Remotely sensing the Nogahabra dune field using airborne LiDAR and high resolution aerial photography

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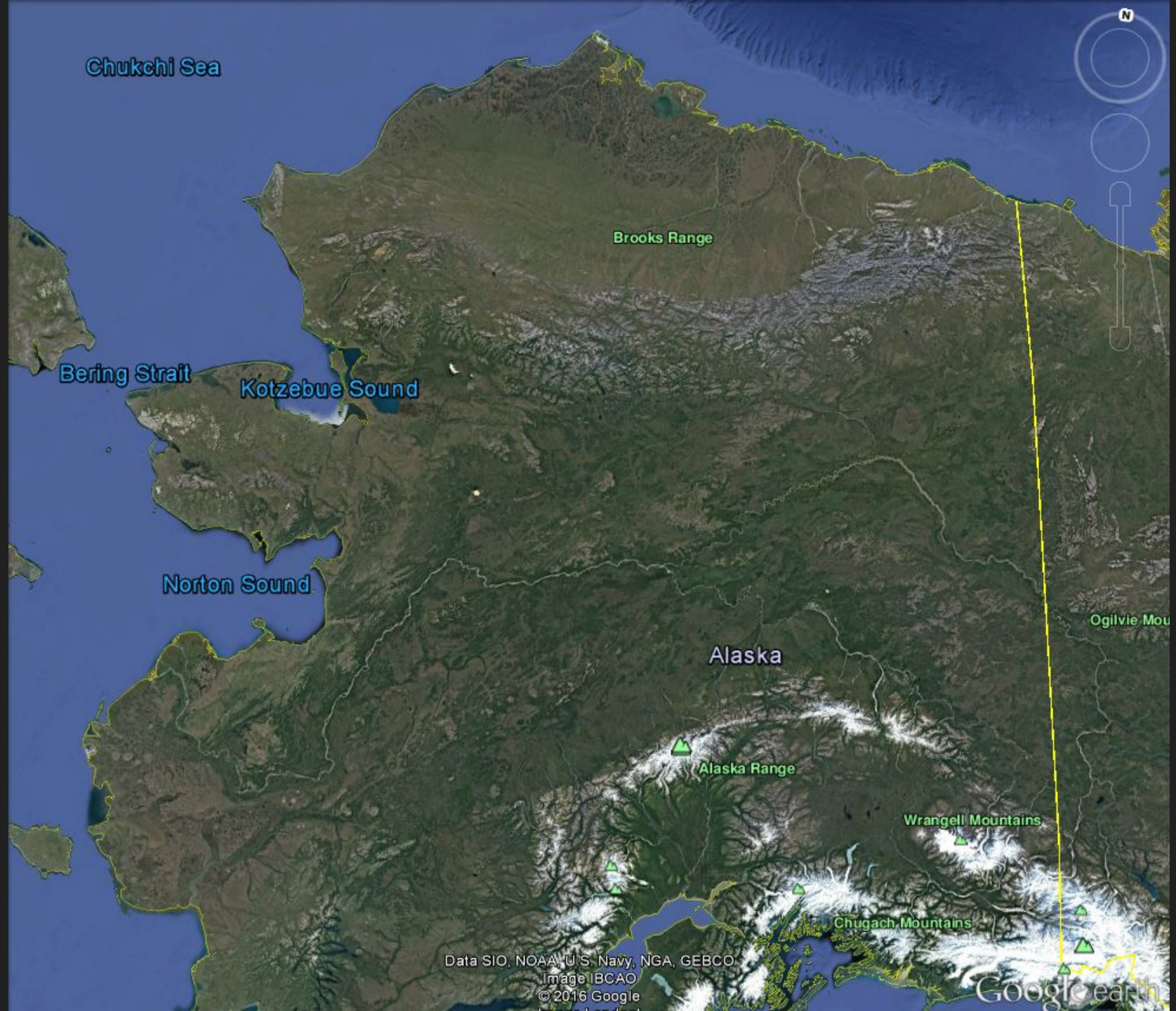
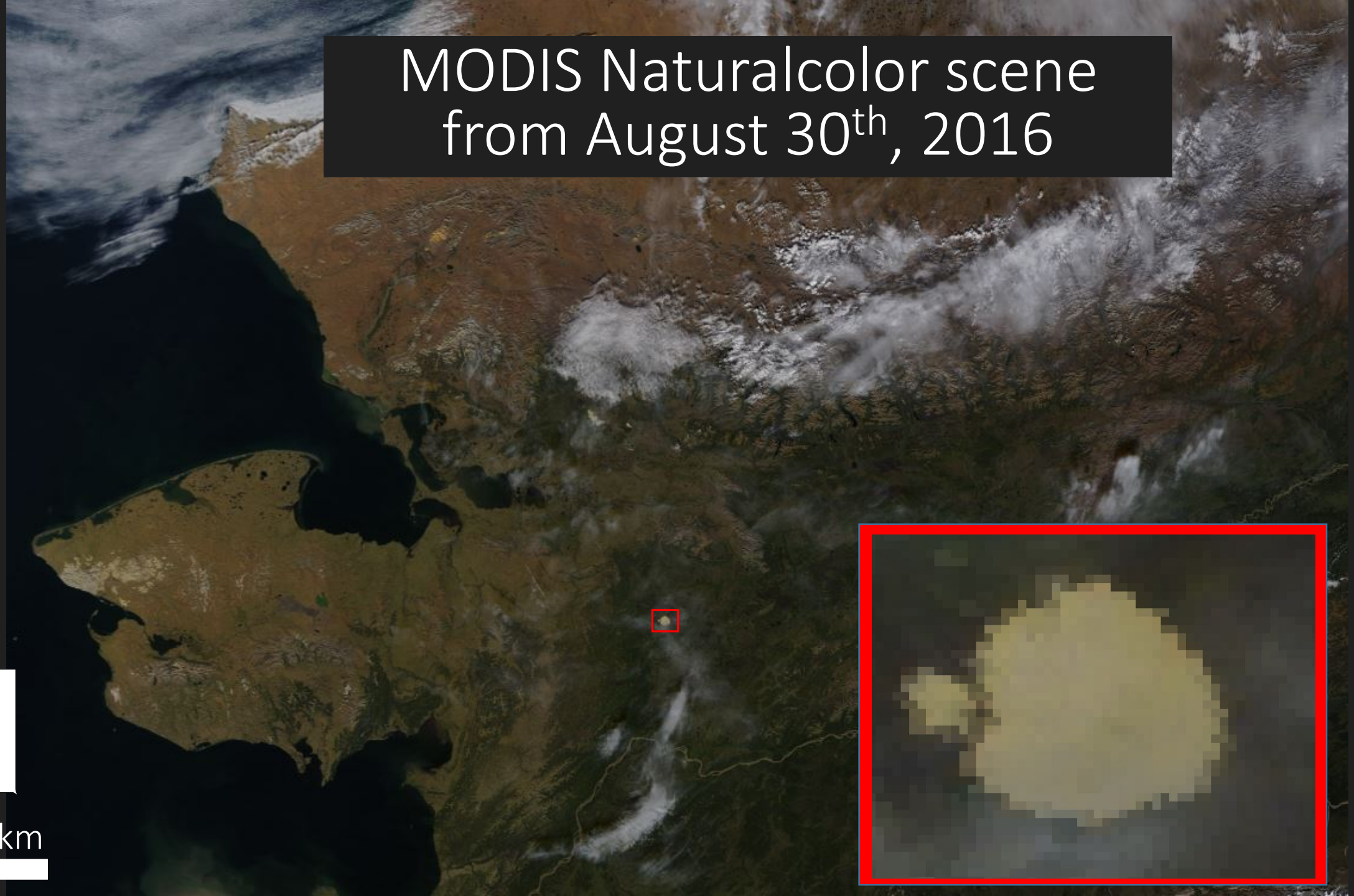
https://commons.wikimedia.org/wiki/File%3ANogahabara_sand_dunes_Koyukuk_NWR_2.jpg

Overview

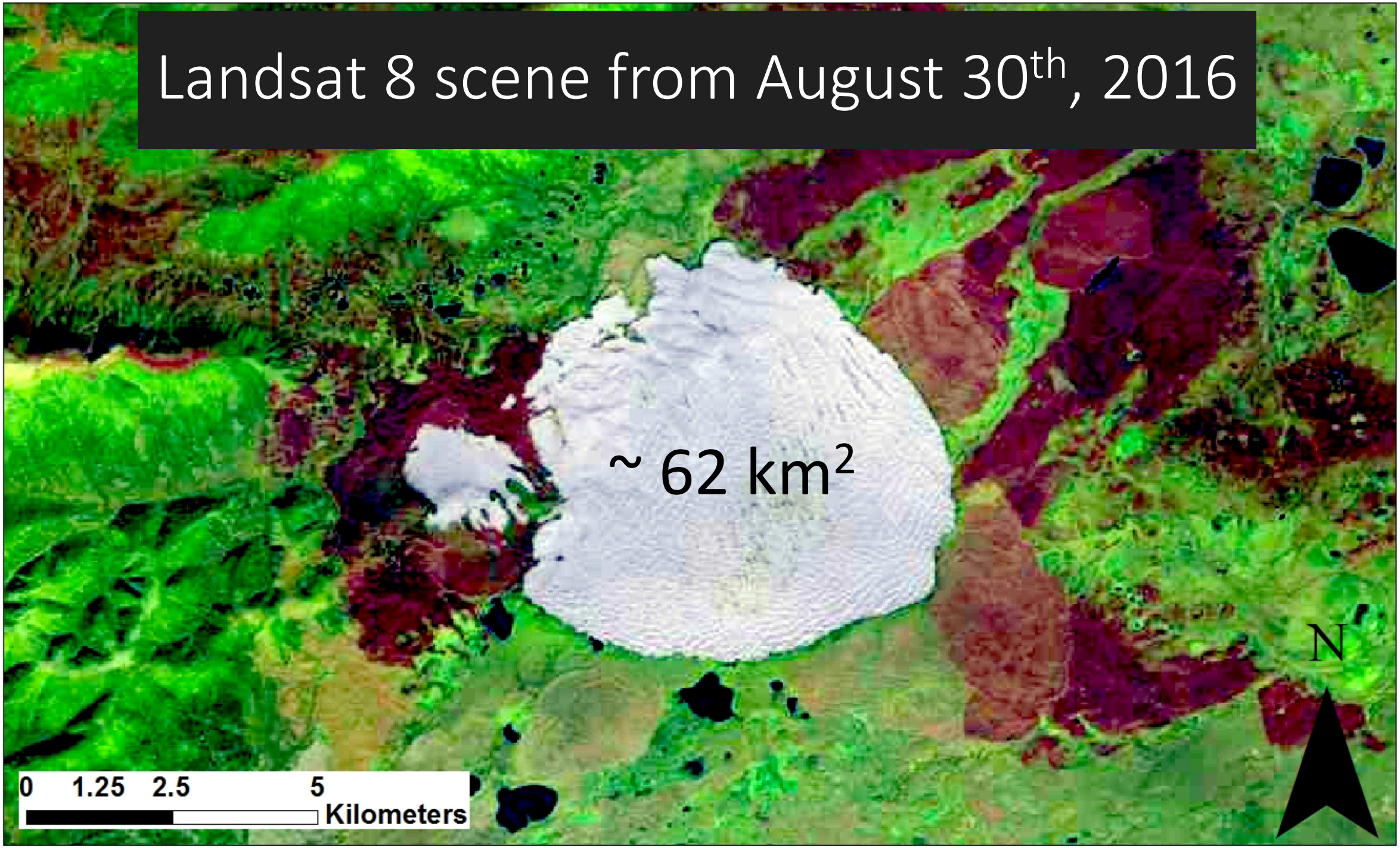
- No-gah-ha- whaa????
- LiDAR flights - Chris Larson – University of Alaska Geophysical Institute
- Base products
- Products put to use

