CUMULATIVE IMPACTS IN ARCTIC ALASKA: HOW MUCH CHANGE IS TOO MUCH?

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Assessment Management Team

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- North Slope Science Initiative

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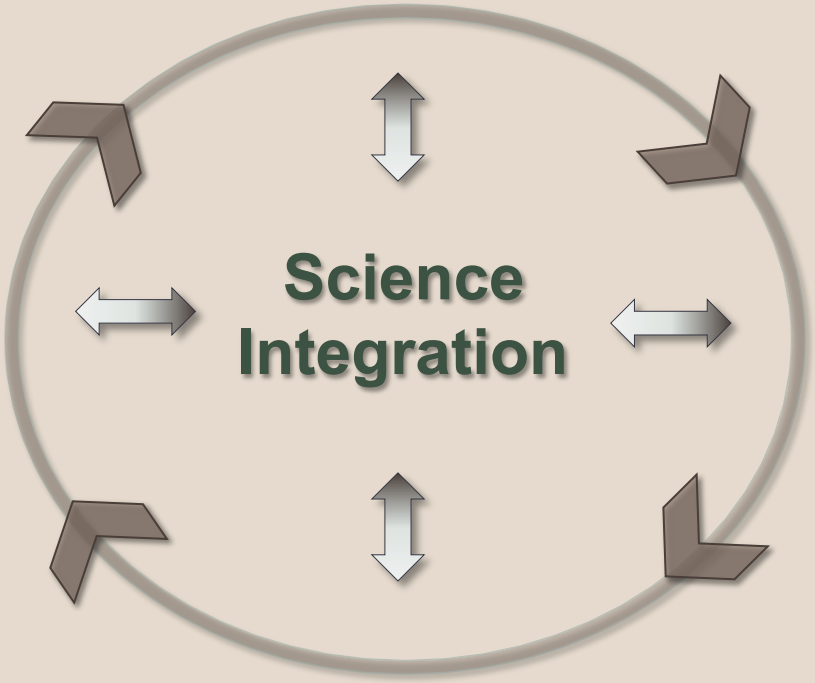
ABA Spatial Levels of Stressors

1. Global and circumpolar (climate change, contaminants)
2. Regional stressors (overexploitation, invasive species)
3. Localized stressors (mineral extraction, oil development)

Rapid Ecoregional Assessments (REAs)

