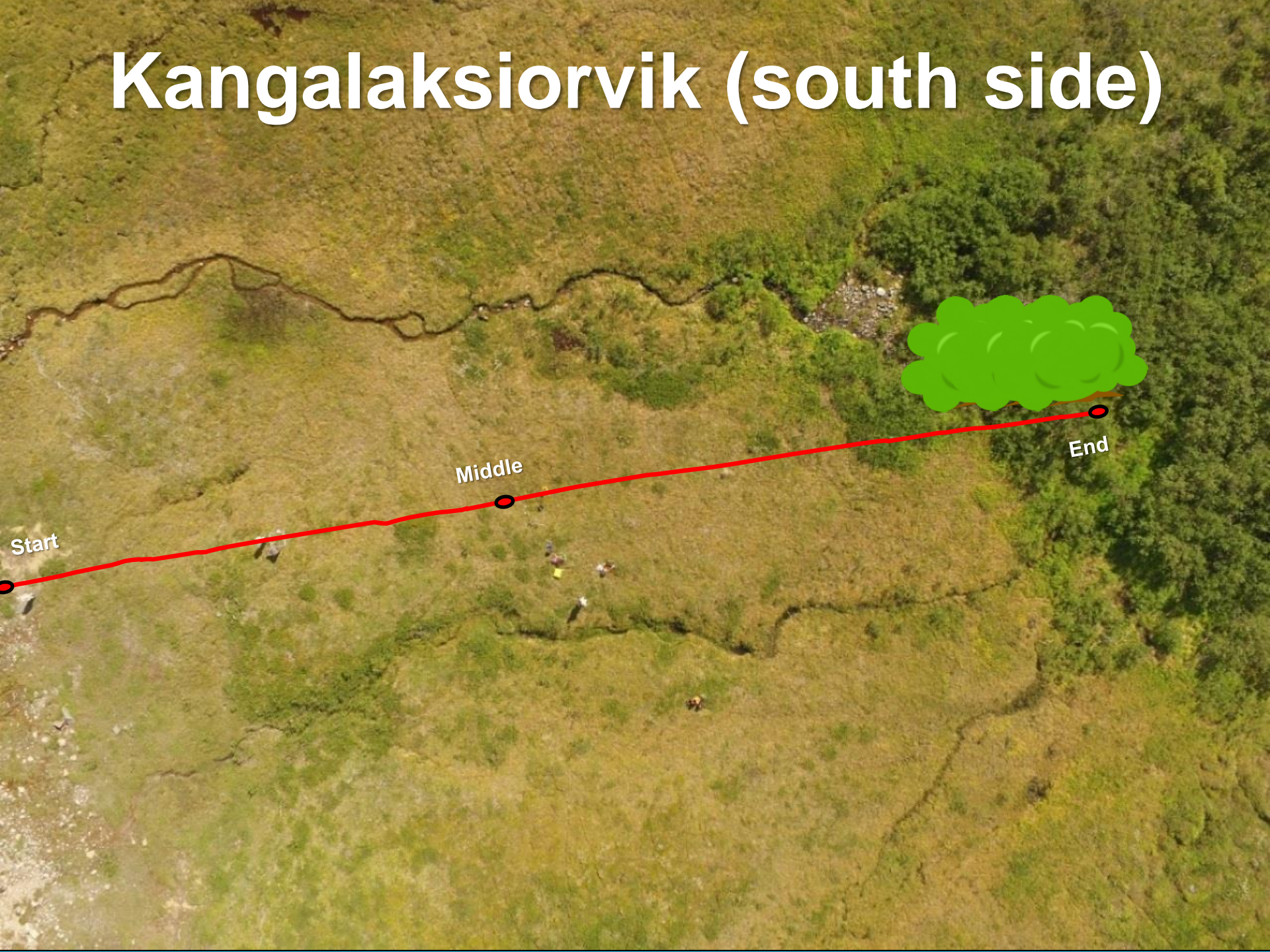
Start

Middle

End



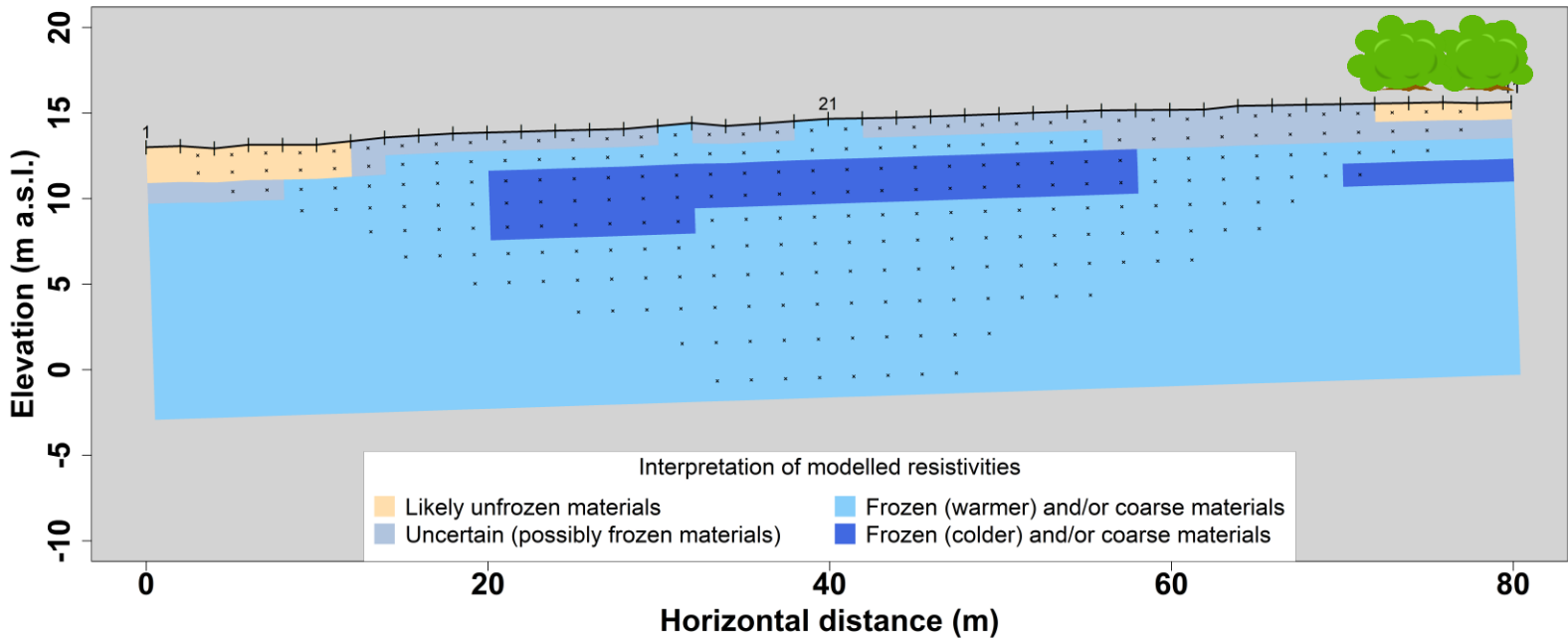
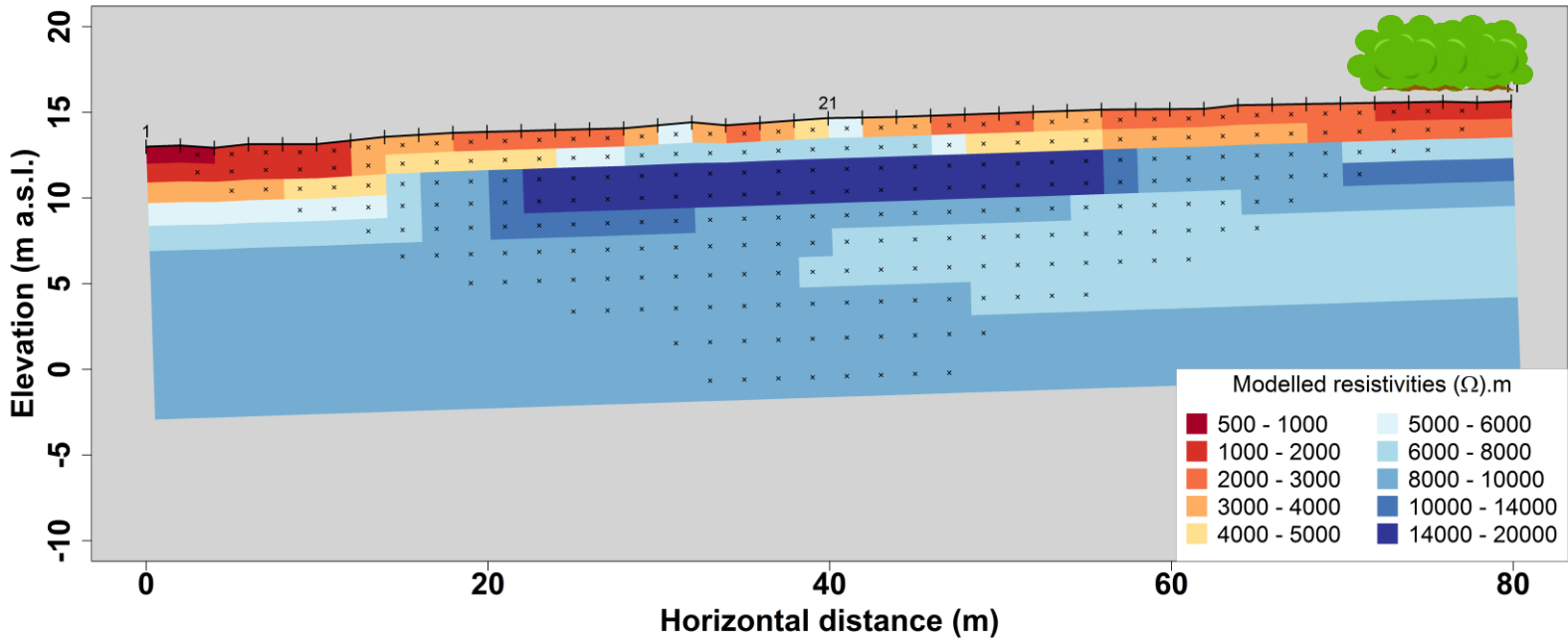
Kangalaksiorvik (south side)