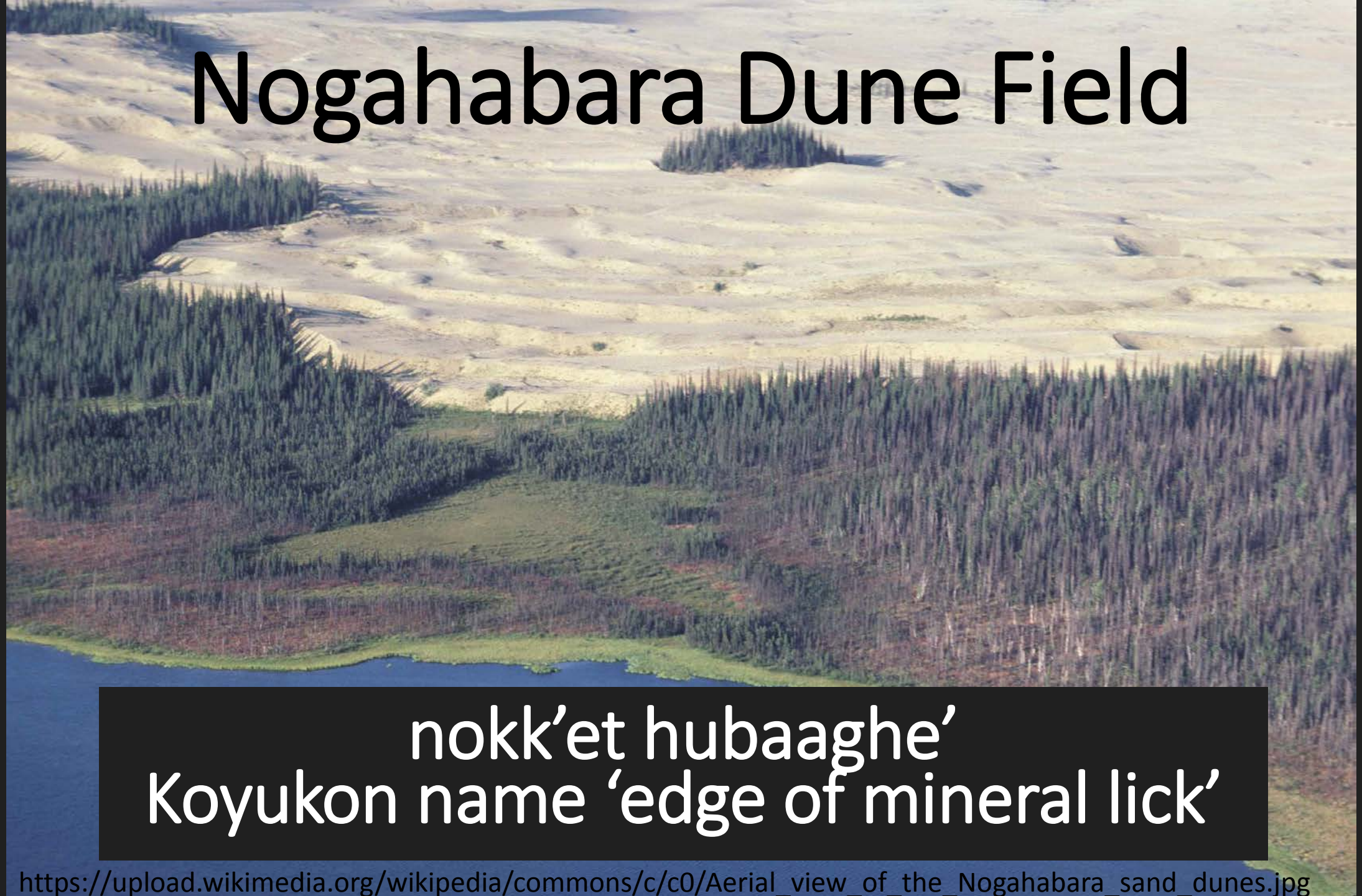

Chukchi Sea
Brooks Range
Bering Strait
Kotzebue Sound
Norton Sound
Alaska
Ogilvie Mou
Alaska Range
Wrangell Mountains
Chugach Mountains
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image IBCAO
© 2016 Google
Google earth

MODIS Naturalcolor scene from August 30th, 2016



Landsat 8 scene from August 30th, 2016

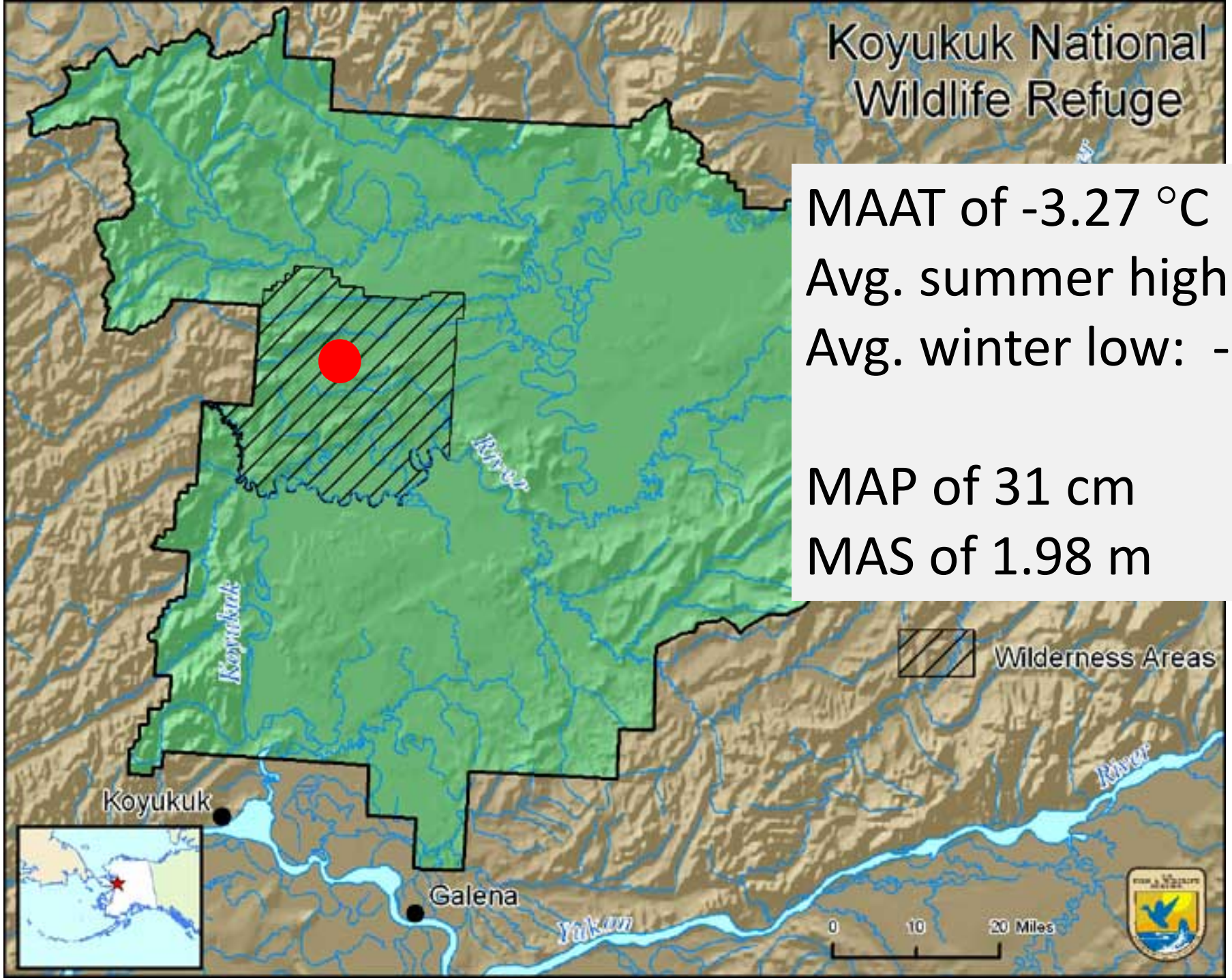




https://upload.wikimedia.org/wikipedia/commons/c/c0/Aerial_view_of_the_Nogahabara_sand_dunes.jpg

Nogahabara Dune Field

http://www.public-domain-image.com/free-images/nature-landscapes/sand-dunes/nogahabara-sand-dunes-scenics-725x471.jpg



MAAT of -3.27 °C

Avg. summer high: 21.6 °C

Avg. winter low: -27.6 °C

MAP of 31 cm

MAS of 1.98 m

Objectives

- Map dune features
- Measure dune attributes
  - Height (LiDAR)
  - Density (LiDAR)
  - Migration direction (LiDAR)
  - Migration rate (LiDAR plus Air Photos)
- Look for climate response

Importance

- Dune activity in response to climate

- Lanscape response to wildfire
  - Vegetation communities
  - Habitat quality
  - Reactivation of dunes following fire?