Landscape Approach

Rapid Ecoregional Assessments



Monitoring for Adaptive Management

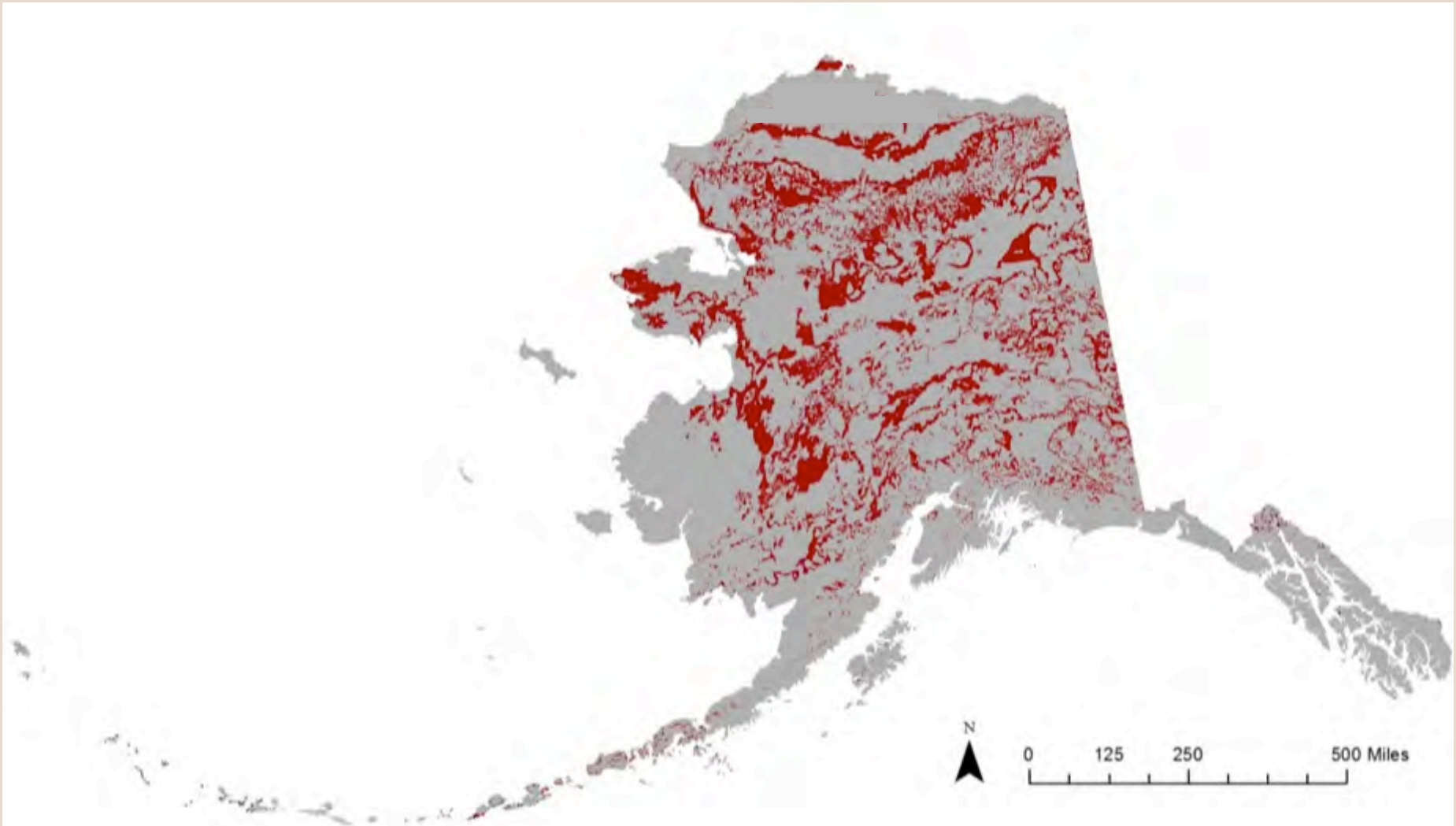
Ecoregional Direction

Field Implementation

Key Outcomes of REA

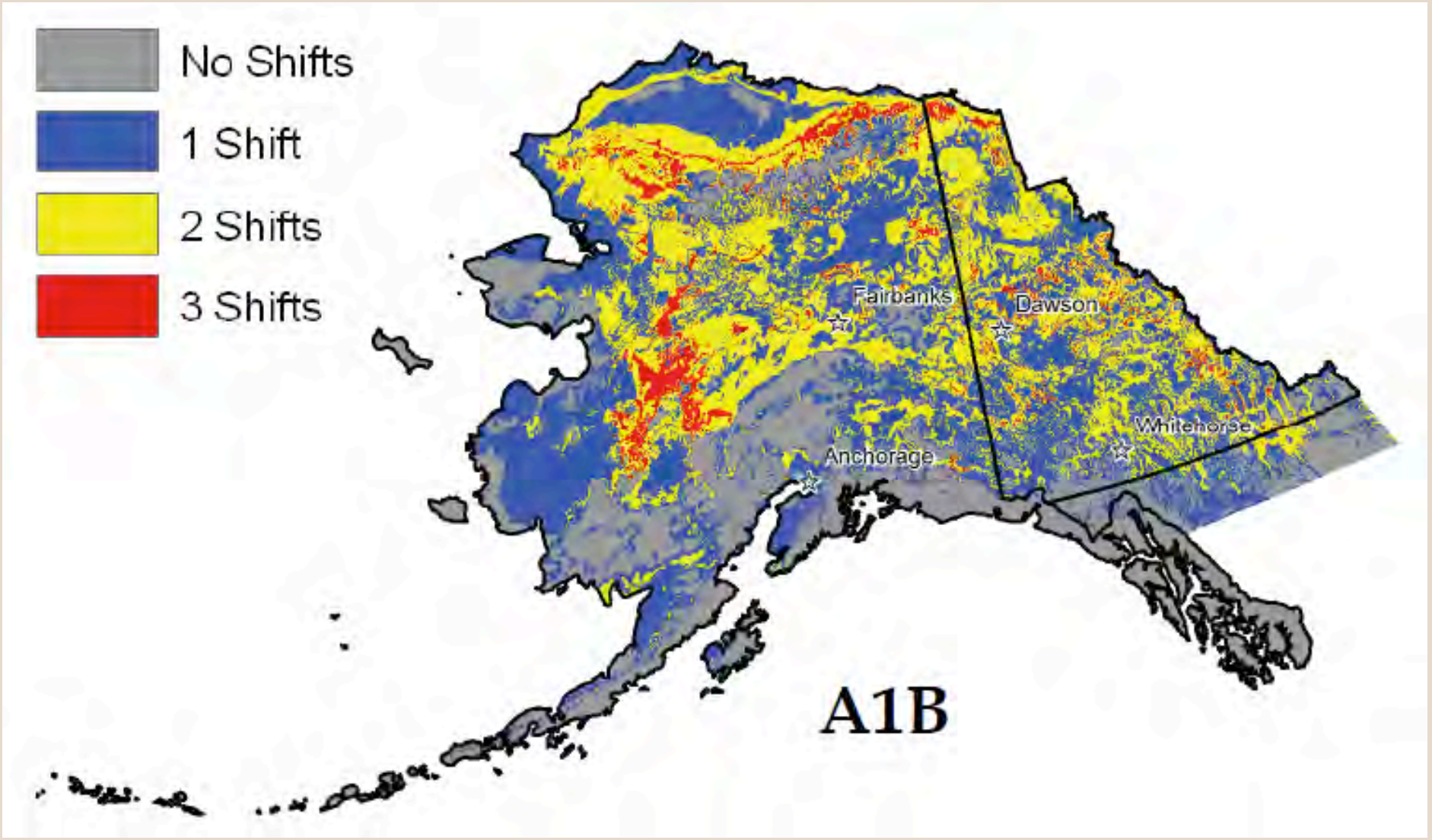
- Baseline conservation data synthesis
- Distribution models for key ecosystem resources
  - Conceptual model of how the ecosystem works
  - Following coarse-filter fine-filter approach
- Distribution models for major agents of change
  - Climate, wildfire, invasive species, human development and *permafrost*
- Intersection of two to show current and future (2025 & 2060) condition of ecological resources

