Model-guided approach to monitoring of Katmai

Sarah Daniels

Nicholas School of the Environment

Duke University

Objectives

- Design an efficient monitoring program of climate change vulnerable sites within Katmai National Park
- Use relevant biophysical parameter proxies and geospatial analysis to locate maximally informative sites
- Perform sensitivity analysis on these areas
- Constrain sites by logistics of access

Why Katmai?

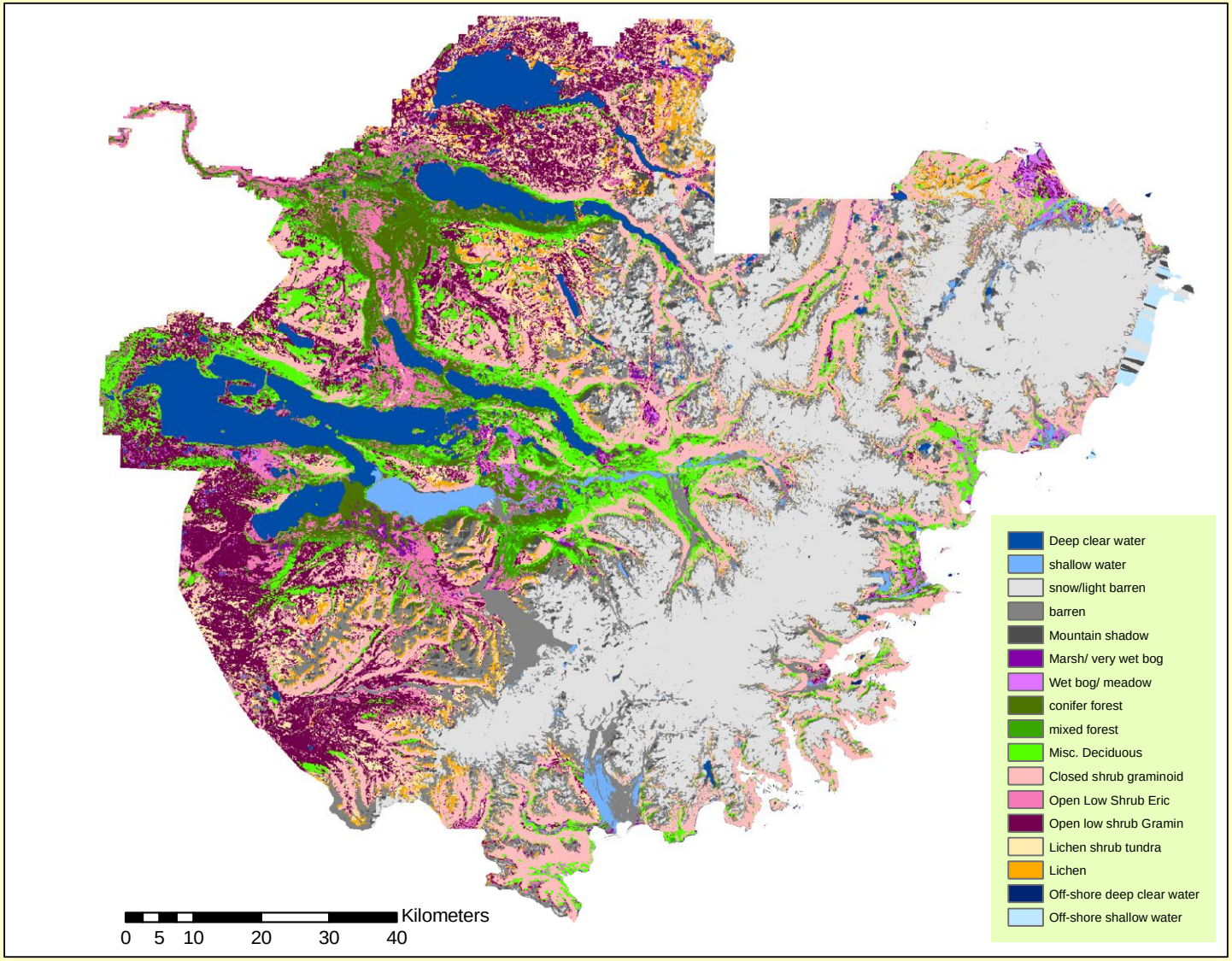
- Variety of terrain
- Variety of land cover types
- Microclimates and local climate effects
- Will be used to refine methods to apply to other SWAN Parks
- Available geospatial data for landscape analysis

Biophysical proxies

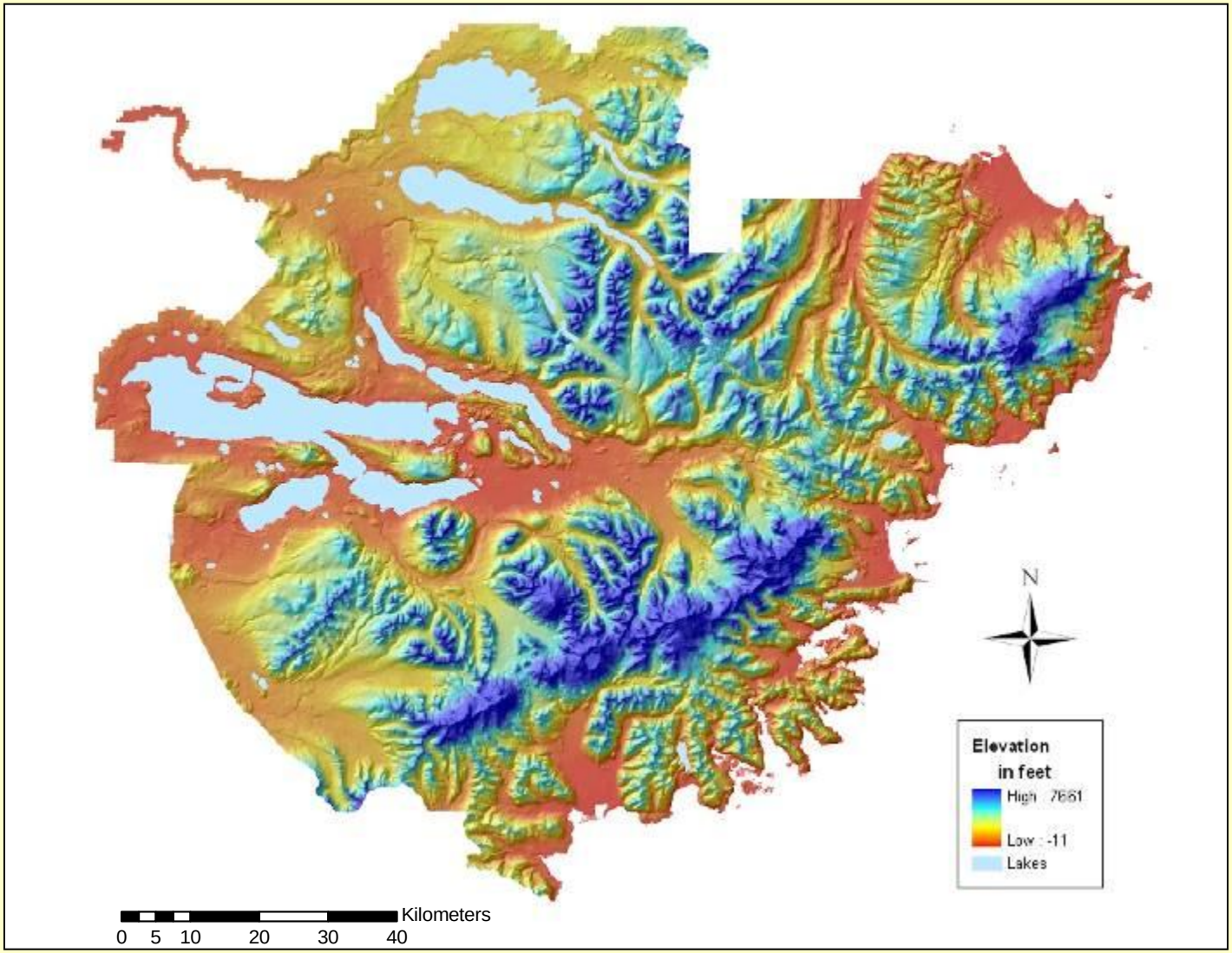
- Landscape study
- Use proxies that correlate with ecological processes
- How do land cover types sort on the biophysical parameters? How to capture diversity?