- Unique inland dune landscape with unique species

LiDAR collected by Chris Larson

1955 Cesna 180 ↑

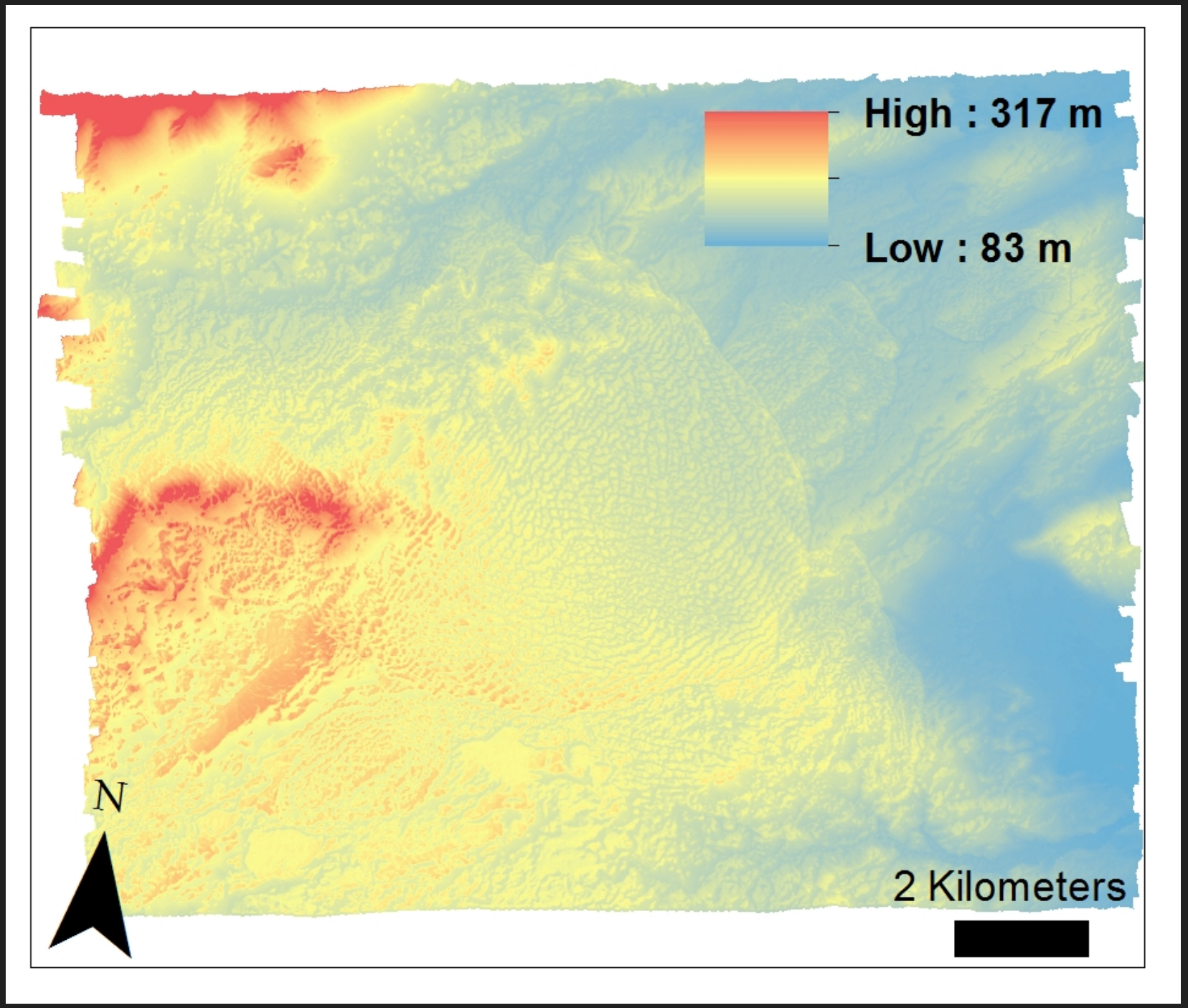
Riegl LMS-Q240i scanner →

LiDAR Details

- Flown Early September 2015
- set to 10,000 shots per second
- +/- 30 degree beam sweep
- rigidly attached to a OxTS Inertial+2 GPS/IMU, which was being fed by a Trimble R7
- flown at 350 to 450 meters above ground elevation
- Speed over ground was typically 80-90 mph
- achieve 2 points per square meter

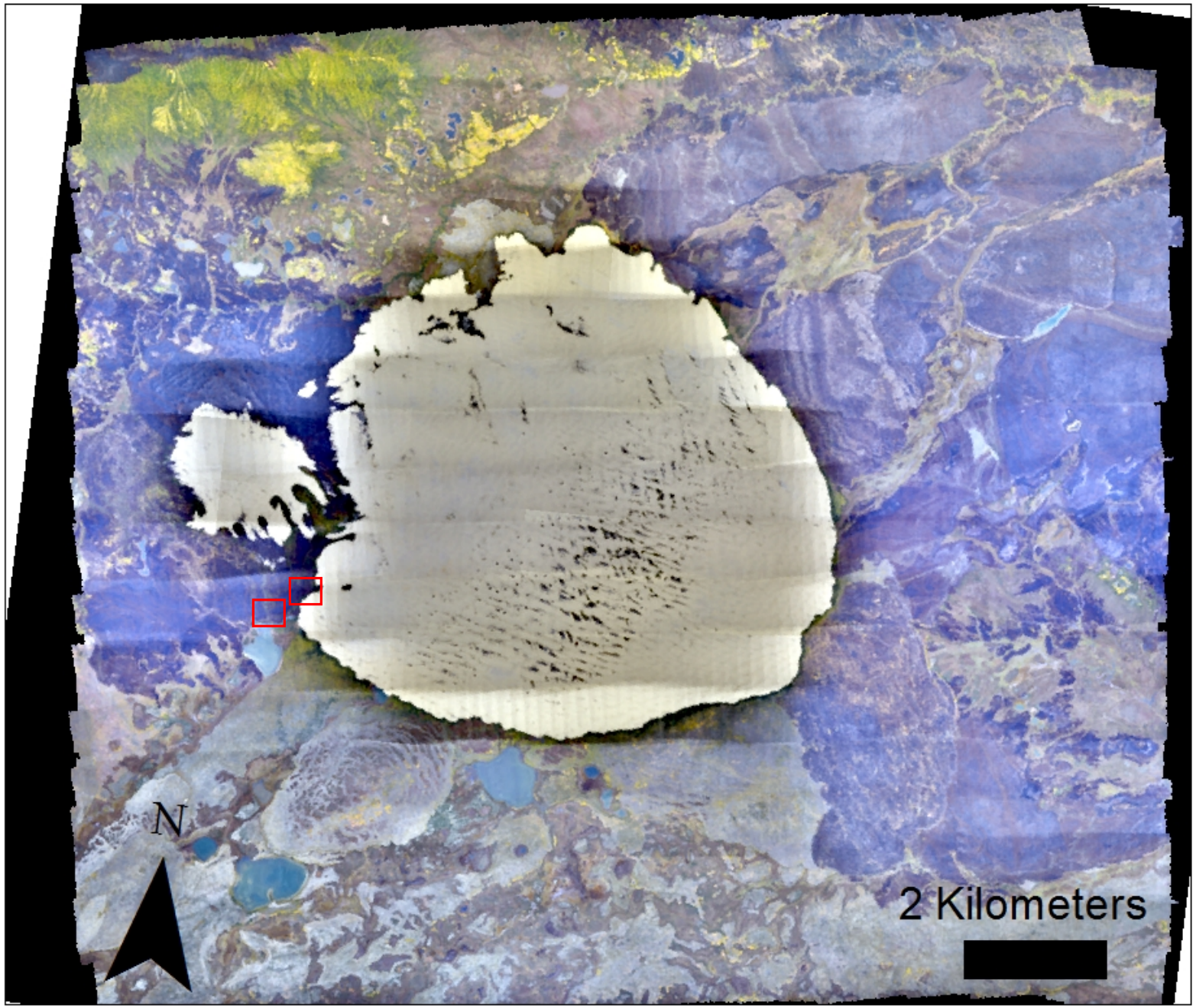
Base products:

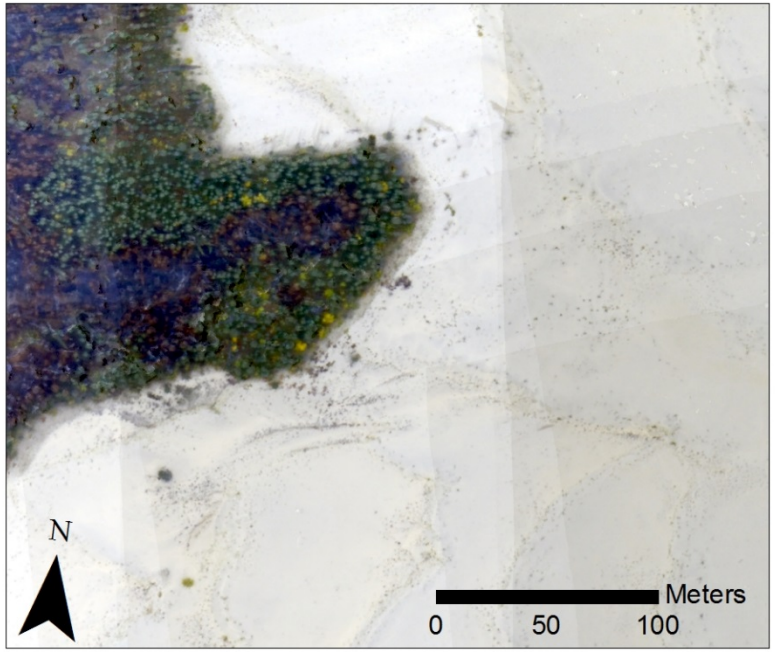
DEM

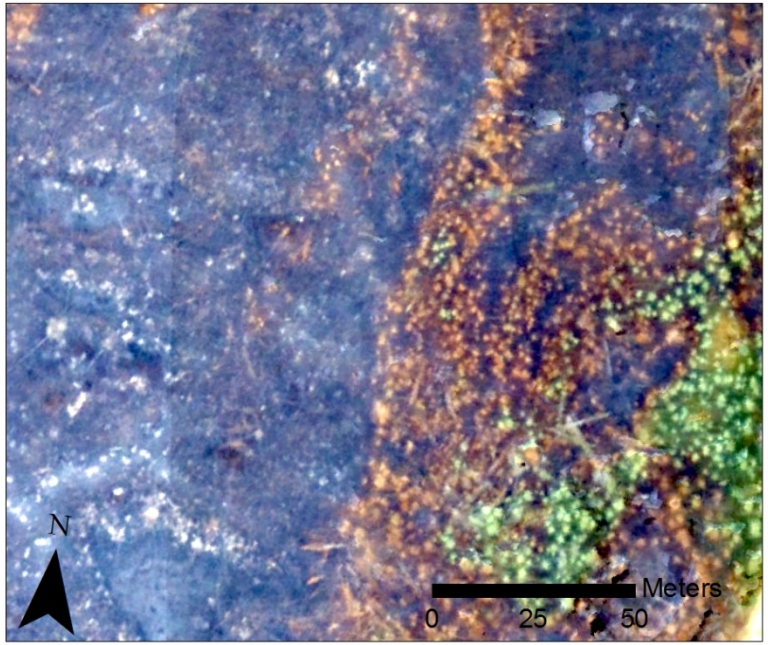


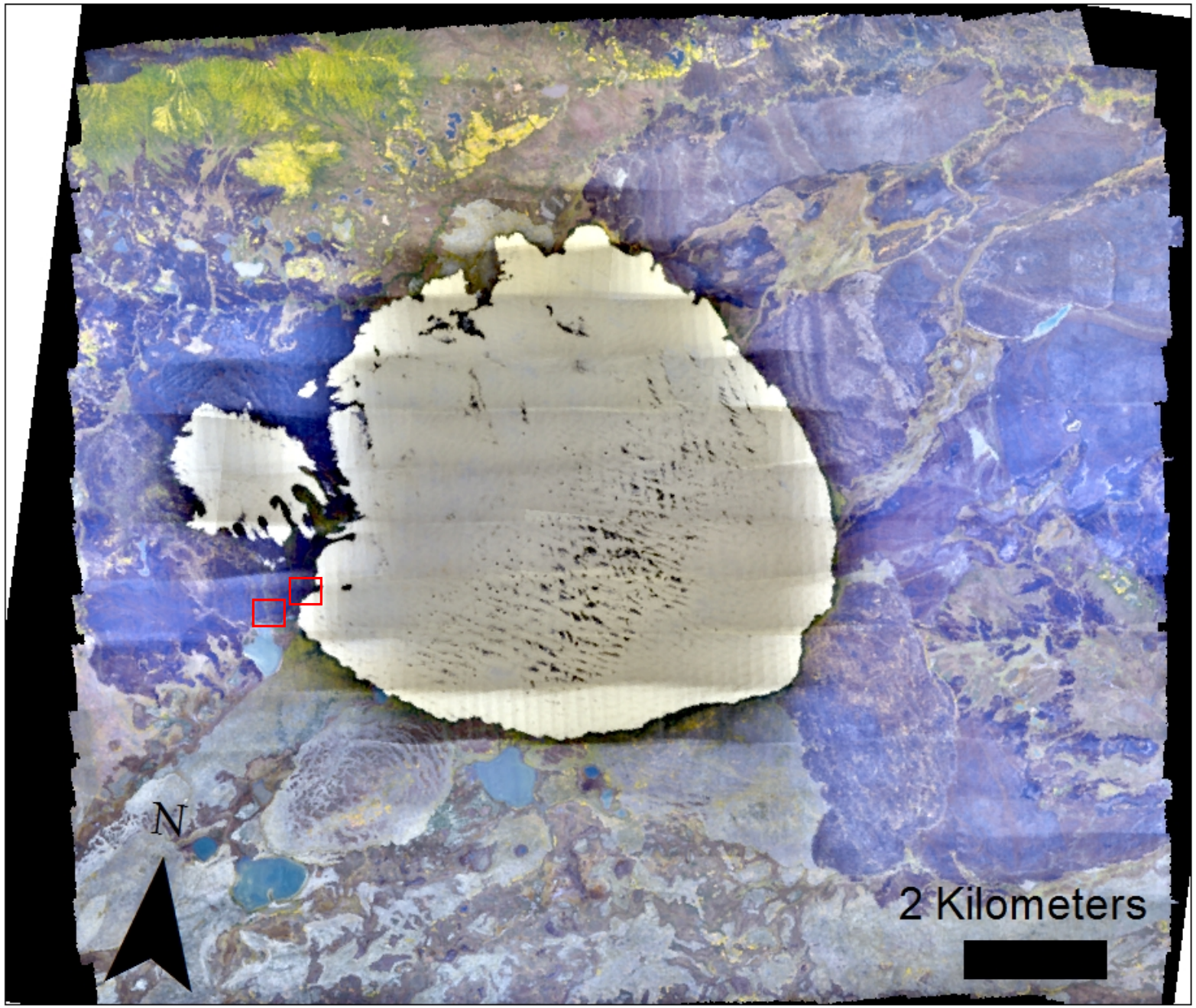
Base products:

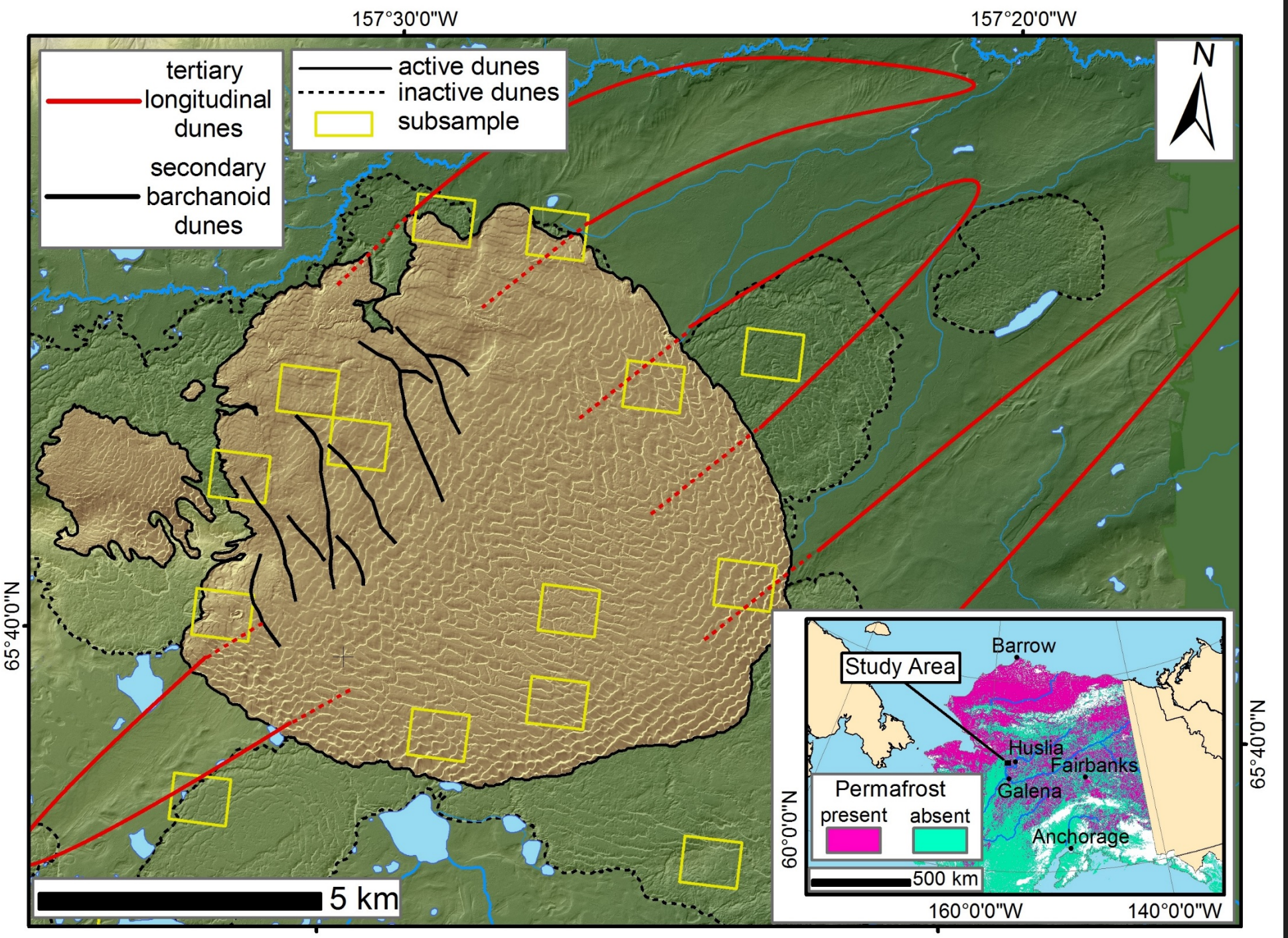
Orthophoto mosaic



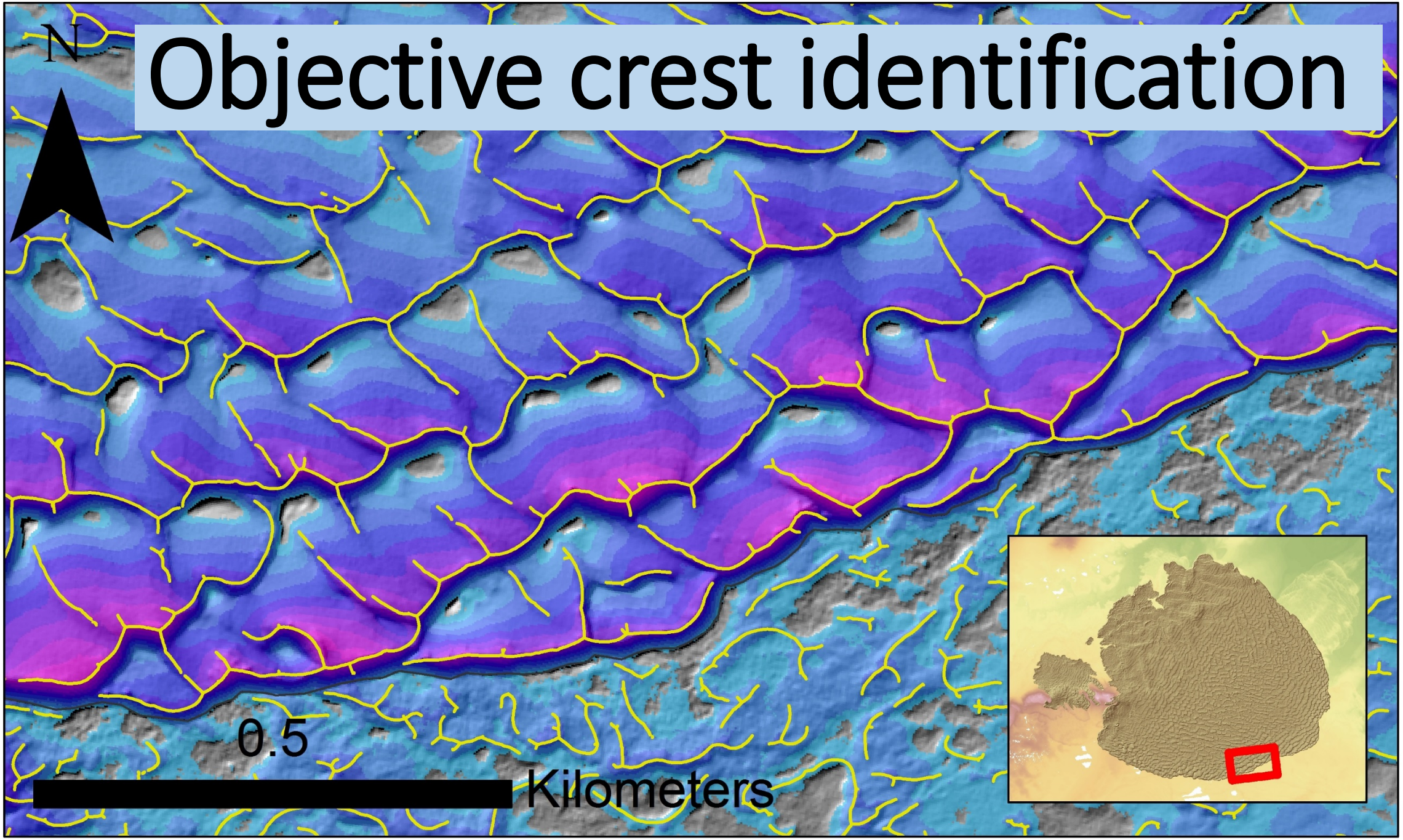

N
Meters
0
50
100

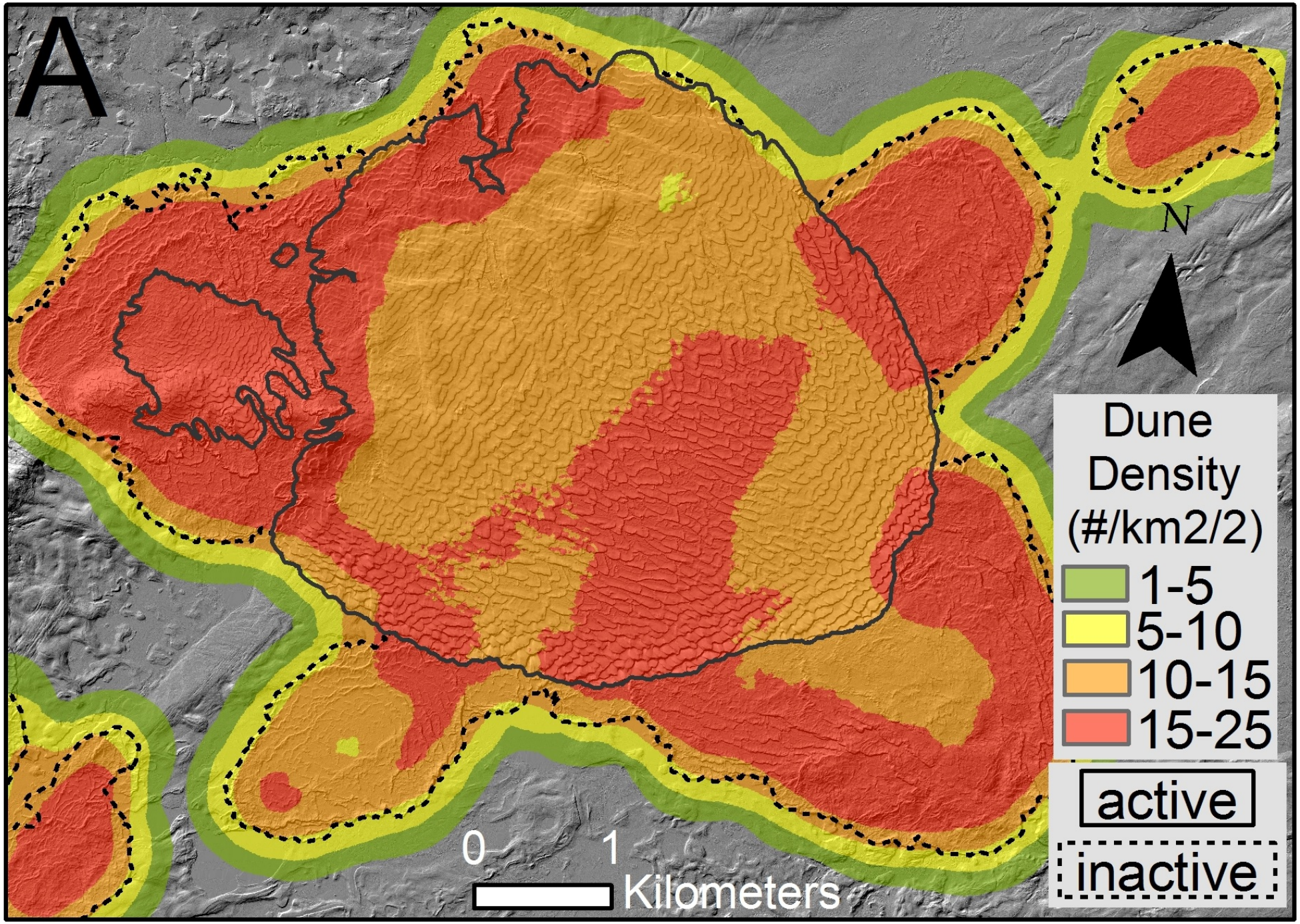

N
Meters
0
25
50

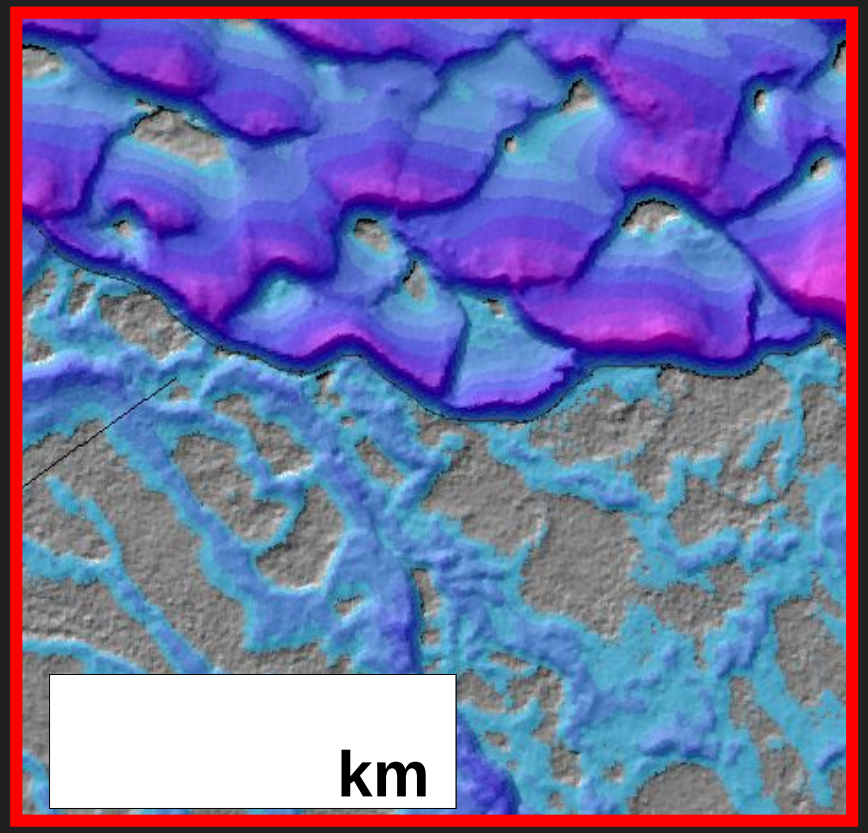

N
2 Kilometers


157°30'0"W
157°20'0"W
65°40'0"N
65°40'0"N
tertiary longitudinal dunes
secondary barchanoid dunes
active dunes
inactive dunes
subsample
N
5 km
Study Area
Barrow
Huslia
Fairbanks
Galena
Anchorage
Permafrost
present
absent
500 km
60°0'0"N
160°0'0"W
140°0'0"W