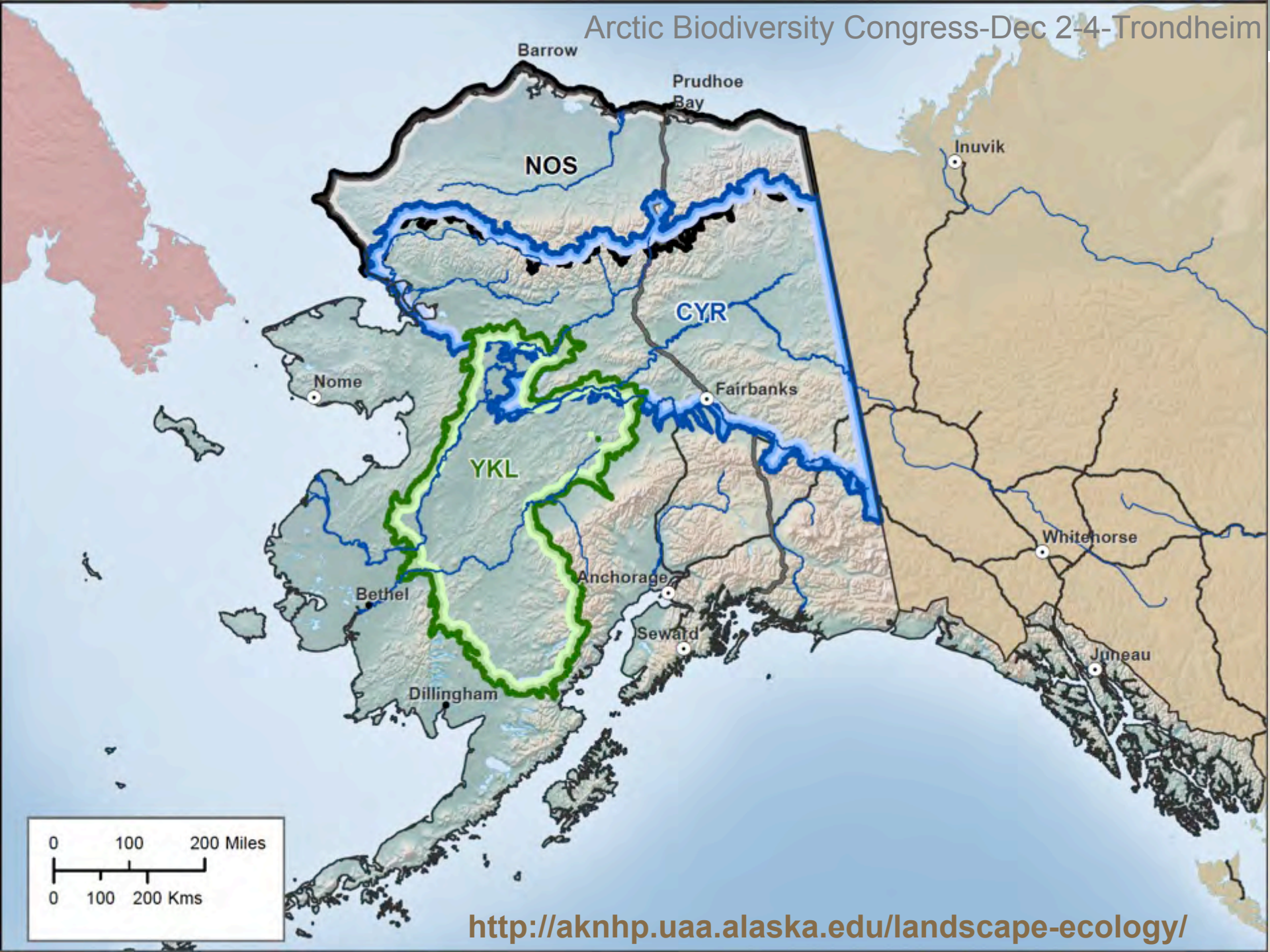
Climate Change 1970-2000

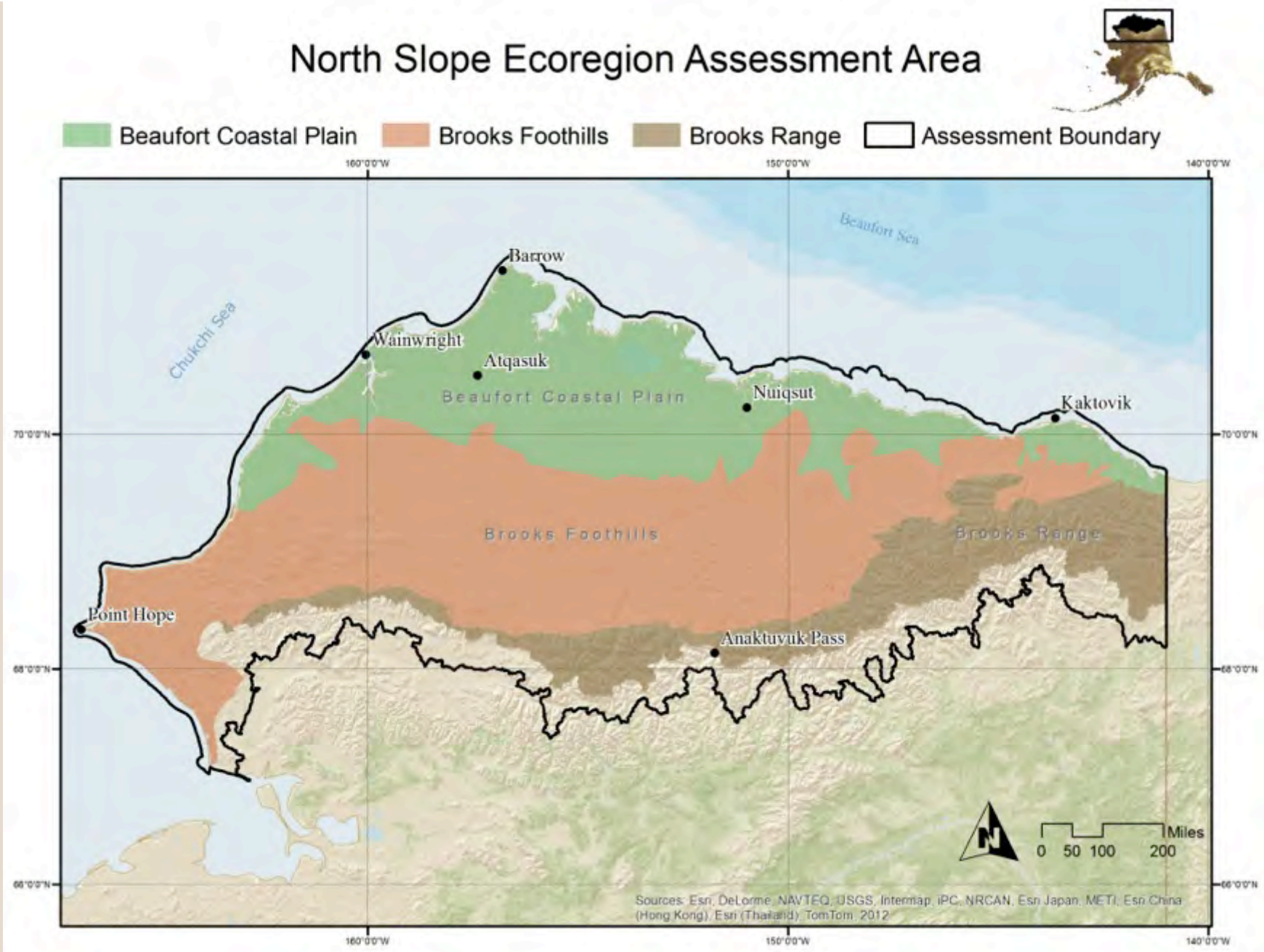


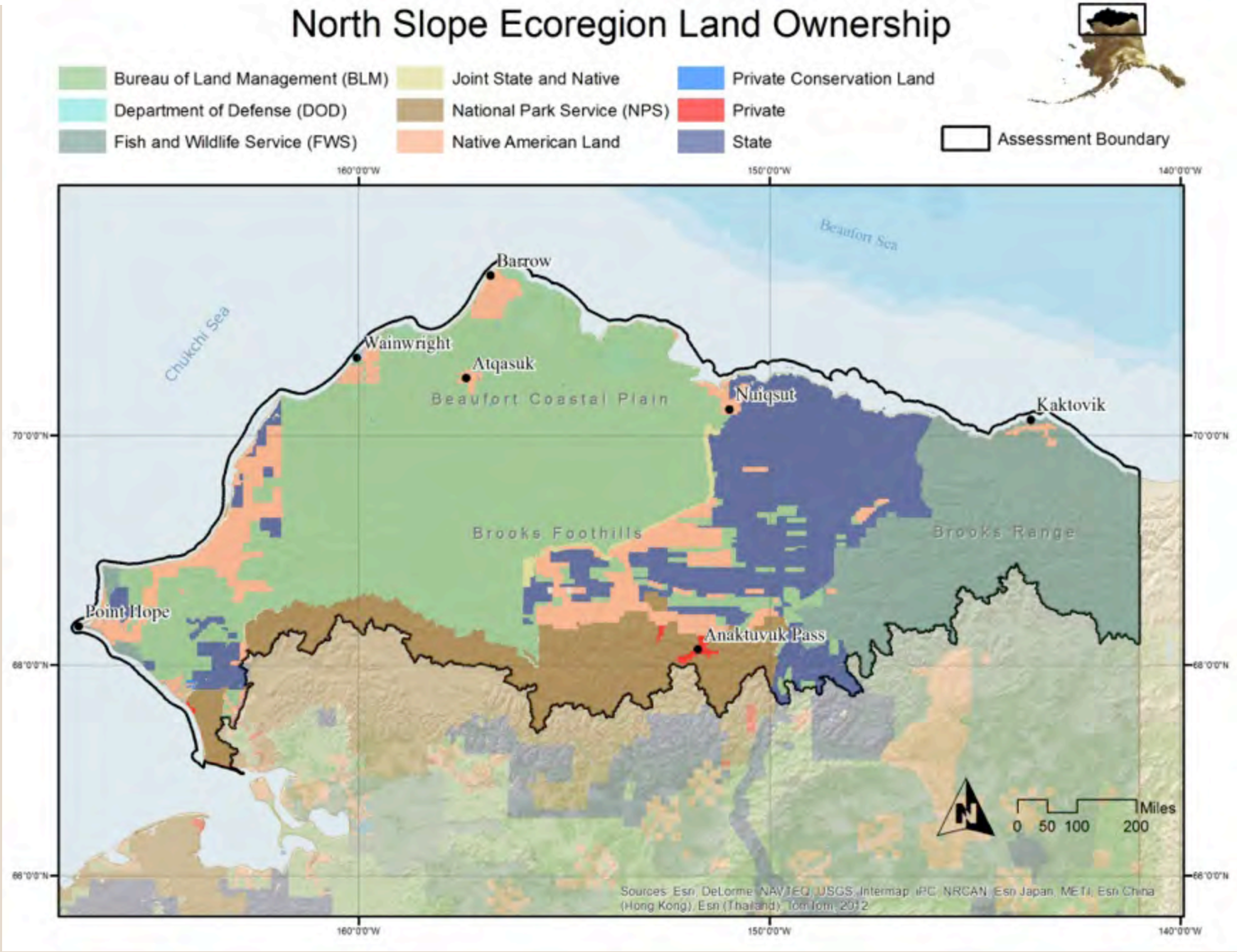
For more information on climate clusters, see https://www.snap.uaf.edu/attachments/Cliomes-FINAL.pdf

Future Climate Change 2010-2100




Barrow
Prudhoe Bay
Inuvik
NOS
CYR
YKL
Nome
Fairbanks
Whitehorse
Anchorage
Bethel
Seward
Juneau
Dillingham
0 100 200 Miles
0 100 200 Kms


North Slope Ecoregion Assessment Area
Beaufort Coastal Plain
Brooks Foothills
Brooks Range
Assessment Boundary
160°0'0"W
150°0'0"W
140°0'0"W
70°0'0"N
68°0'0"N
66°0'0"N
Beaufort Sea
Chukchi Sea
Barrow
Wainwright
Atqasuk
Nuiqsut
Kaktovik
Point Hope
Anaktuvuk Pass
Beaufort Coastal Plain
Brooks Foothills
Brooks Range
0 50 100 200
Miles
Sources: Esri, DeLorme, NAVTEQ, USGS, Intermap, iPC, NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, 2012