Available physical data	Biophysical proxy for
Elevation	Temperature, precipitation
Wetness Index	Available moisture
Hillshade	Radiation load
Slope Transformed Aspect	Radiation load

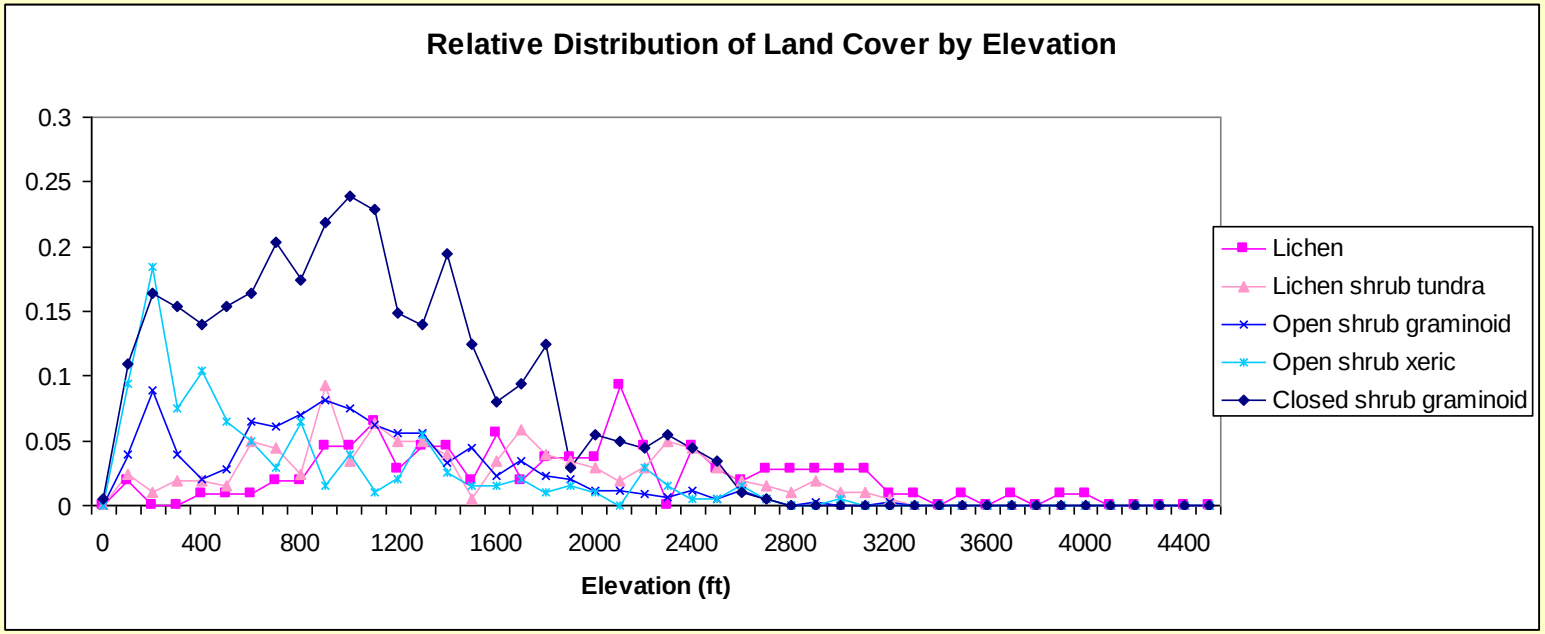
Land Cover

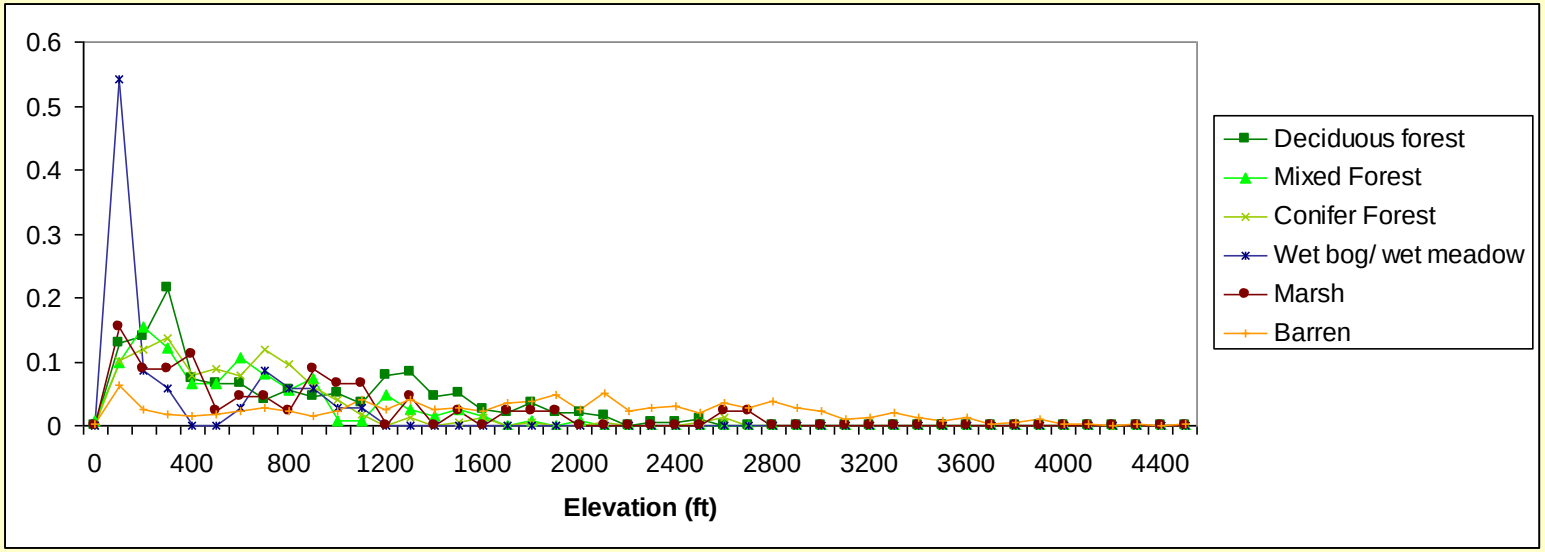

Deep clear water
shallow water
snow/light barren
barren
Mountain shadow
Marsh/ very wet bog
Wet bog/ meadow
conifer forest
mixed forest
Misc. Deciduous
Closed shrub graminoid
Open Low Shrub Eric
Open low shrub Gramin
Lichen shrub tundra
Lichen
Off-shore deep clear water
Off-shore shallow water
Kilometers
0 5 10 20 30 40