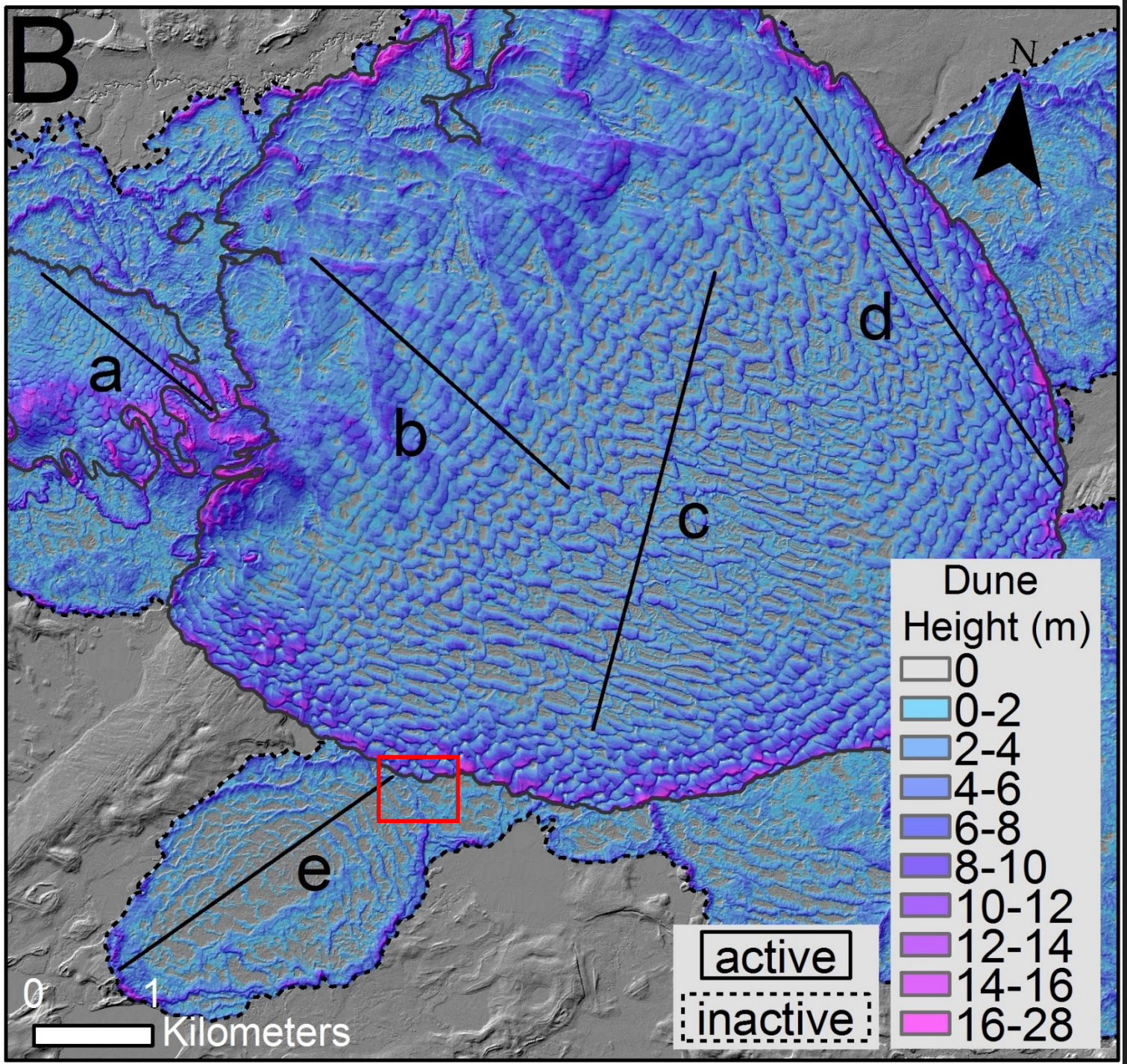
Objective crest identification

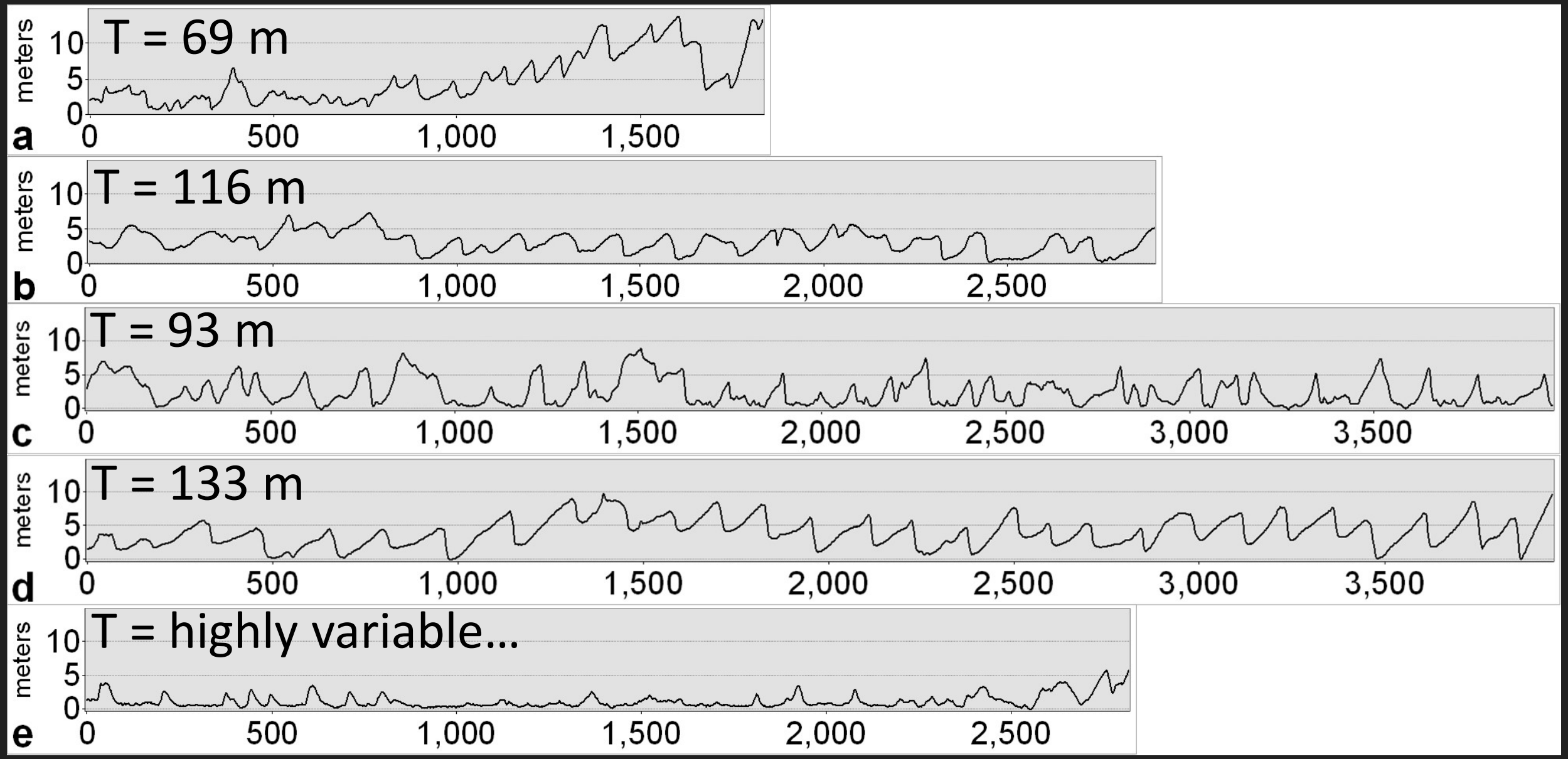



A
N
Dune
Density
(#/km2/2)
1-5
5-10
10-15
15-25
active
inactive
0
1
Kilometers



mean dune height (m)	min dune height (m)	max dune height (m)
5.8	0.2	28.1

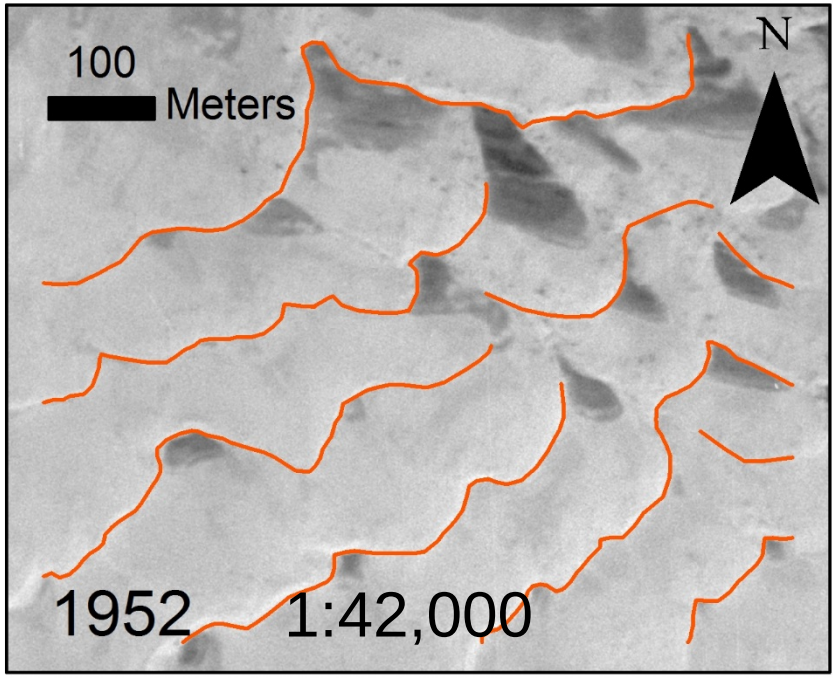