North Slope Ecoregion Land Ownership
Bureau of Land Management (BLM)
Department of Defense (DOD)
Fish and Wildlife Service (FWS)
Joint State and Native
National Park Service (NPS)
Native American Land
Private Conservation Land
Private
State
Assessment Boundary
160°0'0"W
150°0'0"W
140°0'0"W
70°0'0"N
68°0'0"N
66°0'0"N
Beaufort Sea
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0 50 100 200
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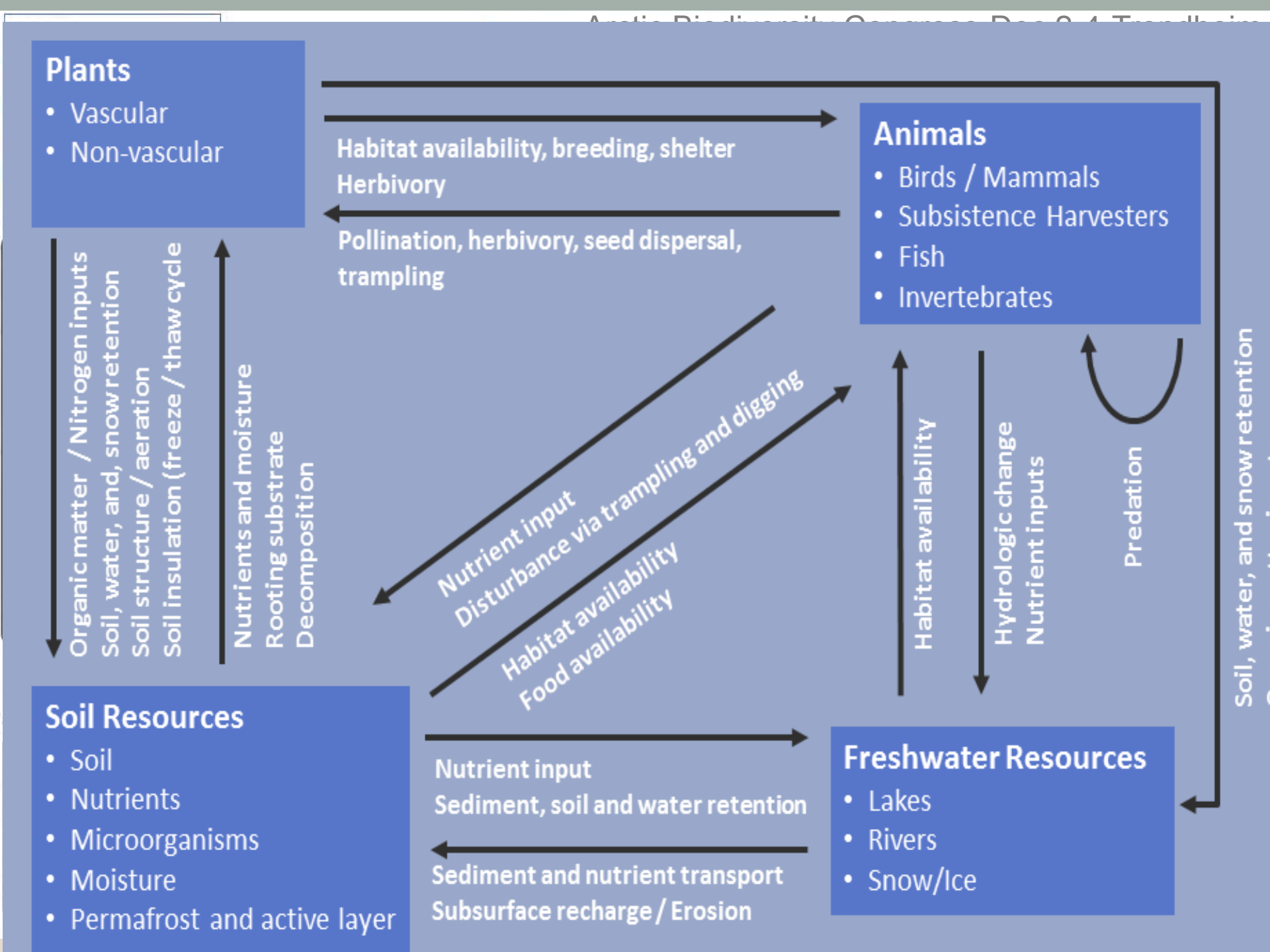

Plants
• Vascular
• Non-vascular
Habitat availability, breeding, shelter
Herbivory
Pollination, herbivory, seed dispersal, trampling
Animals
• Birds / Mammals
• Subsistence Harvesters
• Fish
• Invertebrates
Organic matter / Nitrogen inputs
Soil, water, and, snow retention
Soil structure / aeration
Soil insulation (freeze / thaw cycle
Nutrients and moisture
Rooting substrate
Decomposition
Nutrient input
Disturbance via trampling and digging
Habitat availability
Food availability
Habitat availability
Hydrologic change
Nutrient inputs
Predation
Soil, water, and snow retention
Soil Resources
• Soil
• Nutrients
• Microorganisms
• Moisture
• Permafrost and active layer
Nutrient input
Sediment, soil and water retention
Sediment and nutrient transport
Subsurface recharge / Erosion
Freshwater Resources
• Lakes
• Rivers
• Snow/Ice

Key Aquatic Habitats

Connected Lakes

Important breeding habitat for aquatic insects, fish, waterbirds and shorebirds and provide subsistence and recreational use

Disconnected Lakes

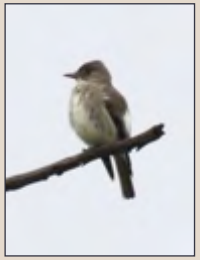
Important breeding habitat for aquatic insects, fish, waterbirds and shorebirds; flood storage, groundwater regeneration; invertebrate and waterfowl habitat