Elevation

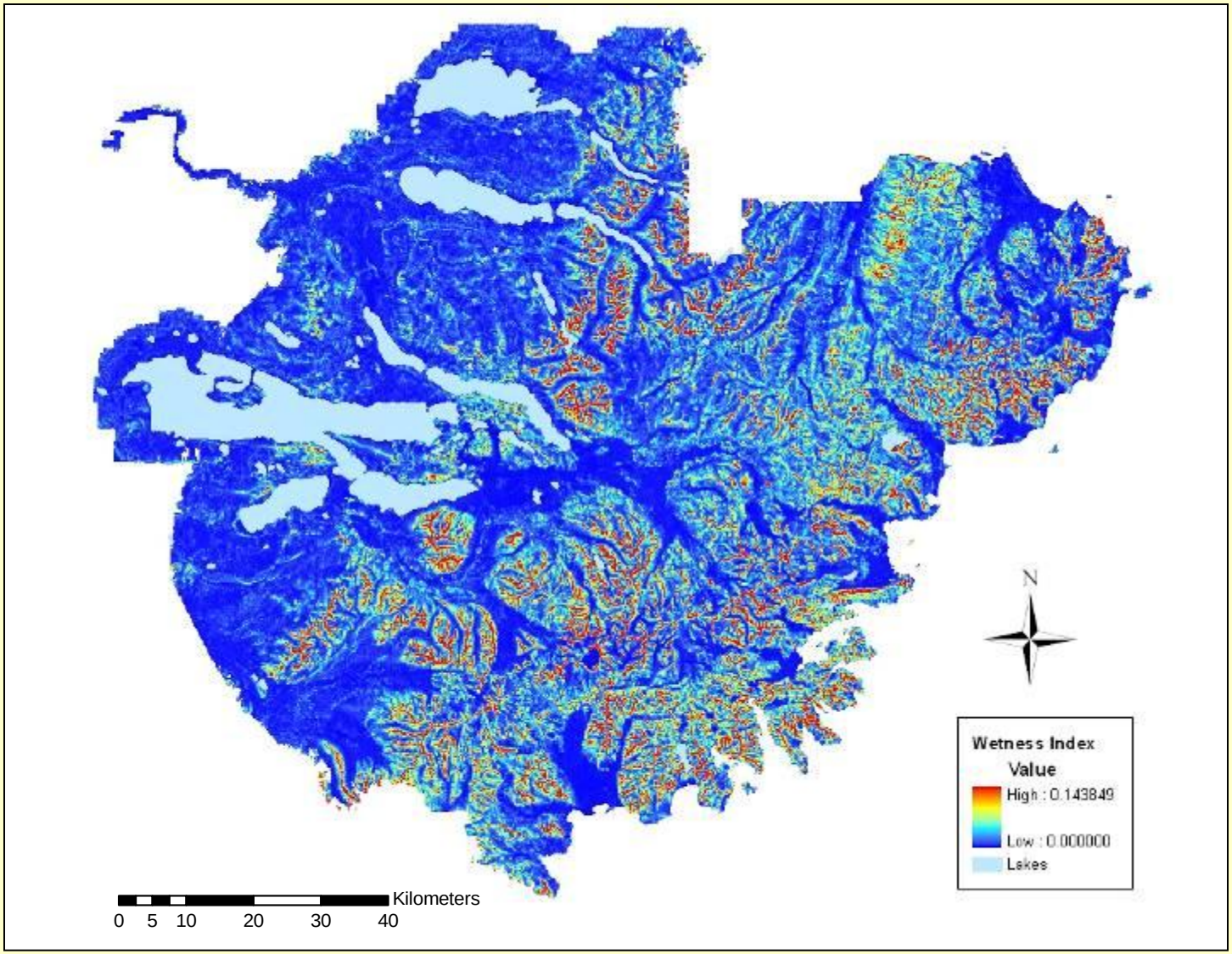

N
Elevation
in feet
High : 7661
Low : -11
Lakes
Kilometers
0 5 10 20 30 40

Elevation

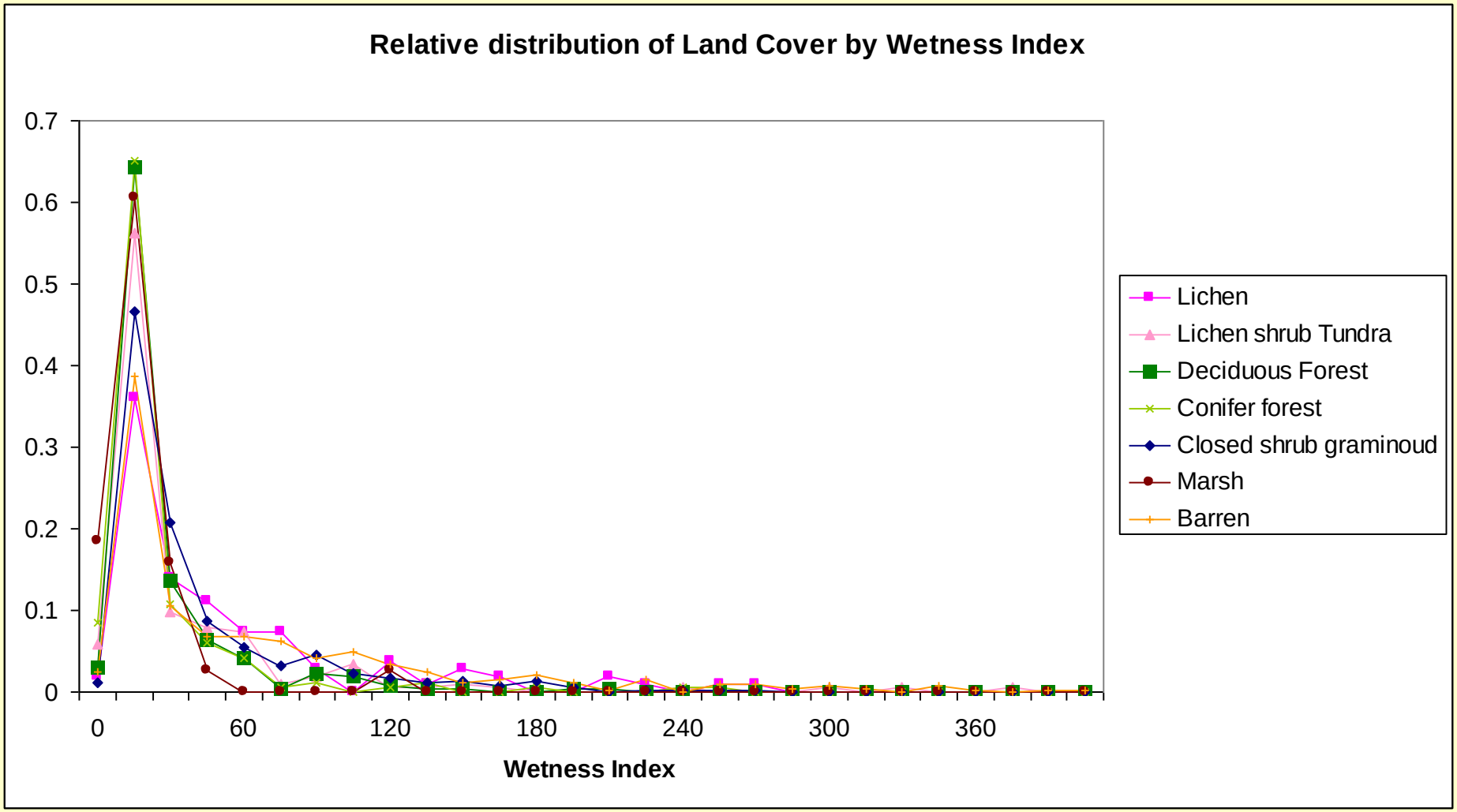

Relative Distribution of Land Cover by Elevation
0.3
0.25
0.2
0.15
0.1
0.05
0
0
400
800
1200
1600
2000
2400
2800
3200
3600
4000
4400
Elevation (ft)
Lichen
Lichen shrub tundra
Open shrub graminoid
Open shrub xeric
Closed shrub graminoid