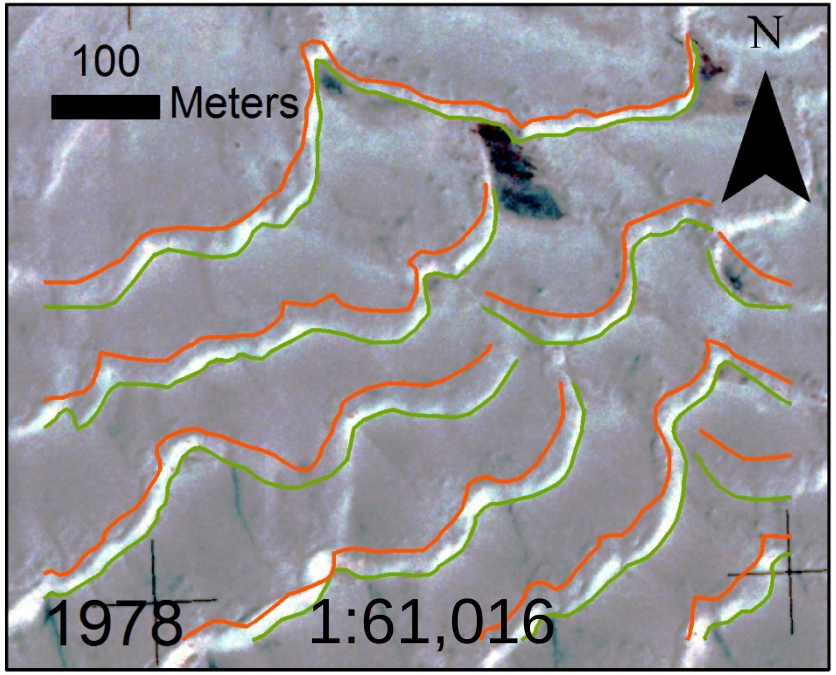

T = 69 m
a
T = 116 m
b
T = 93 m
c
T = 133 m
d
T = highly variable…
e
meters
10
5
0
0
500
1,000
1,500
2,000
2,500
3,000
3,500

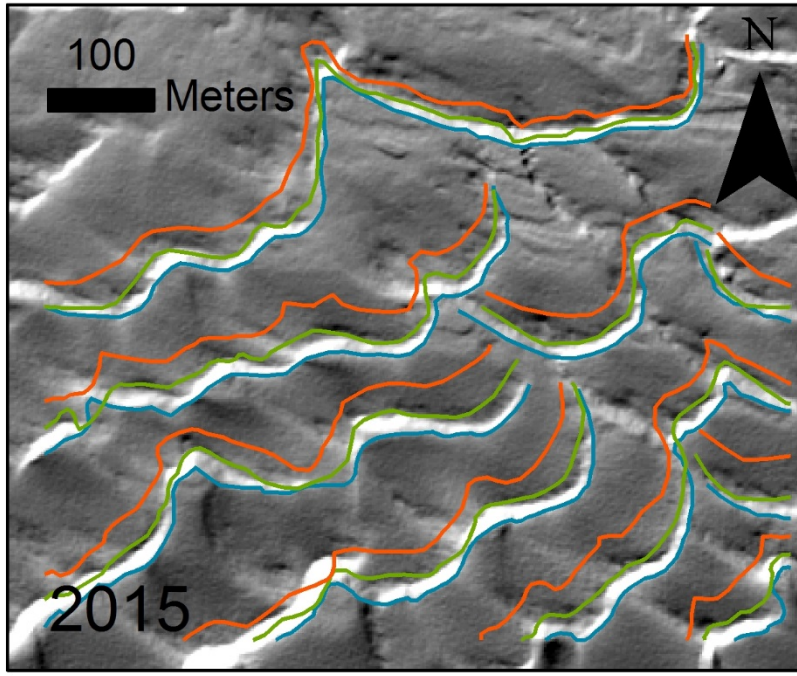
Measured migration rates

0.68
+- 0.18
(m/yr)

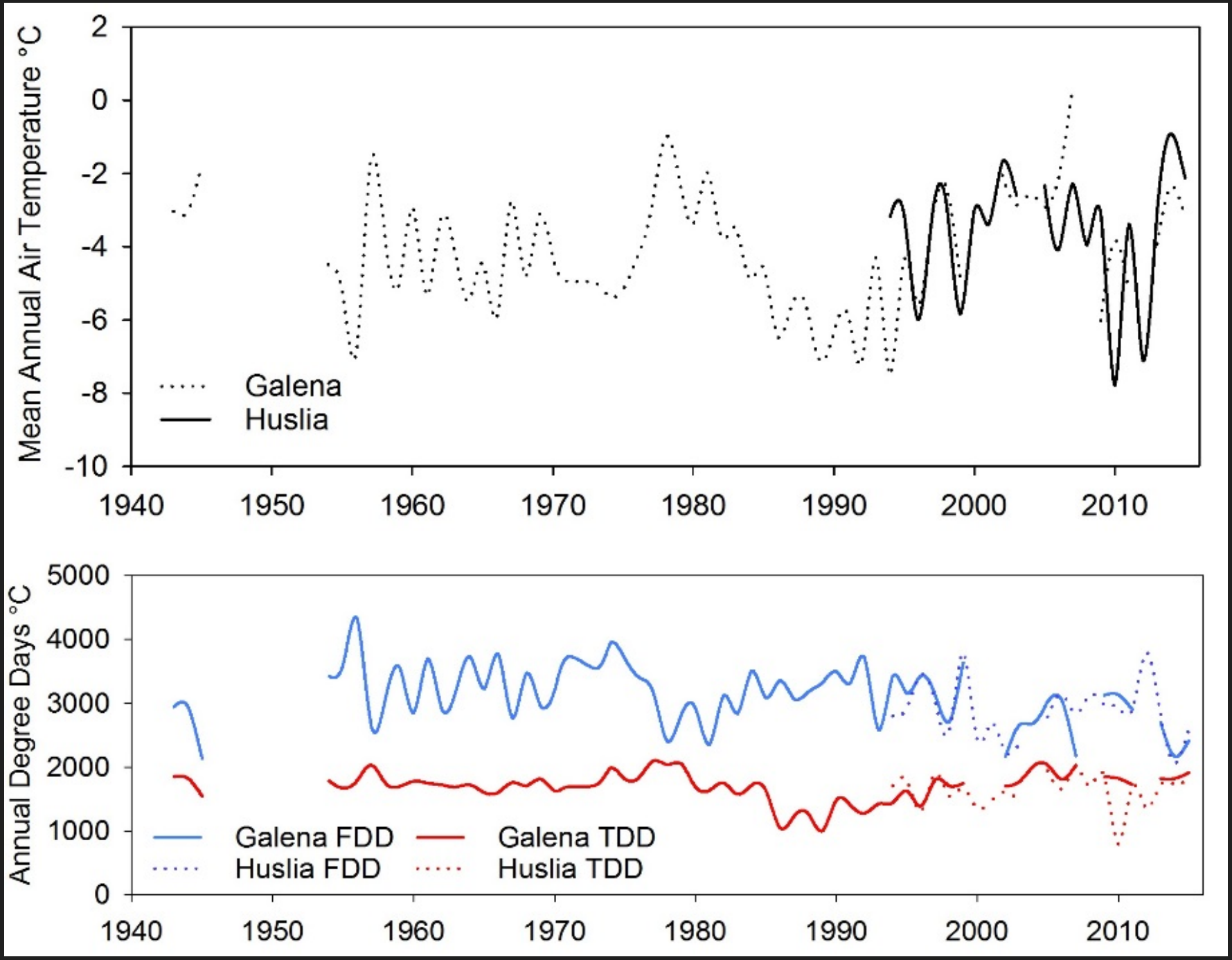
0.43
+- 0.09
(m/yr)