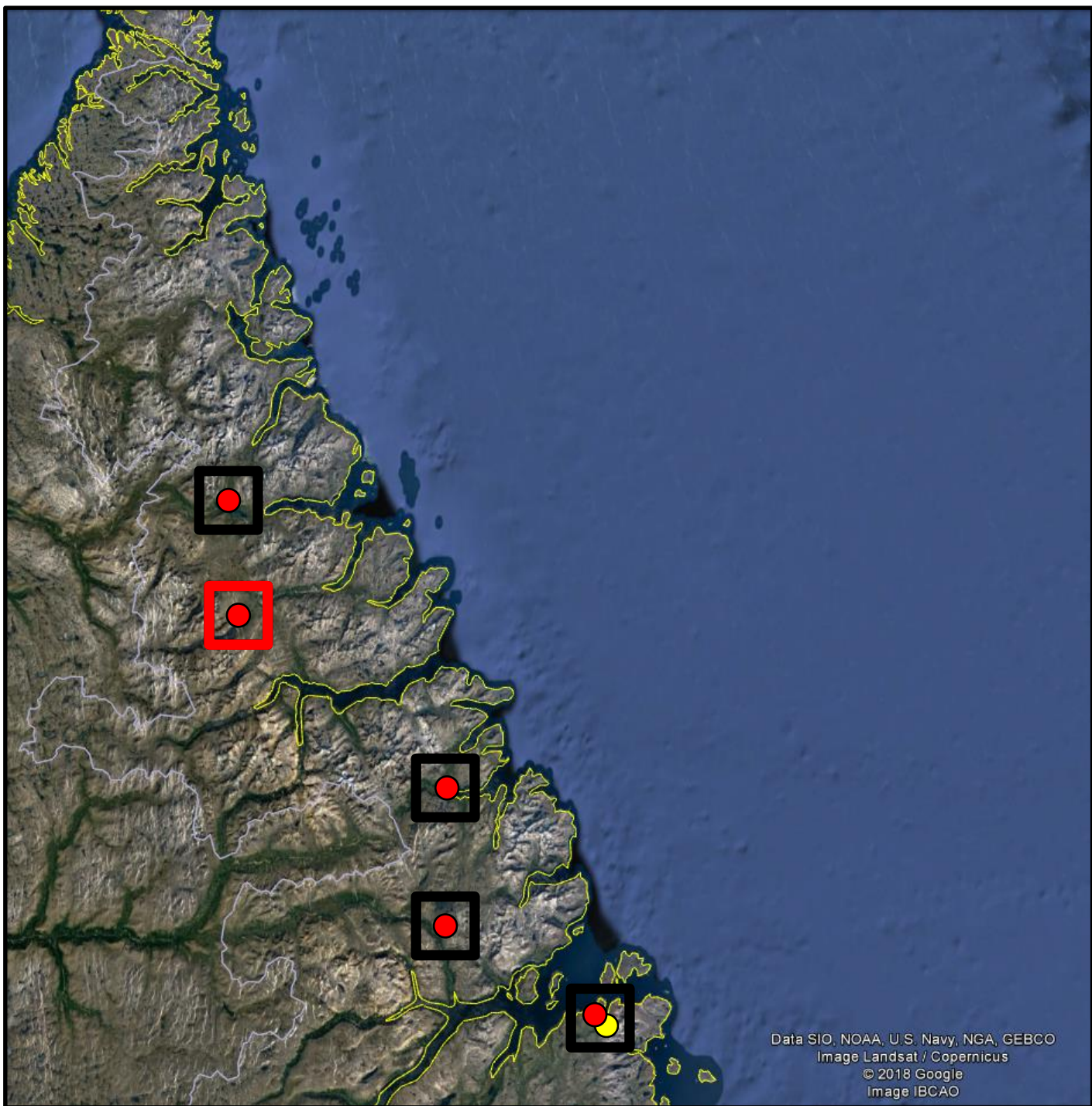


Start

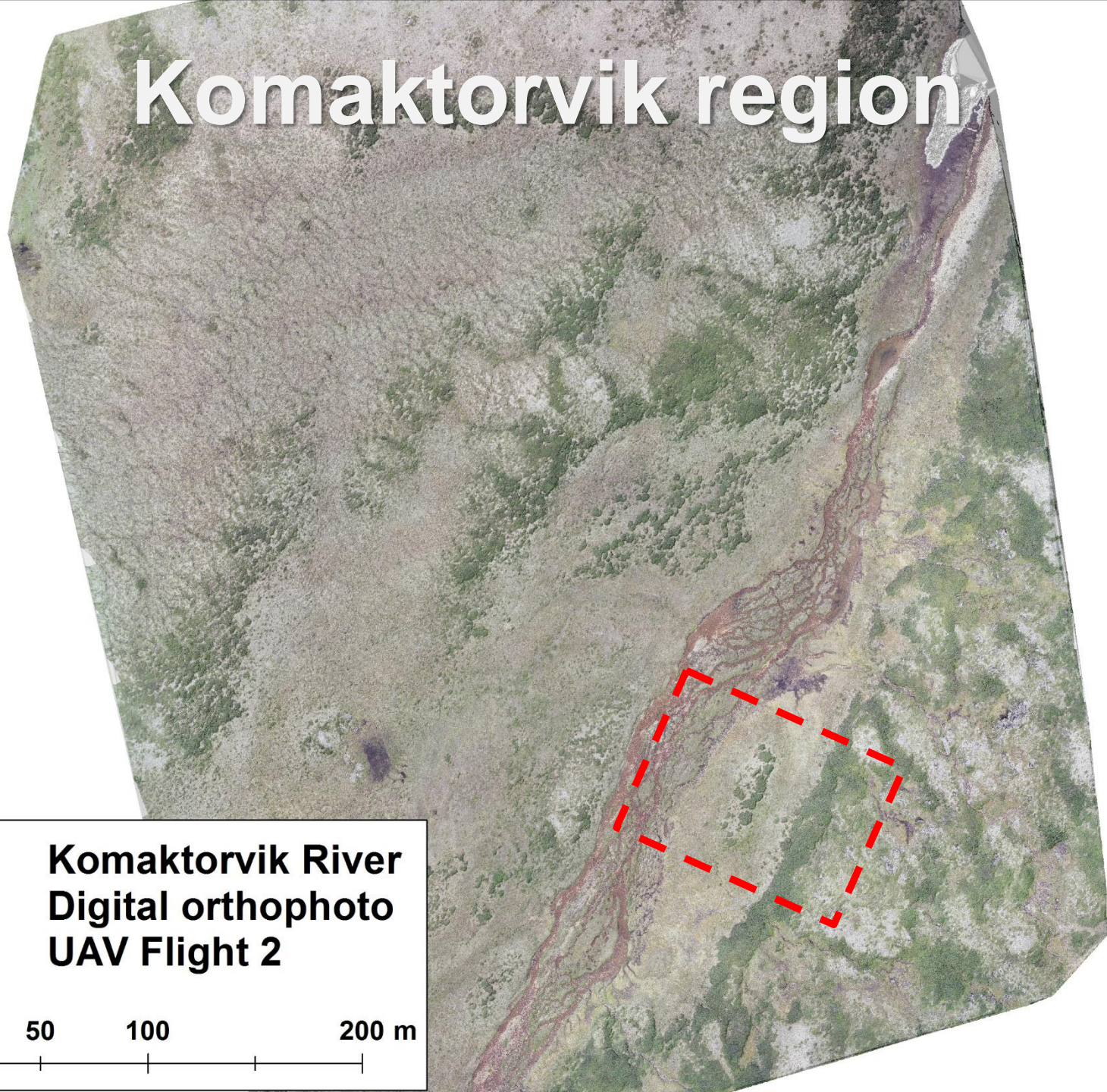
Middle

End





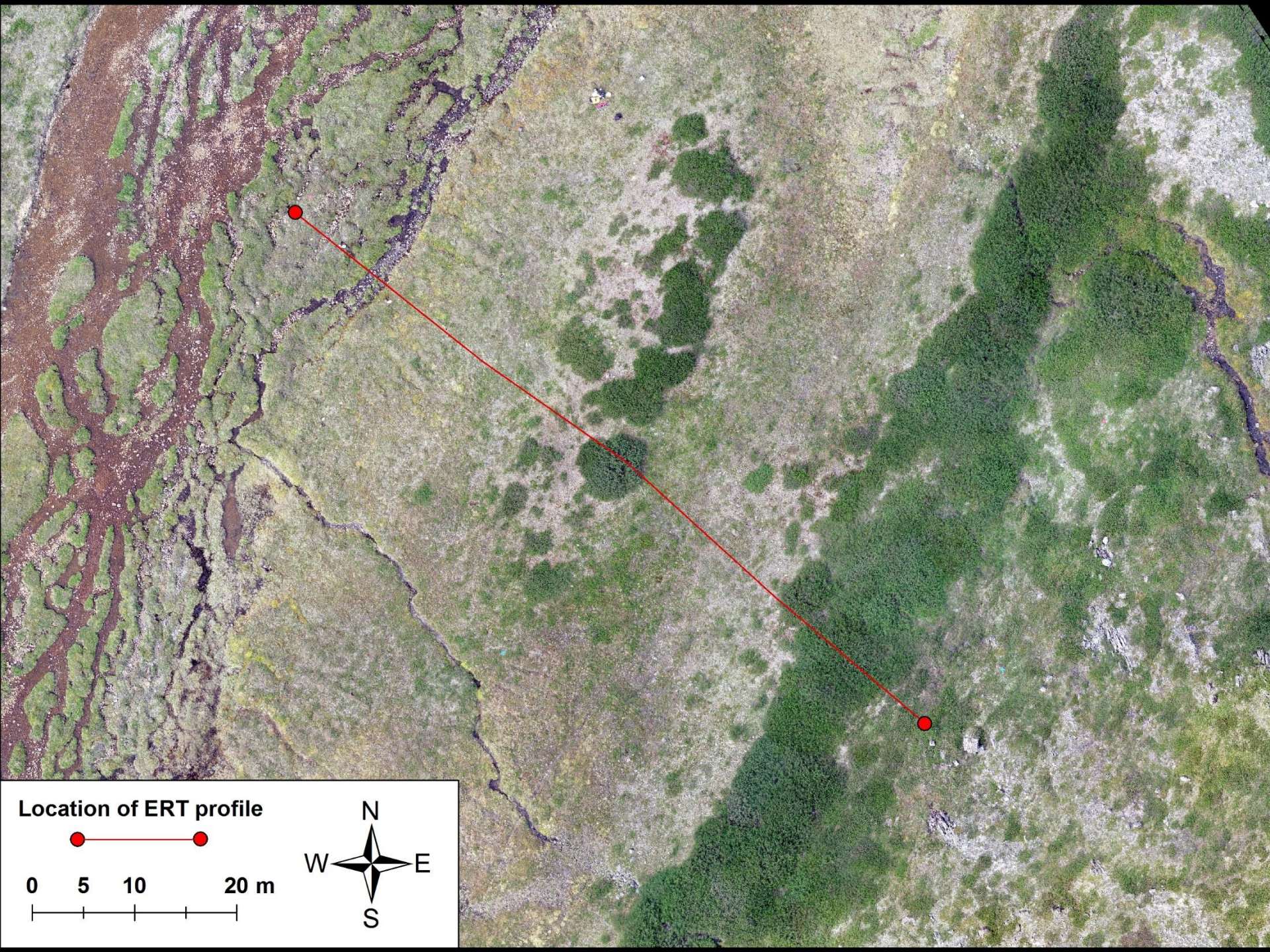
Komaktorvik region



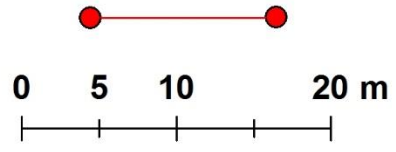
Komaktorvik River
Digital orthophoto
UAV Flight 2