Streams

High stream connectivity in the summer, important spawning, rearing, and overwintering habitat

Key Terrestrial Species

Conservation Element (CE)	Ecosystem Function
Moose (*Alces americanus*)	Subsistence and prey resource, herbivory
Caribou (*Rangifer tarandus*)	Subsistence and prey resource, herbivory, vegetation disturbance (trampling)
Muskox (*Ovibos moschatus*)	Subsistence and prey resource, herbivory, vegetation disturbance (trampling)
North American beaver (*Castor canadensis*)	Mechanical disturbance, major driver of hydrologic change on aquatic and riparian ecosystems
Gray wolf (*Canis lupus*)	Predation (top level carnivore)
American peregrine falcon (*Falco peregrinus anatum*)	Predation (large avian predator); BLM Sensitive Species
Trumpeter swan (*Cygnus buccinator*)	Large bodied waterfowl, surrogate for condition and availability of freshwater resources; BLM Sensitive Species
Olive-sided flycatcher (*Contopus cooperi*)	Insectivorous avian predator; boreal forest indicator species; BLM Sensitive Species



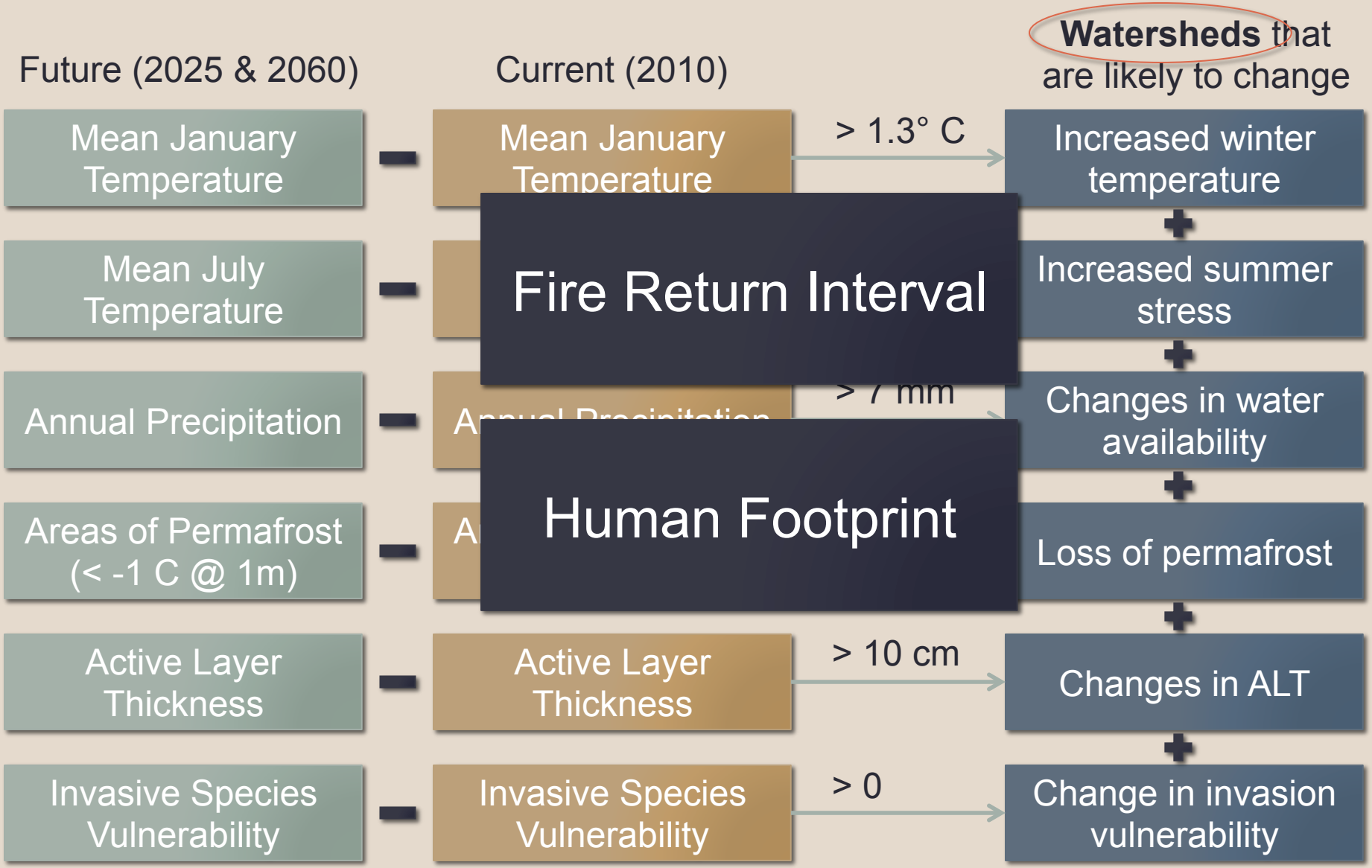
Change Agents

- Climate Change
  - However we want to conceptualize it
  - A2 scenario from IPCC IV, 5 GCM average
- Wildfire
  - Changes in return interval and successional response
  - ALFRESCO
- Invasive Species
  - Vulnerability of areas to becoming infested
- Land Use and Development
  - Trend future estimate of land use and development