0.6
0.5
0.4
0.3
0.2
0.1
0
0
400
800
1200
1600
2000
2400
2800
3200
3600
4000
4400
Elevation (ft)
Deciduous forest
Mixed Forest
Conifer Forest
Wet bog/ wet meadow
Marsh
Barren

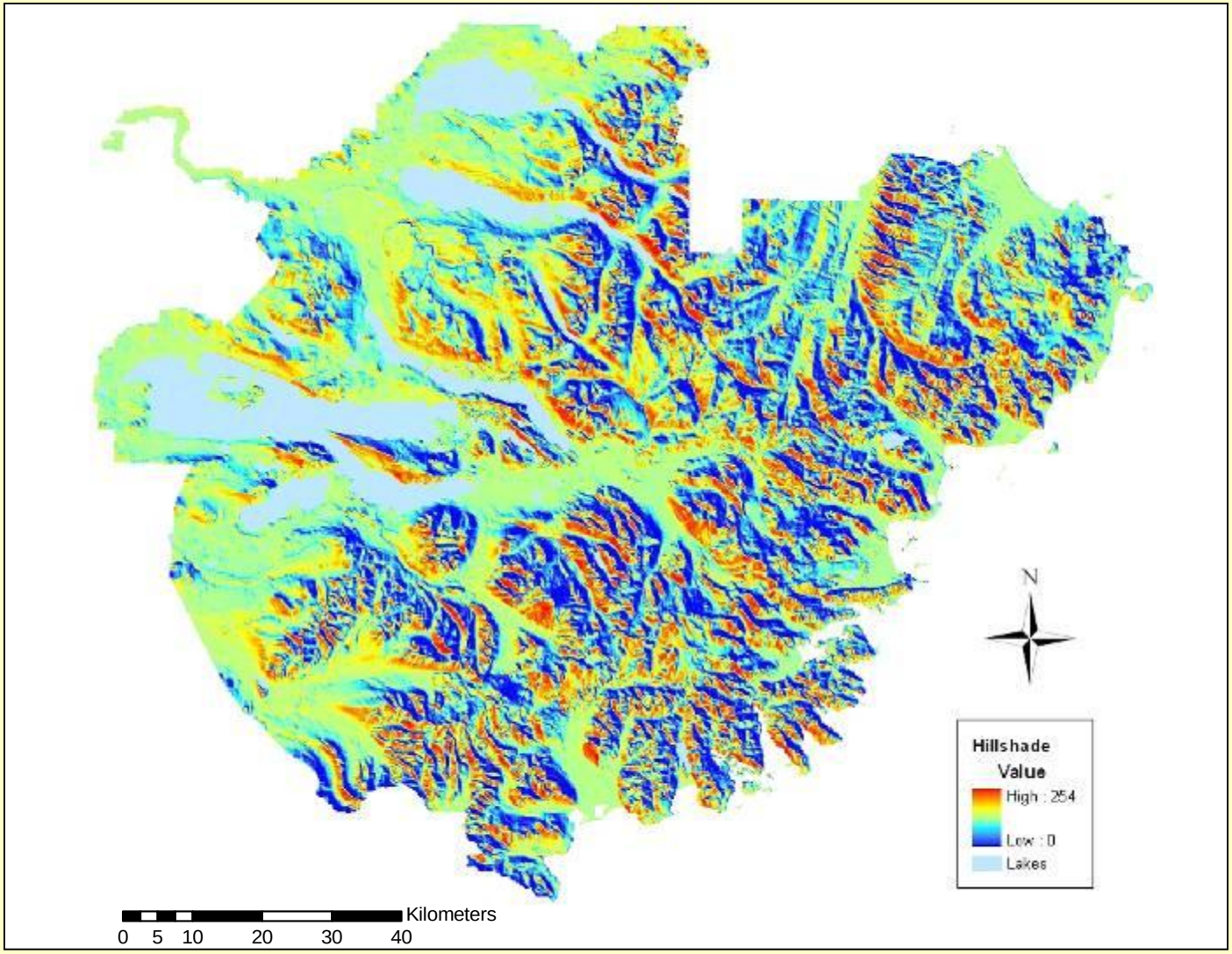
Wetness Index



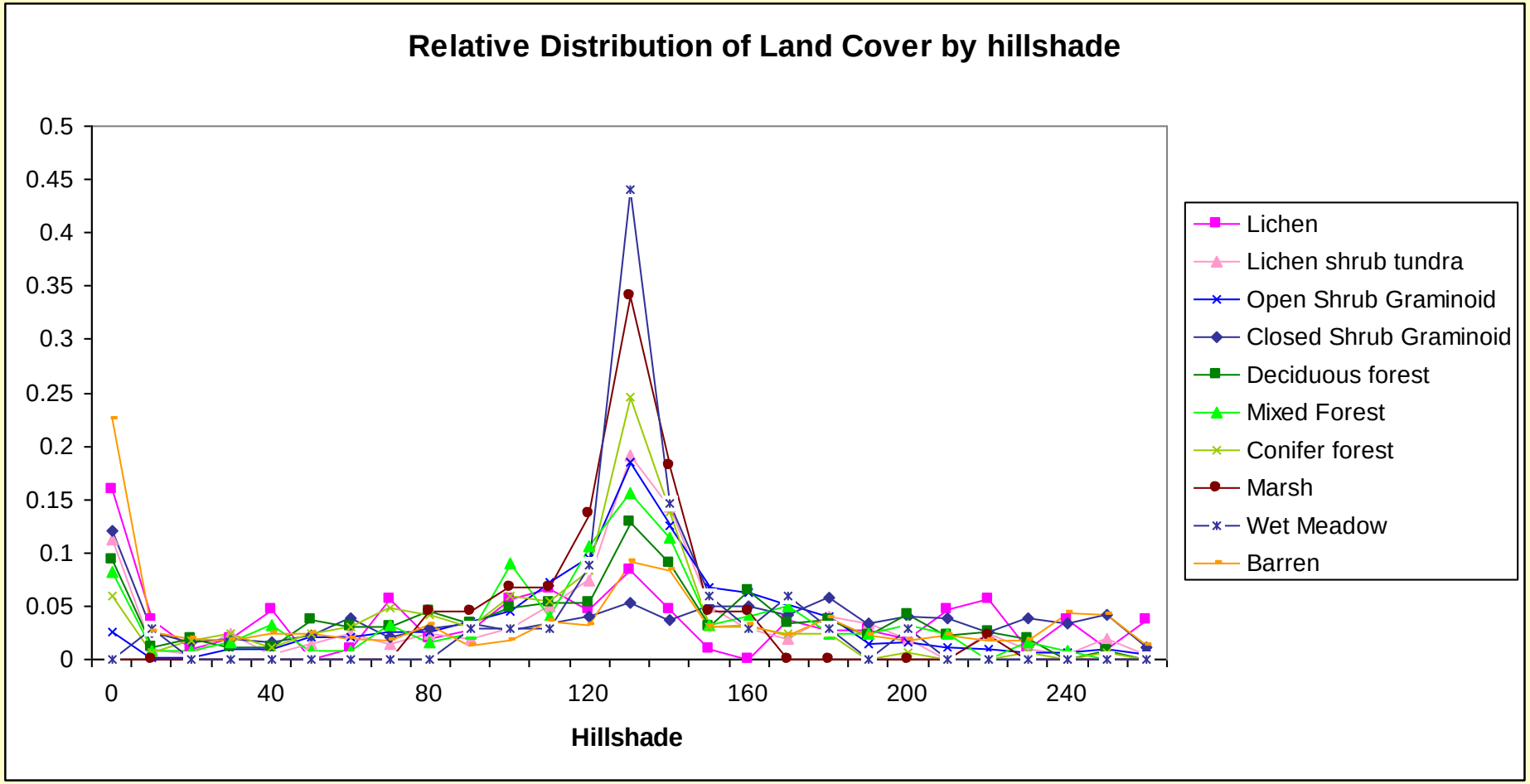
Wetness Index



Hillshade


N
Hillshade
Value
High : 254
Low : 0
Lakes
Kilometers
0 5 10 20 30 40

Hillshade


Relative Distribution of Land Cover by hillshade
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
0
40
80
120
160
200
240
Hillshade
Lichen
Lichen shrub tundra
Open Shrub Graminoid
Closed Shrub Graminoid
Deciduous forest
Mixed Forest
Conifer forest
Marsh
Wet Meadow
Barren

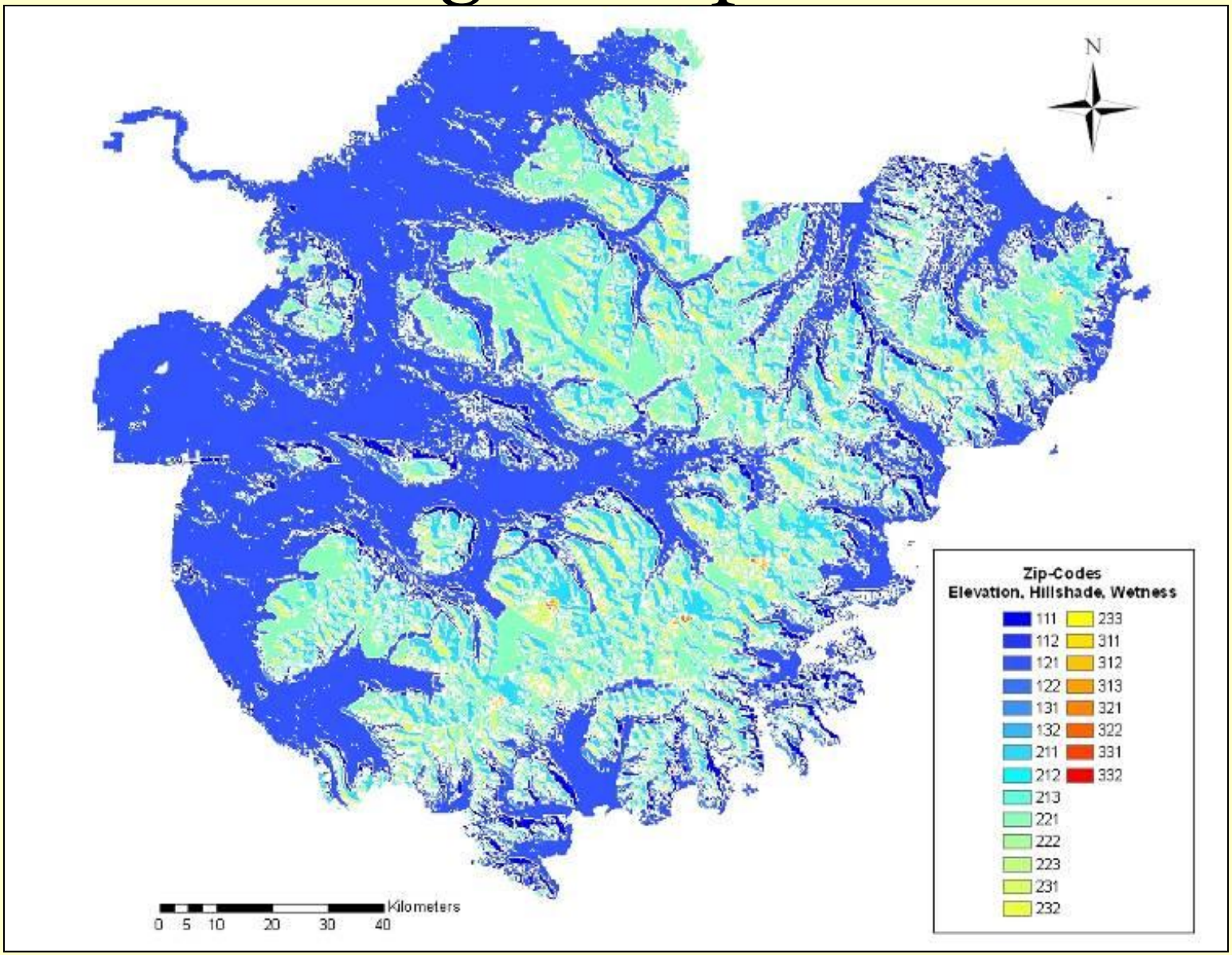
Using proxies to select sites

- Capturing the diversity of land cover types and climate sensitivity
- Maximize information from sites
- Create “ecological zipcodes”