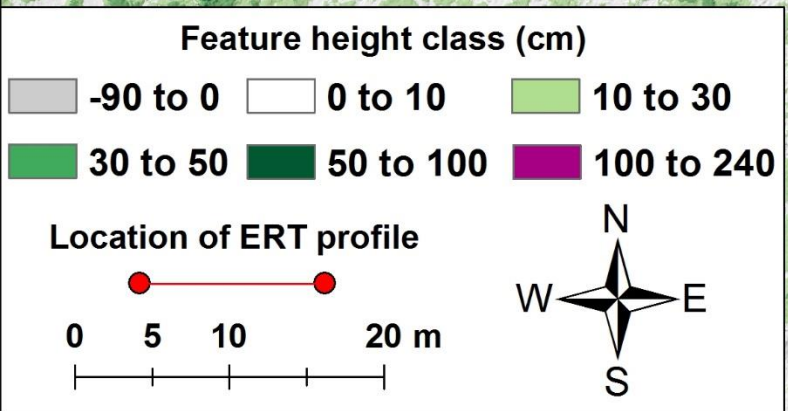
0 50 100 200 m

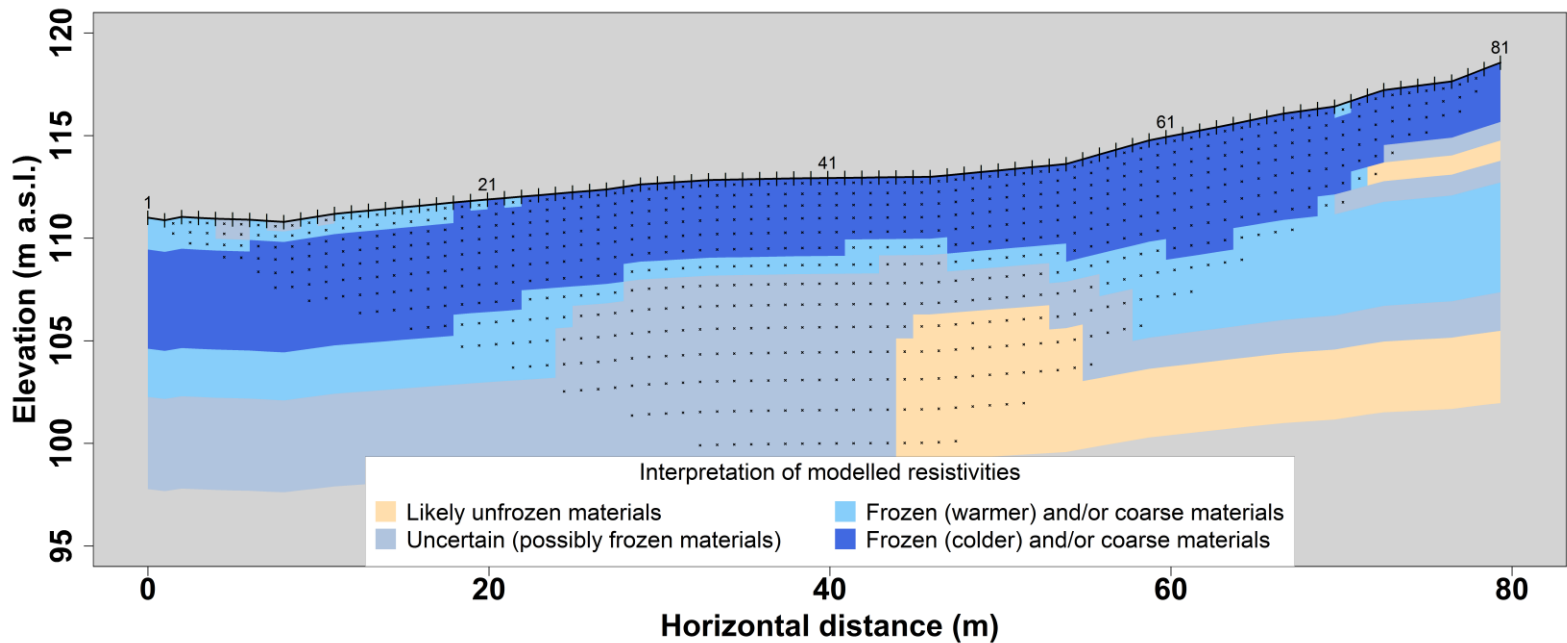
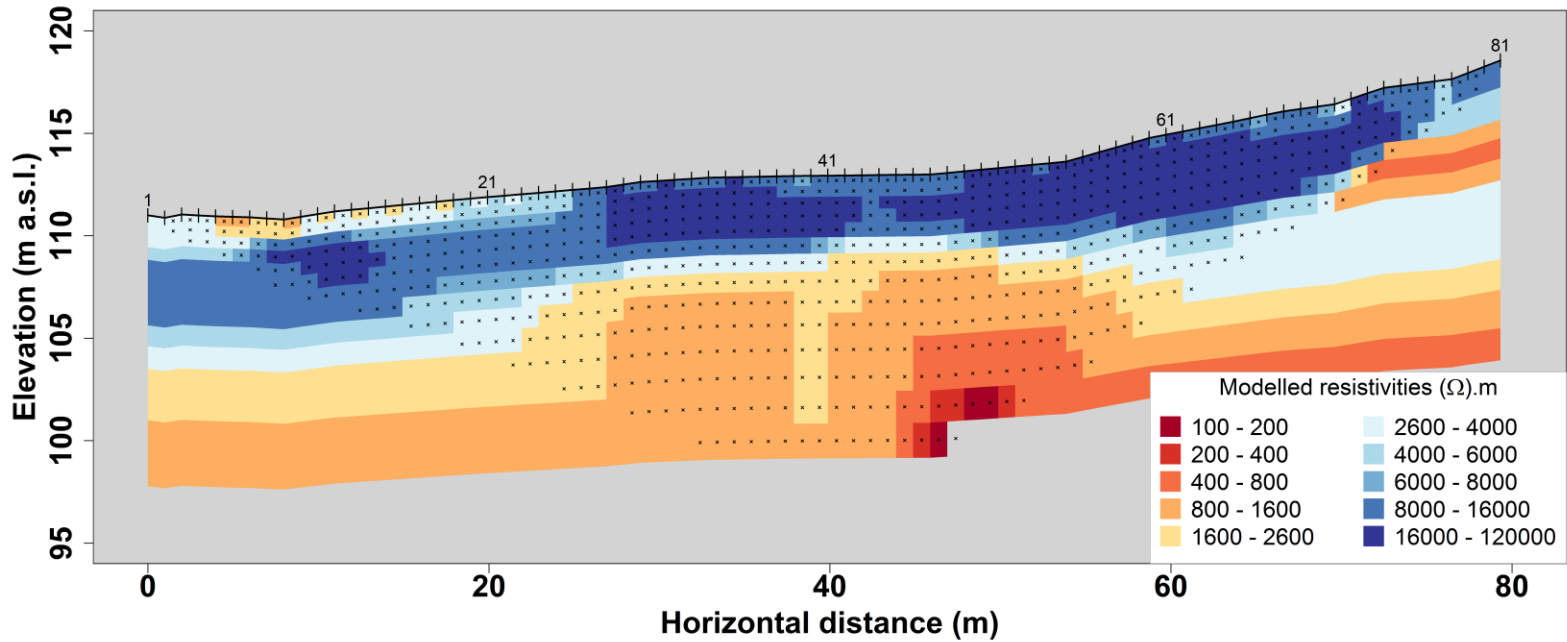
A horizontal scale bar with tick marks at 0, 50, 100, and 200 meters.