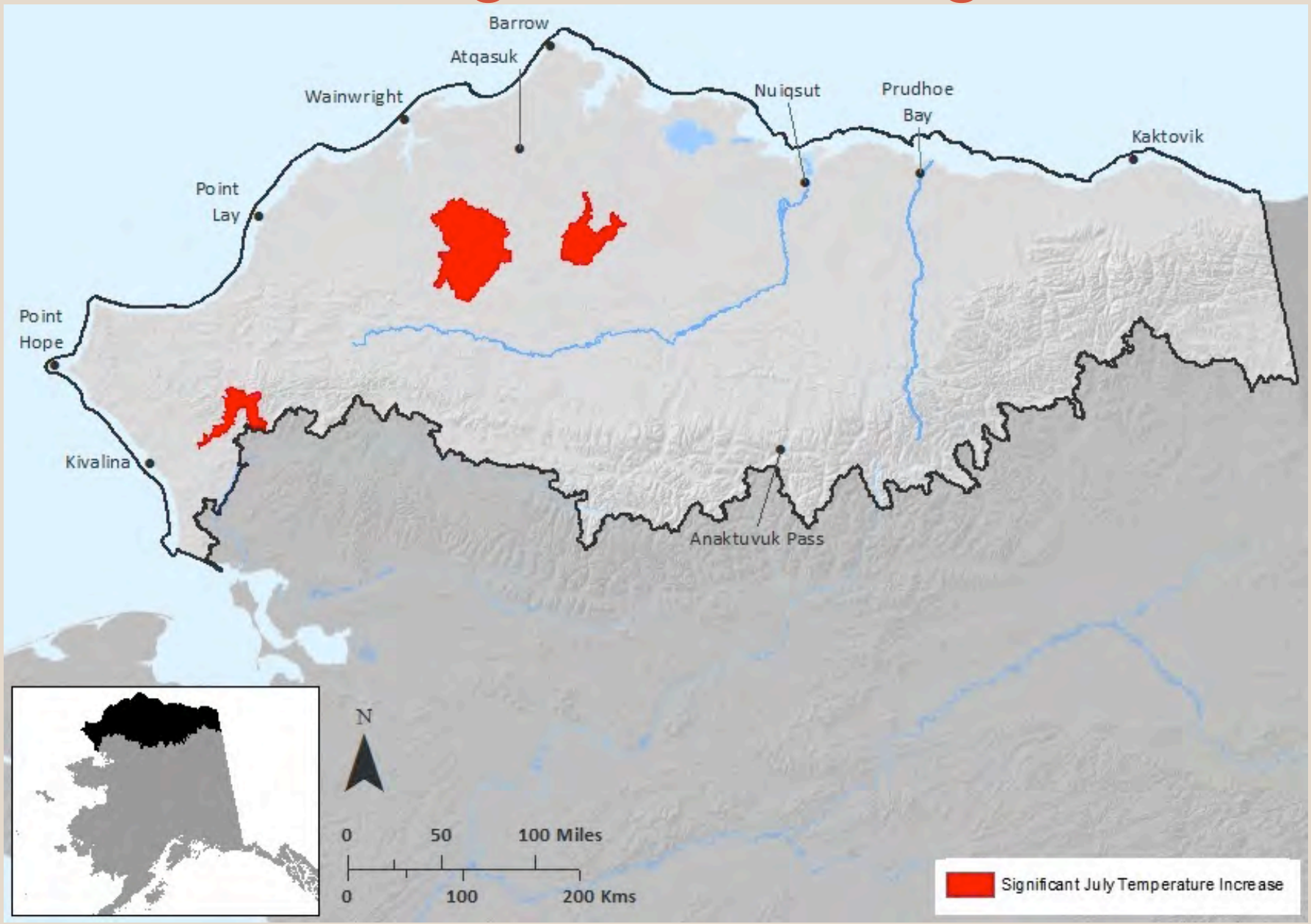
Integrated Products

- Landscape condition
  - Model of intactness and landscape integrity
- Assess current and future *status* of key species and habitats
  - Look at intactness of underlying habitat
- Combine to get a sense of ecological integrity
- Assess key attributes of species and habitats that make them susceptible to change
  - Develop indicators for how specific variables might impact habitat availability
- Cumulative impacts
  - Where on the landscape do we expect to see the most change?

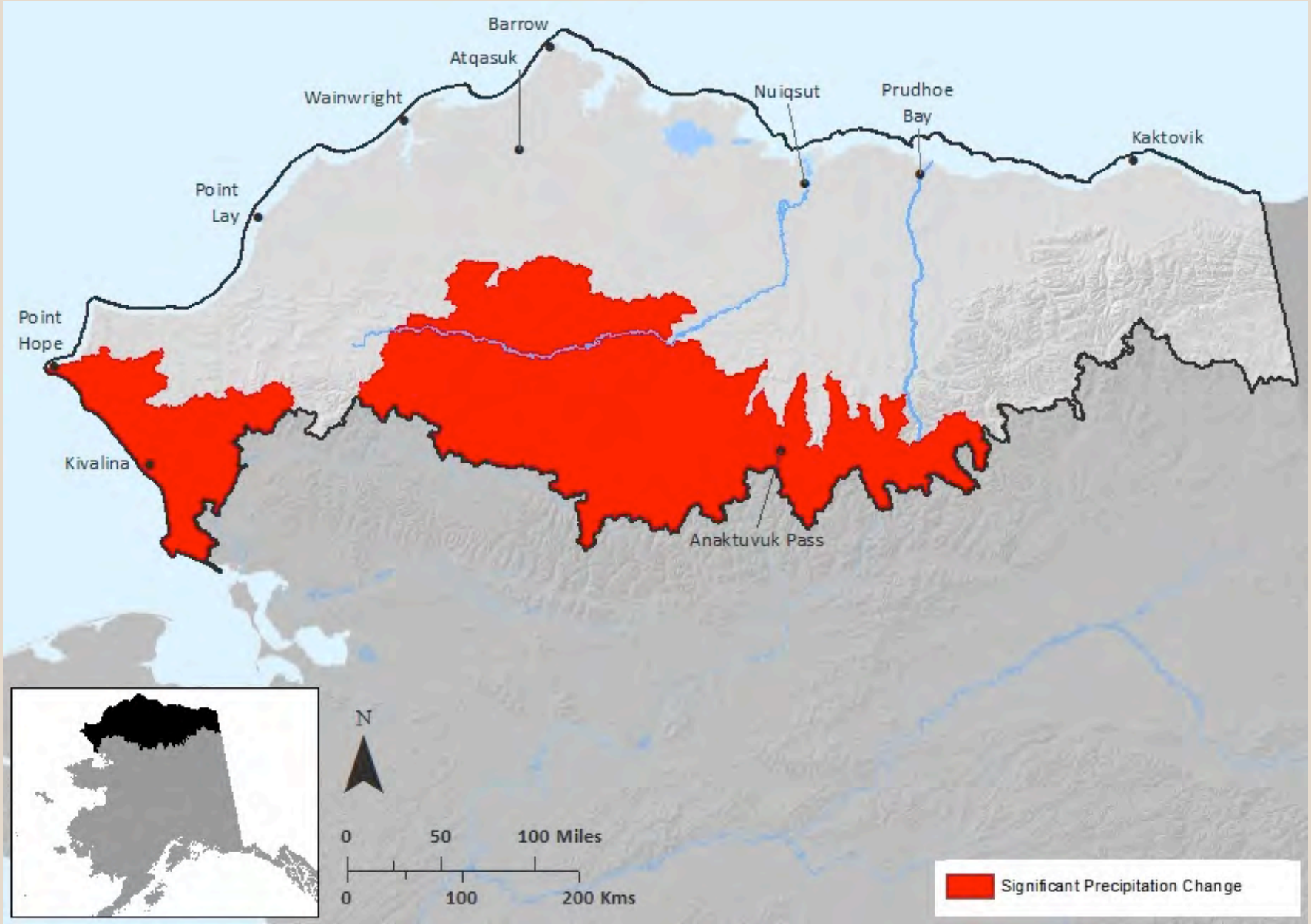
Cumulative Impacts Model (CIM)