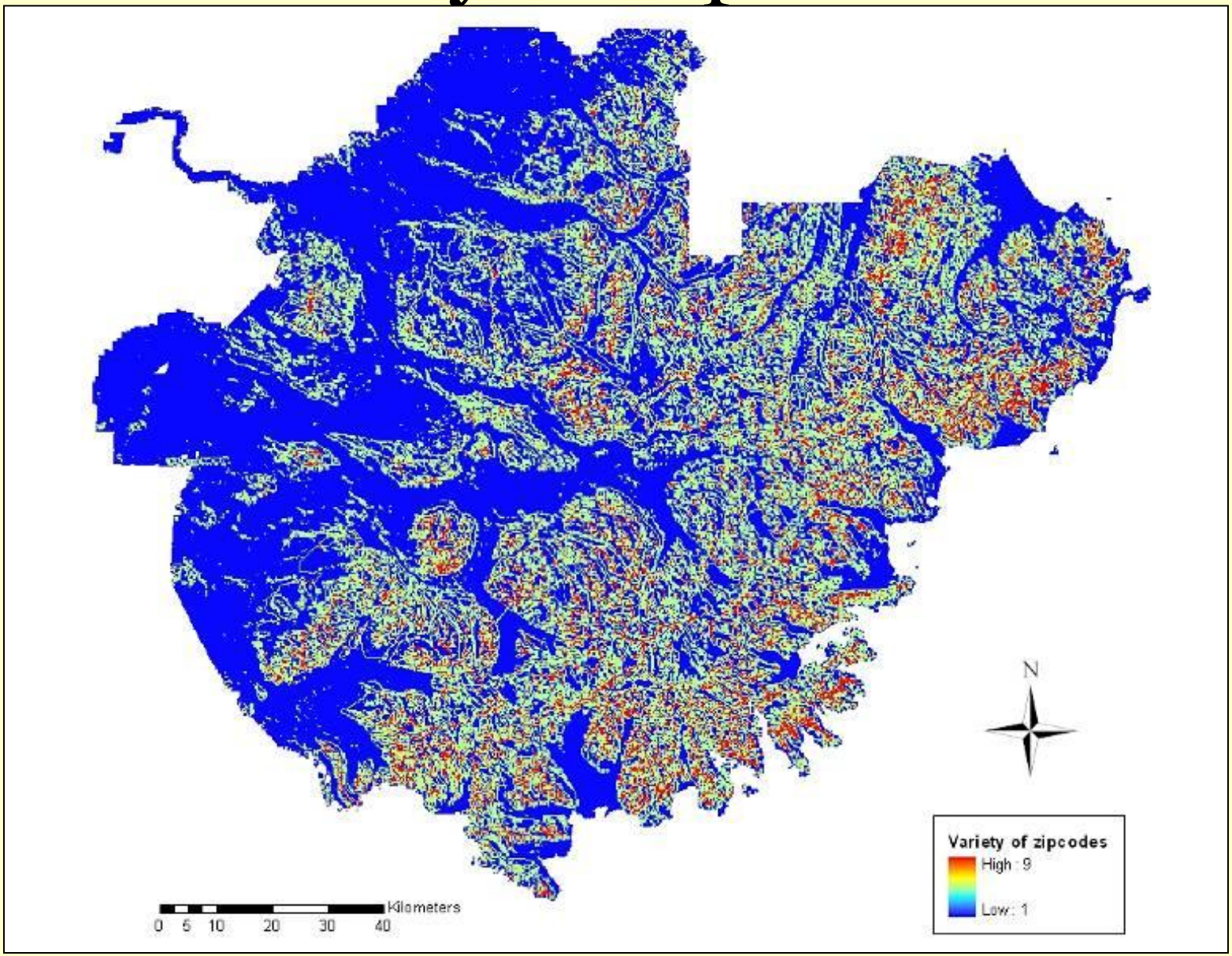
Ecological Zipcodes

- Combine indices into one measure
- Partition parameters into high (top 20%), low (bottom 20%) and intermediate values
- Zipcode = 100*Elevation + 10*Hillshade + Wetness
- 121 is: low elevation, intermediate hillshade, wet