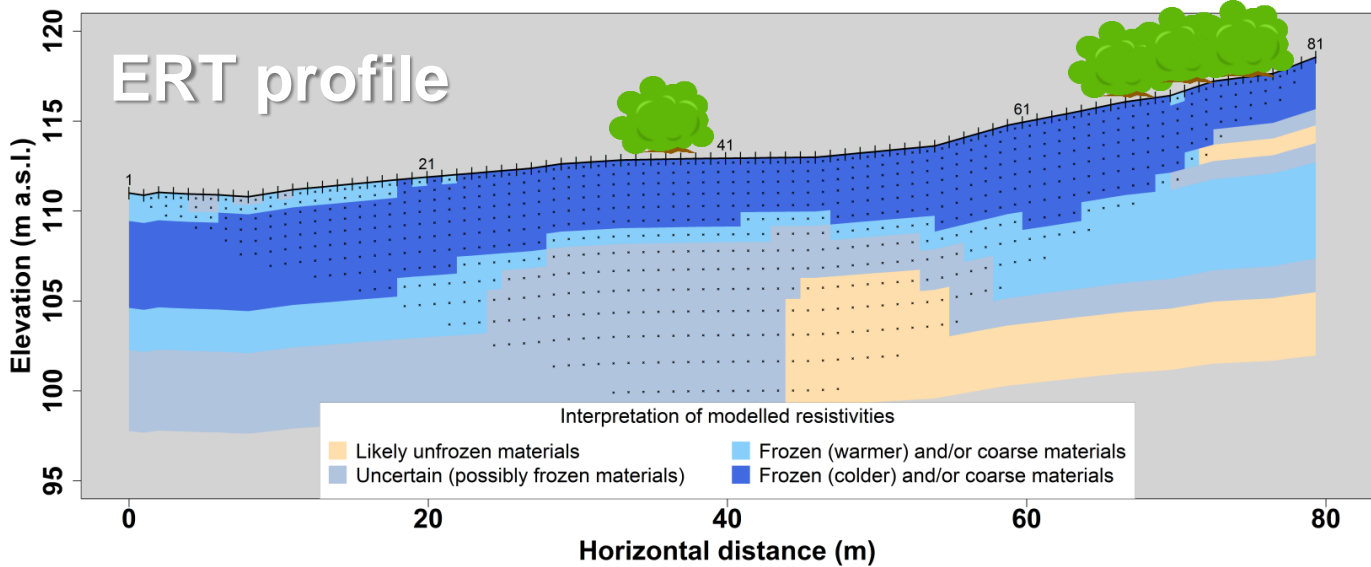


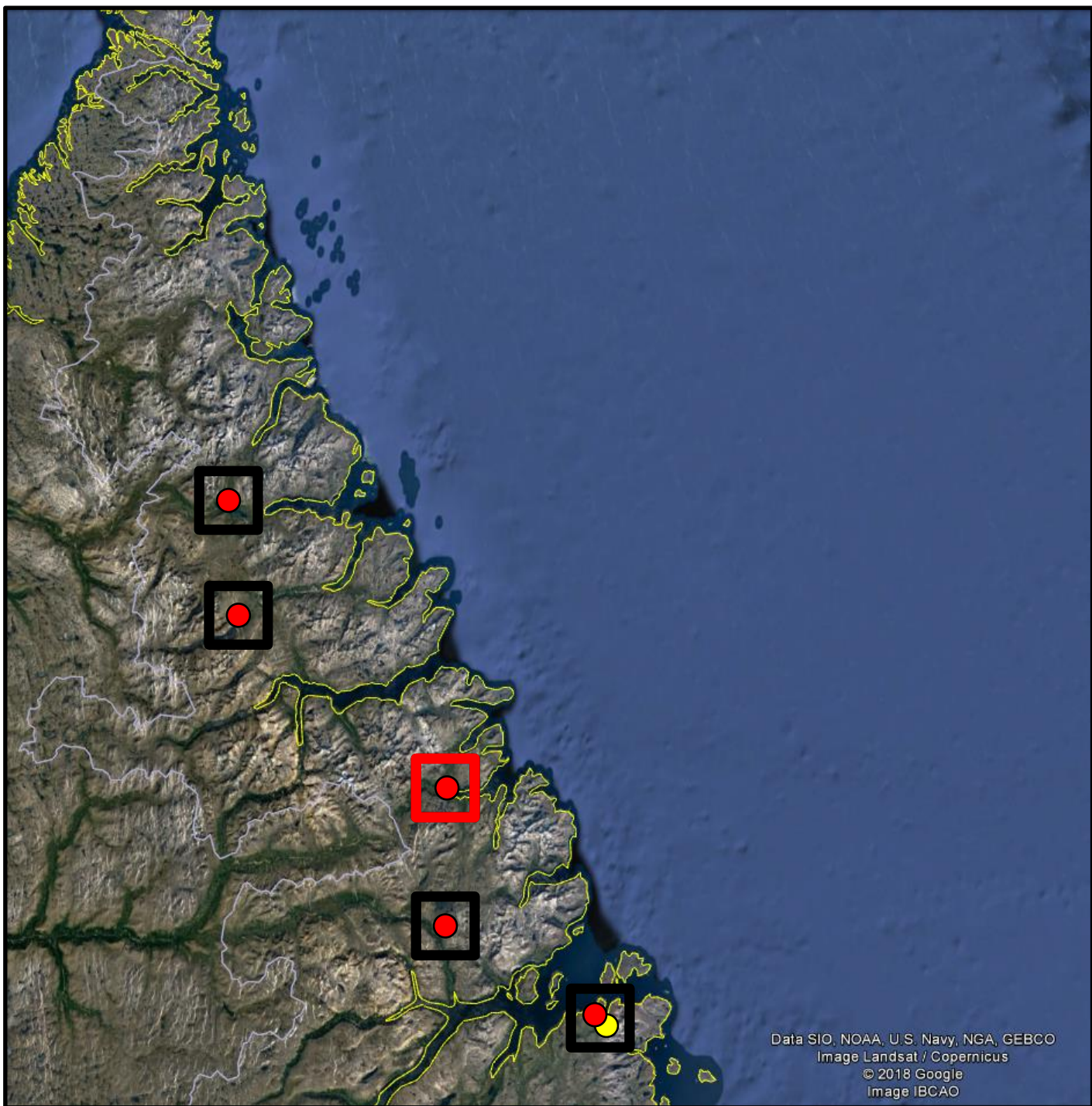
Location of ERT profile





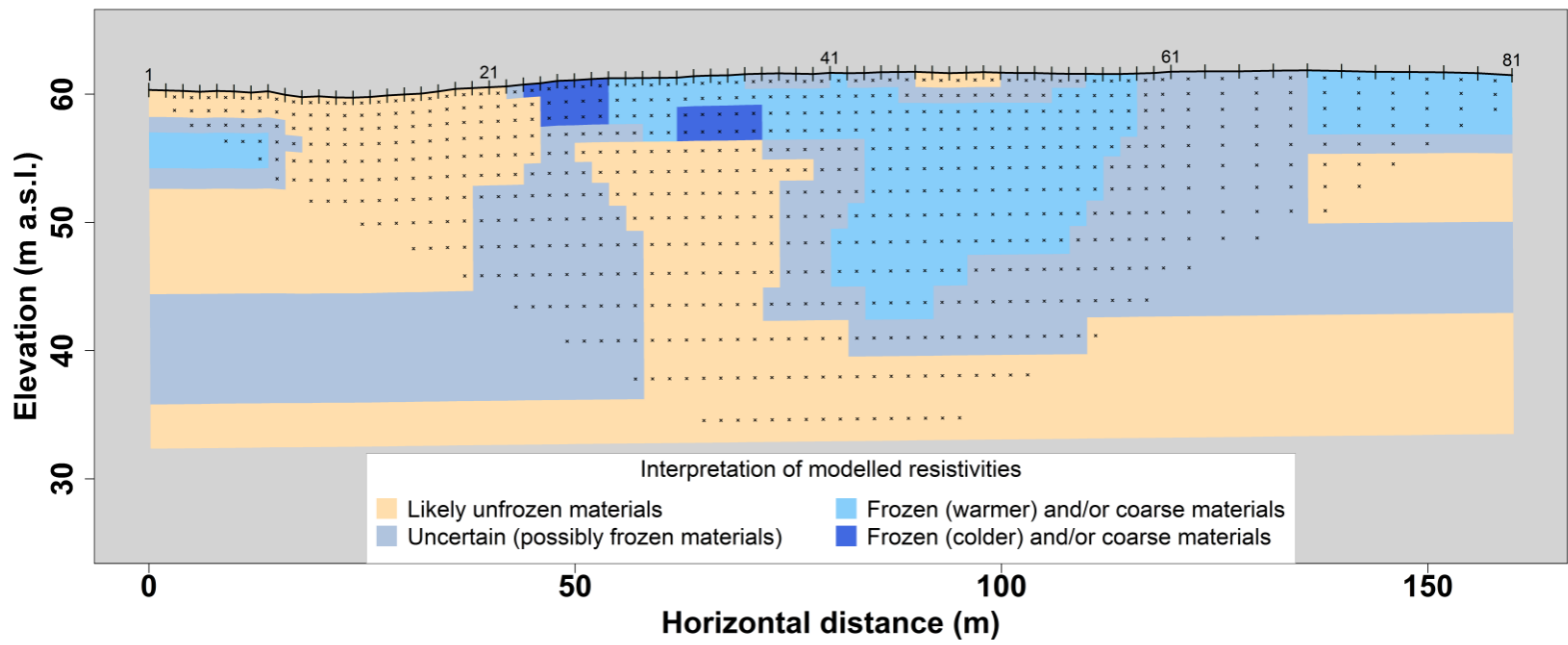
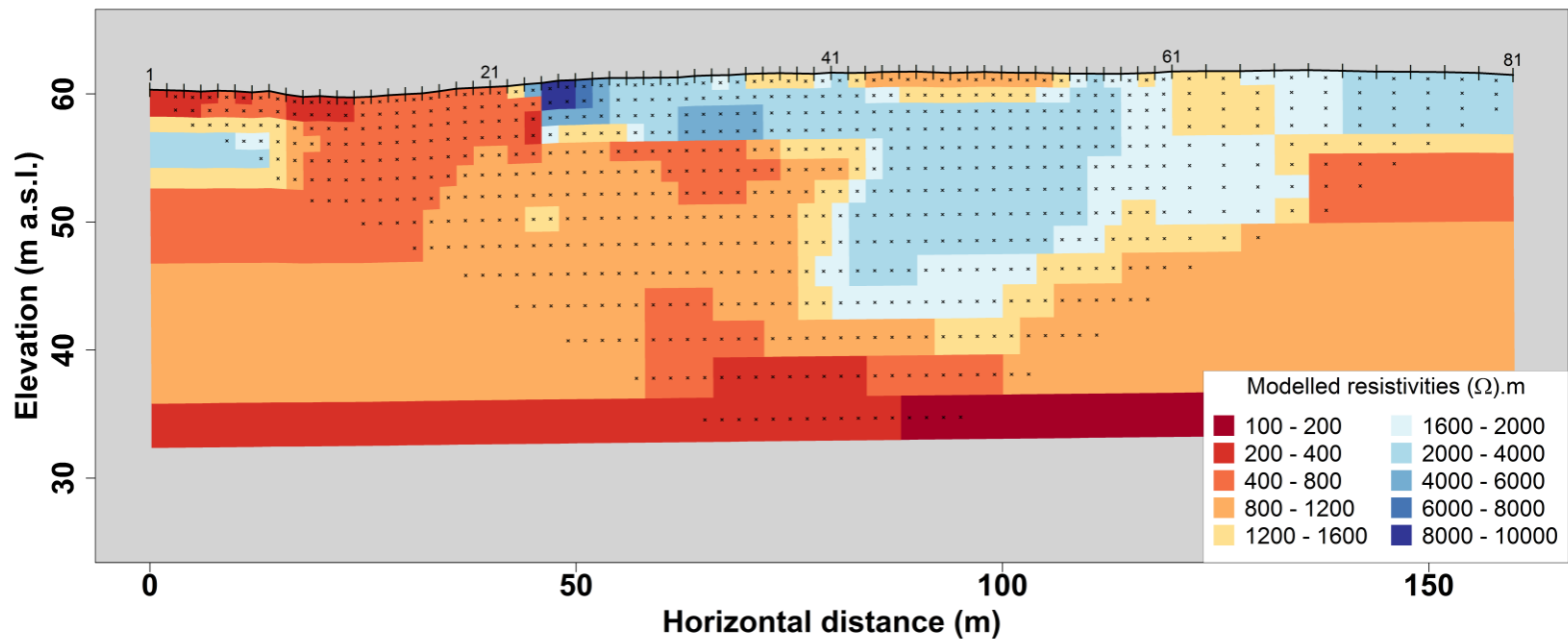






Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat / Copernicus
© 2018 Google
Image IBCAO





ERT Summary

- **Kangalaksiorvik Lake**

- Tall shrubs impacted permafrost thickness & active layer depth on south-facing slope;
- North facing slope showed small active layer response;

- **Komaktorvik River**

- Tall shrubs did not impact active layer depth but did impact permafrost thickness;
- Nearby survey (**not shown**) showed deep active layer with no difference between tall shrubs/tundra

- **Ramah Bay**

- Tall shrubs throughout the site eliminated permafrost in some areas, deepened active layer/created talik in others;