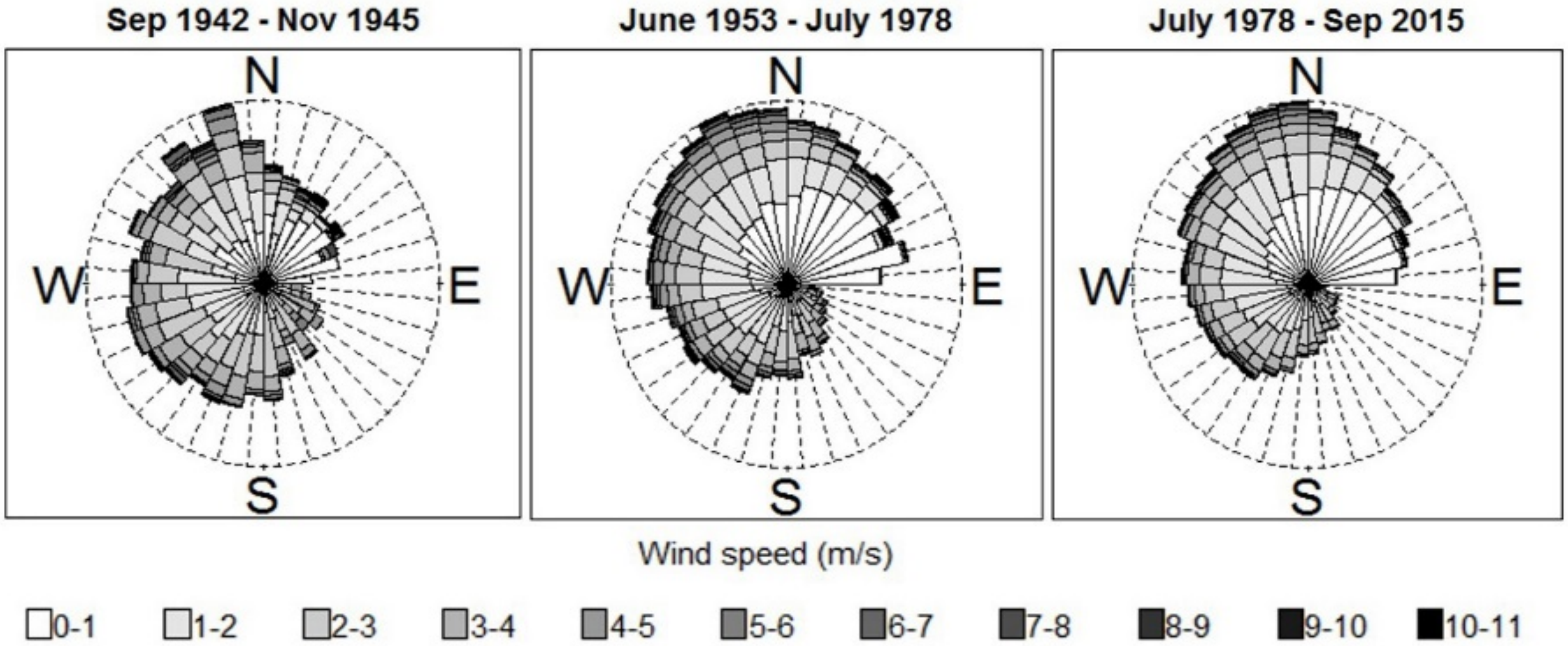


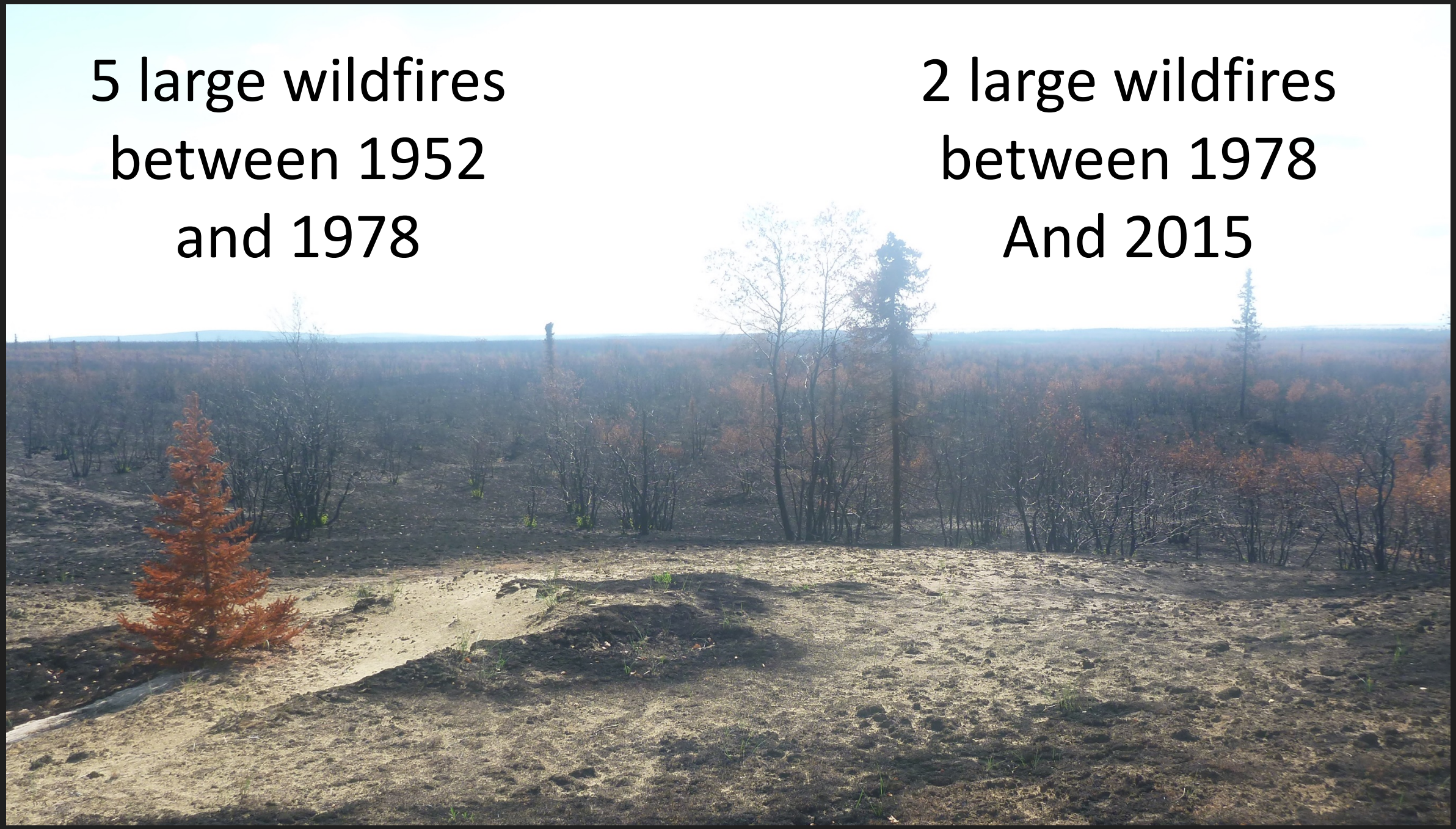


Available air temp data show no major trends



Wind data by era shows little change



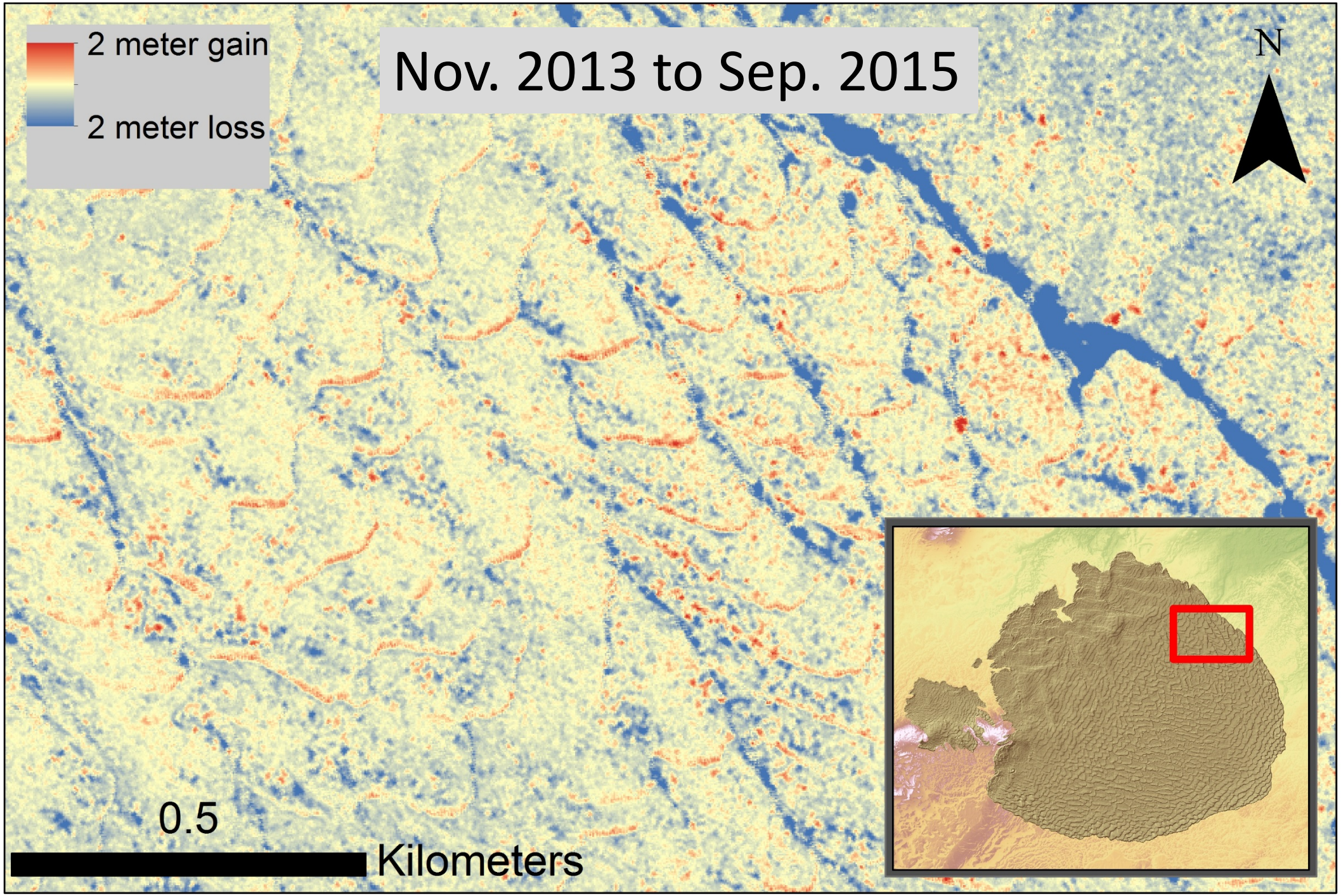

5 large wildfires
between 1952
and 1978
2 large wildfires
between 1978
And 2015

Implication

- There are abundant large inactive circumpolar dune fields.
- Boreal and Arctic biomes are expected to see more frequent and intense fire regiems
- Could fire lead to dune activation?

Conclusion

- LIDAR data has offered new detailed look into subarctic dune field structure and processes
- Dune migration rates appear variable over time
- Dune migration may be responding to climate that is also conducive to wildfire


2 meter gain
2 meter loss
Nov. 2013 to Sep. 2015
N
0.5
Kilometers

Thank you