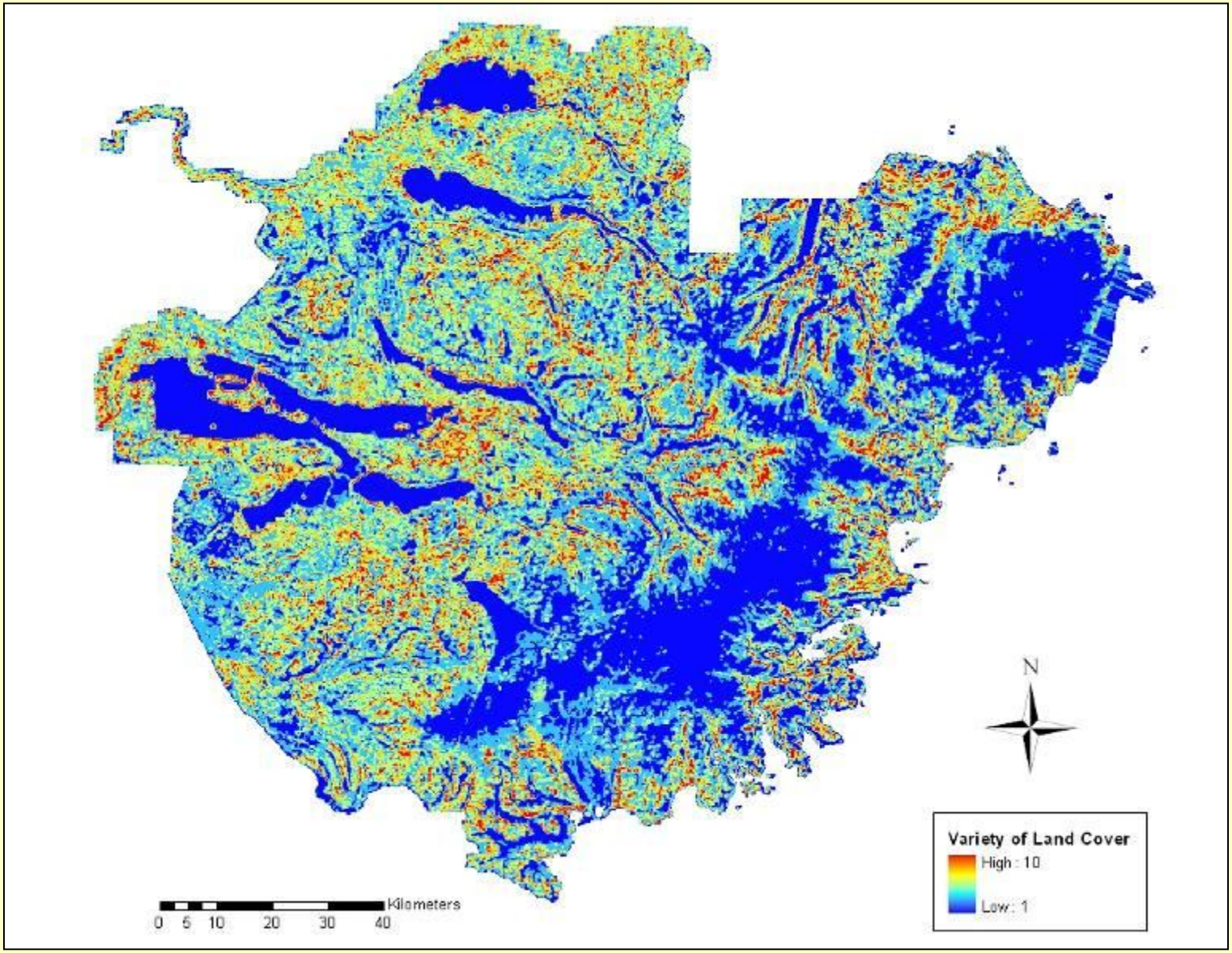
Ecological Zip-codes



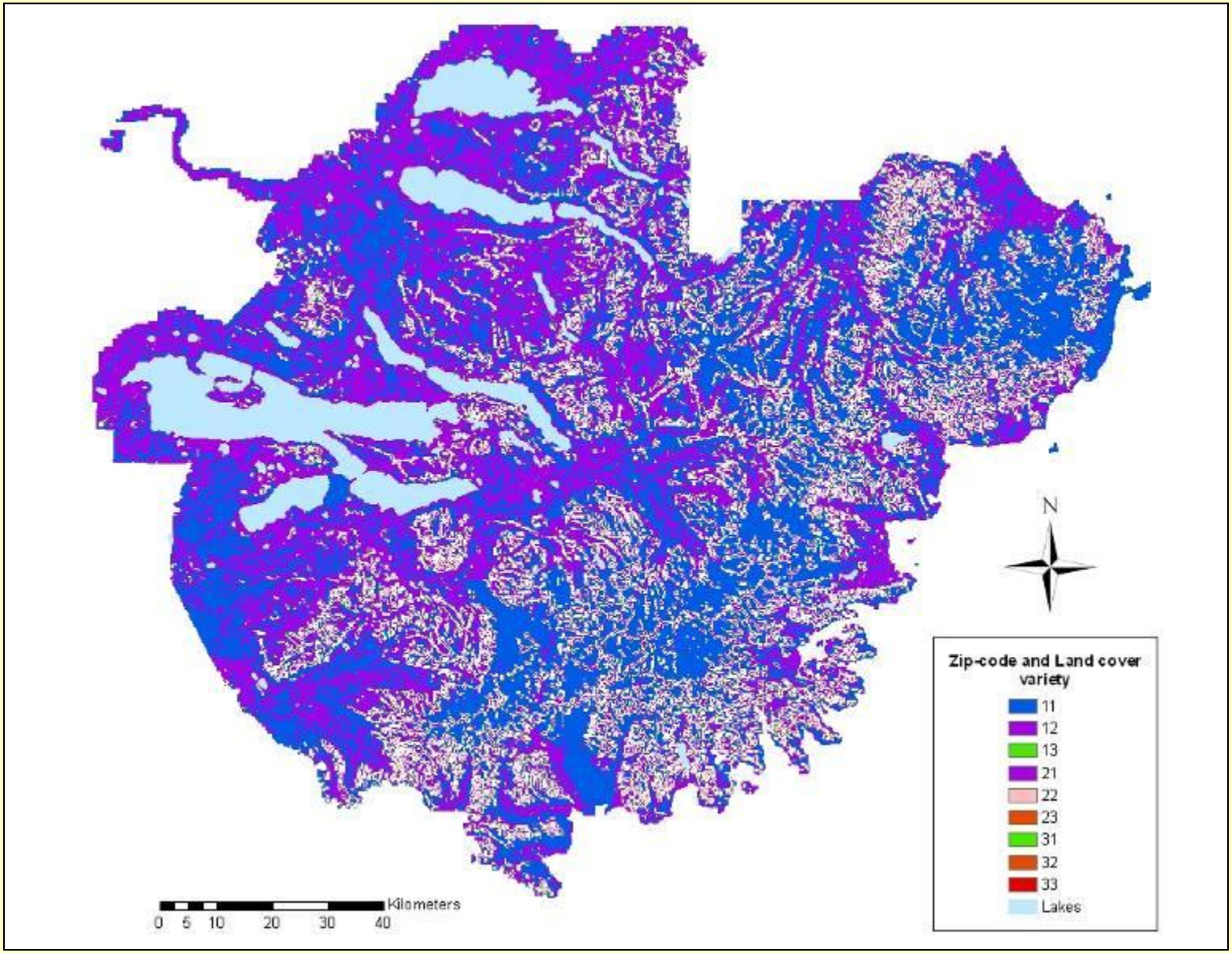
Variety of Zip-codes



Variety of land cover types



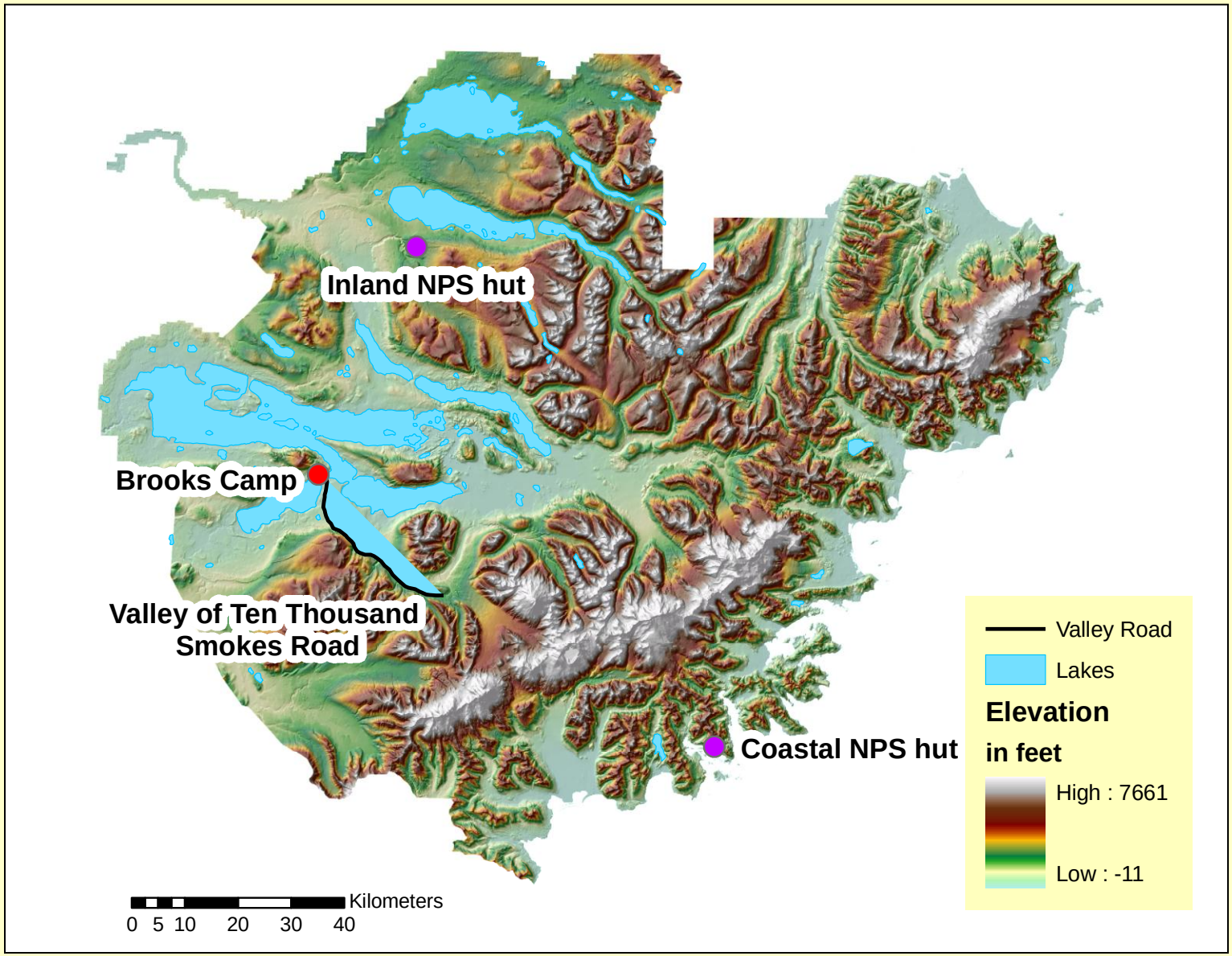
Variety of zip-codes and land cover



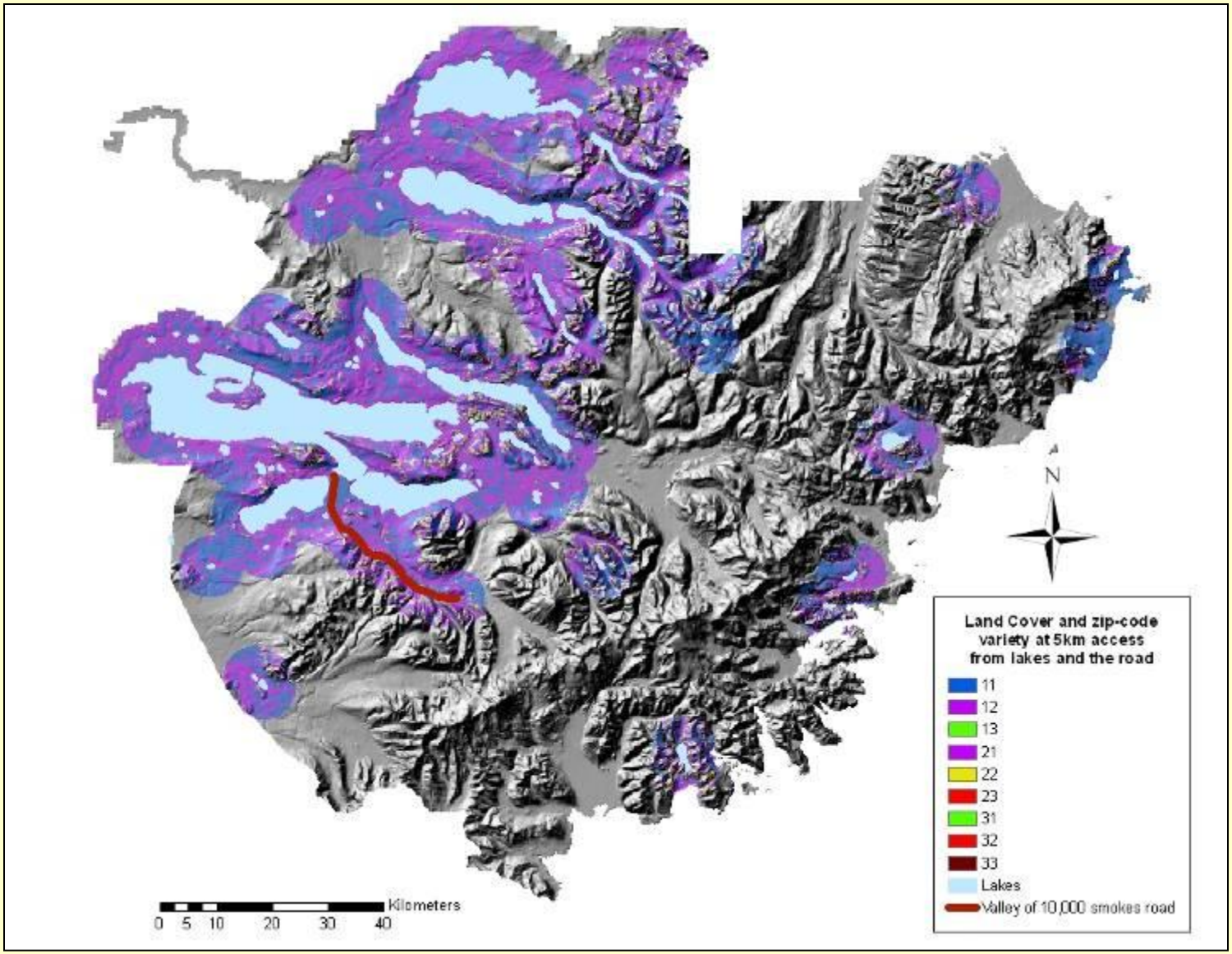
Climate change sensitivity

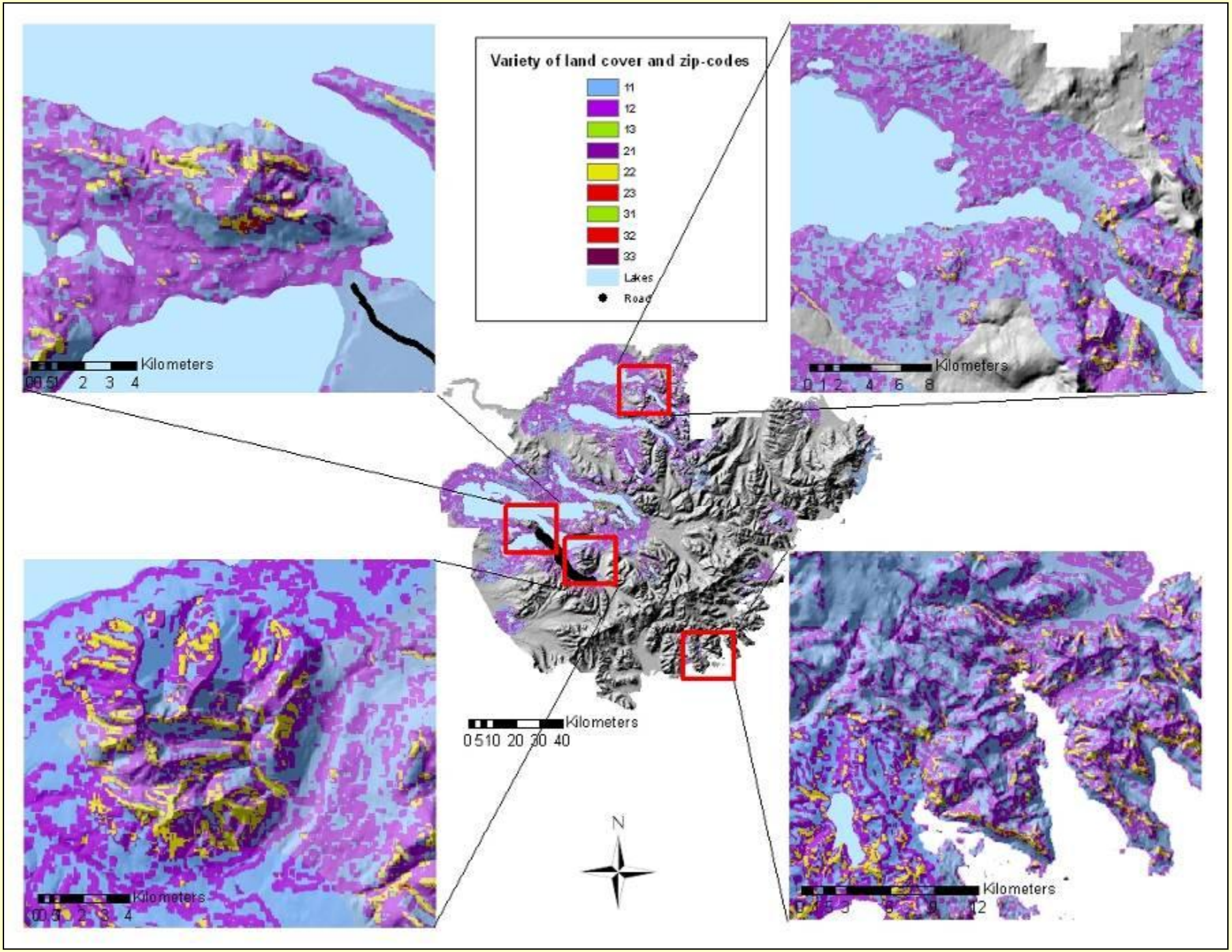
- Lack of information on lapse rates, effects of aspect and slope on temperature
- Climate change research on boreal forest responses to change in temperature and moisture
- Vegetation distribution response?

Access


Inland NPS hut
Brooks Camp
Valley of Ten Thousand Smokes Road
Coastal NPS hut
Valley Road
Lakes
Elevation in feet
High : 7661
Low : -11
Kilometers
0 5 10 20 30 40

Land cover and zip-code variety 5 km from lakes and road




Variety of land cover and zip-codes
11
12
13
21
22
23
31
32
33
Lakes
Road
Kilometers
0 1 2 3 4
Kilometers
0 1 2 4 6 8
Kilometers
0 5 10 20 30 40
N
Kilometers
0 0.5 1 2 3 4
Kilometers
0 3 6 9 12

Future tasks

- Climate sensitivity of biophysical proxies
- Integration of climate monitoring and vegetation monitoring
- Translate climate sensitivities into units of land area

Thank you

- Dean Urban

- Alan Bennett
- Troy Hamon and the rangers and staff of Katmai National Park

- NPS and the Nicholas School