Simple theory

Past shrub cover

Present or future shrub cover



Active layer (freeze-thaw layer)

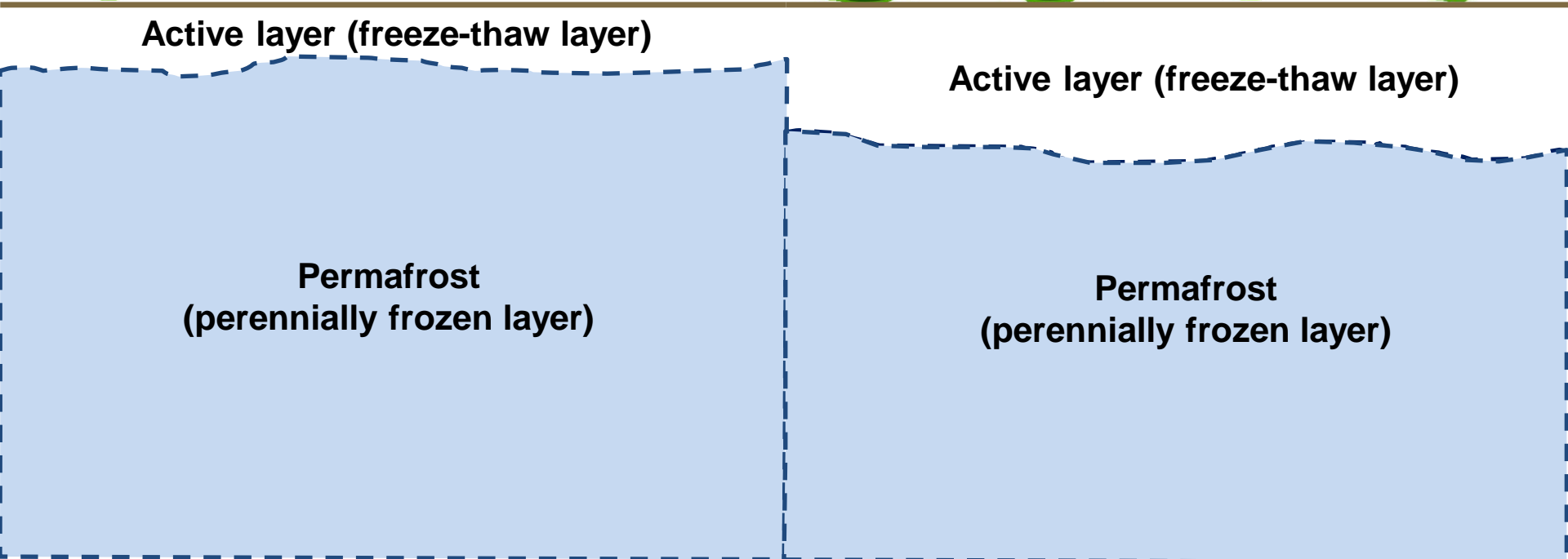
Active layer (freeze-thaw layer)

Permafrost
(perennially frozen layer)

Permafrost
(perennially frozen layer)

Unfrozen ground

Unfrozen ground



ERT Summary

- **Kangalaksiorvik Lake**

- Tall shrubs impacted permafrost thickness & active layer depth on south-facing slope; ✓
- North facing slope showed small active layer response for even taller shrubs; ✓ X

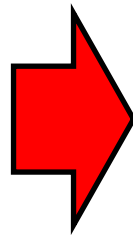
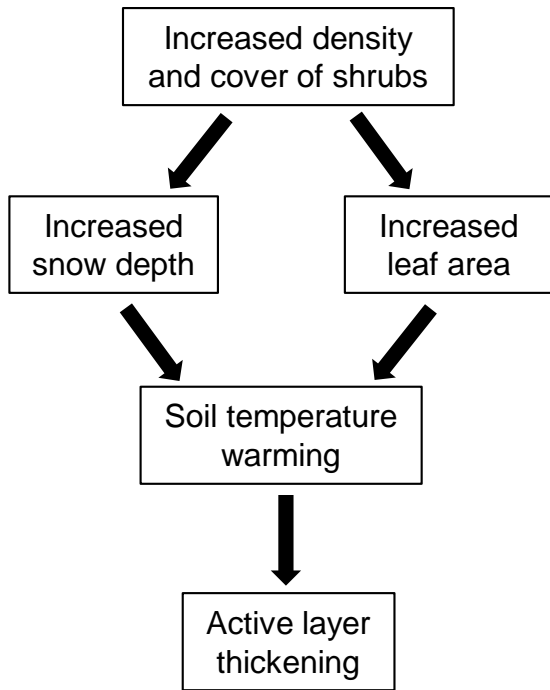
- **Komaktorvik River**

- Tall shrubs did not impact active layer depth but did impact permafrost thickness; X
- Nearby survey (**not shown**) showed deep active layer with no difference between tall shrubs/tundra X

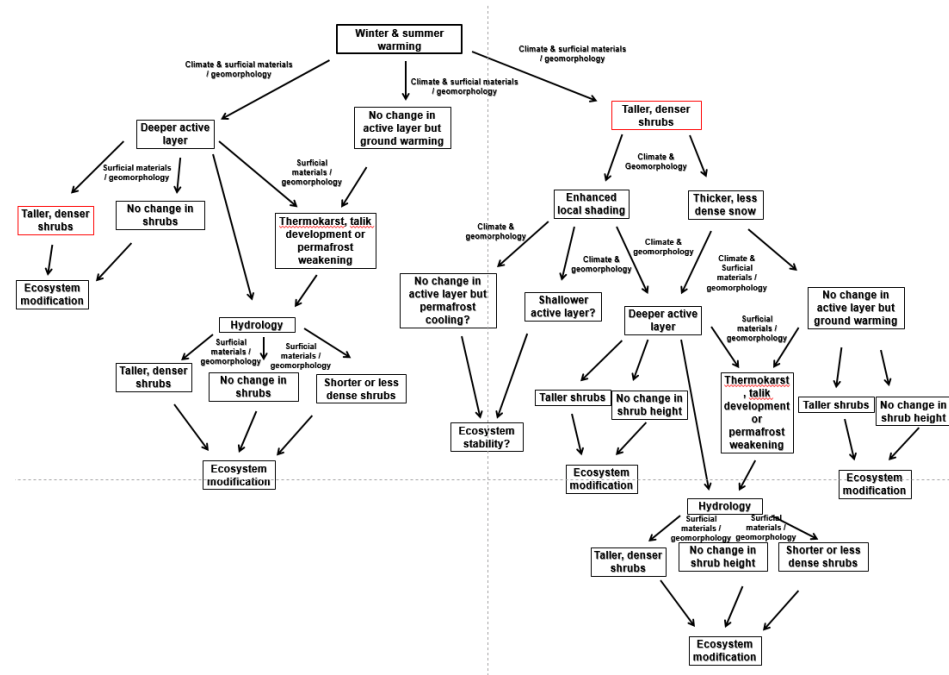
- **Ramah Bay**

- Tall shrubs throughout the site eliminated permafrost in some areas, deepened active layer/created talik in others; ✓ X

Ecosystem-only approach



Integrated ecosystem-geosystem approach



Integrated theory

Past shrub cover

Present or future shrub cover



Active layer (freeze-thaw layer)

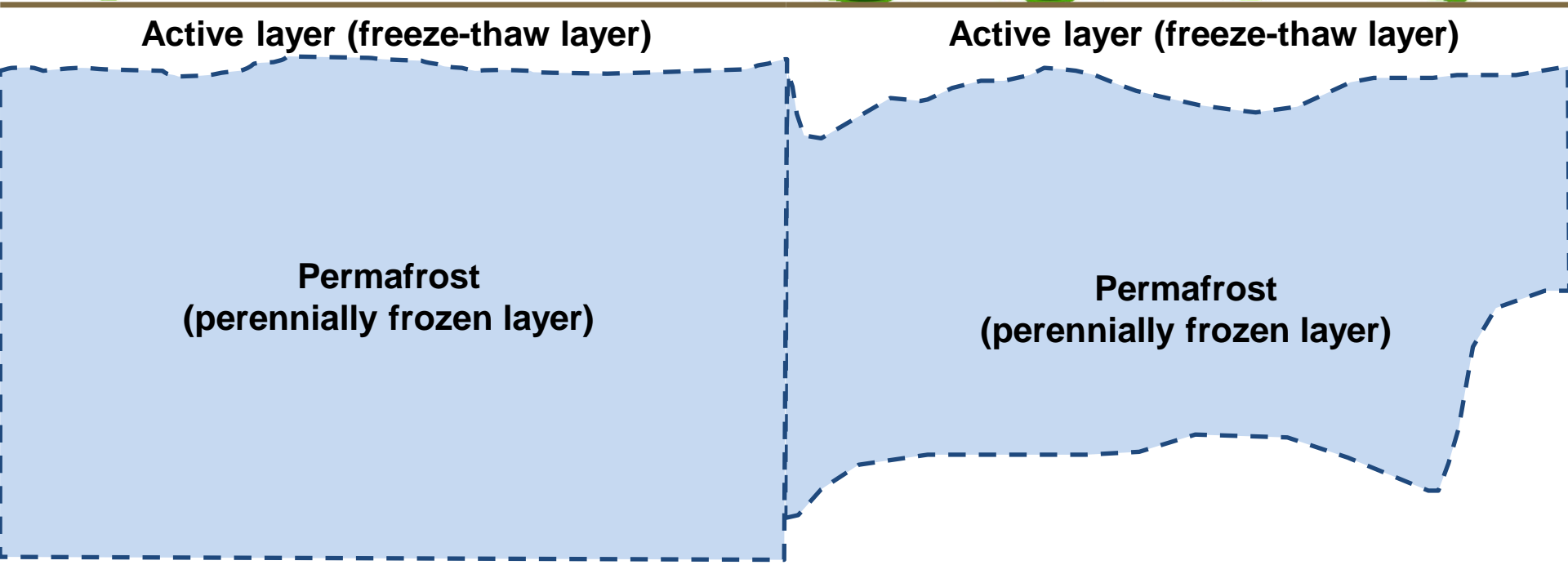
Active layer (freeze-thaw layer)

Permafrost
(perennially frozen layer)

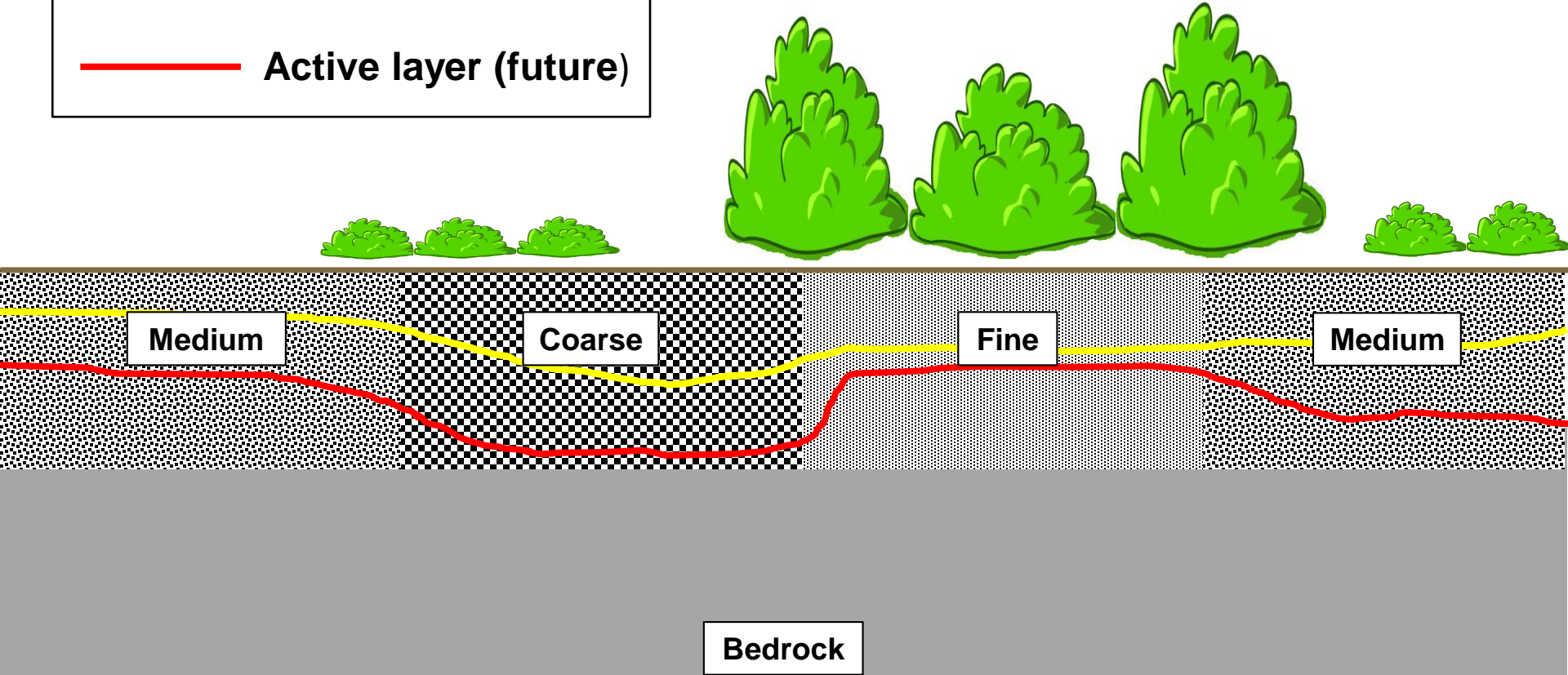
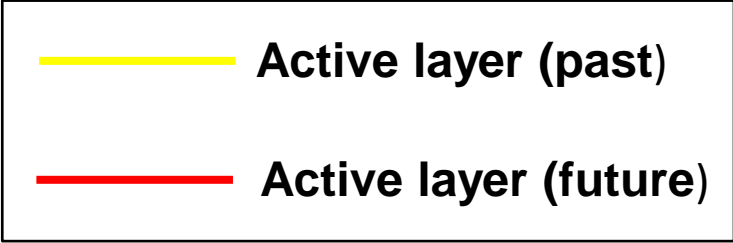
Permafrost
(perennially frozen layer)

Unfrozen ground

Unfrozen ground



Present or future conditions



Acknowledgements



 Parks Canada
Parcs Canada

ArcticNet
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