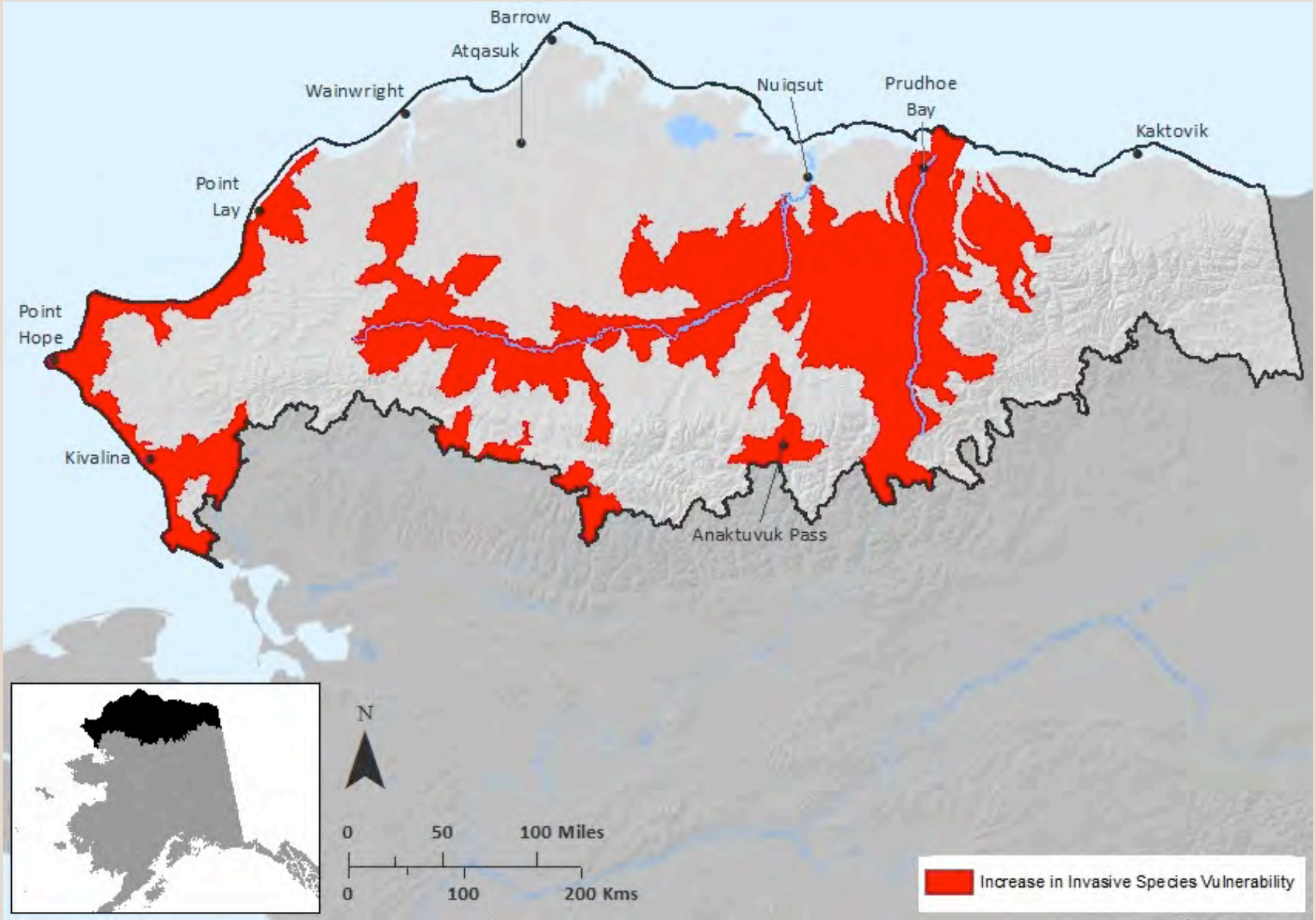
Near-Term Significant Change



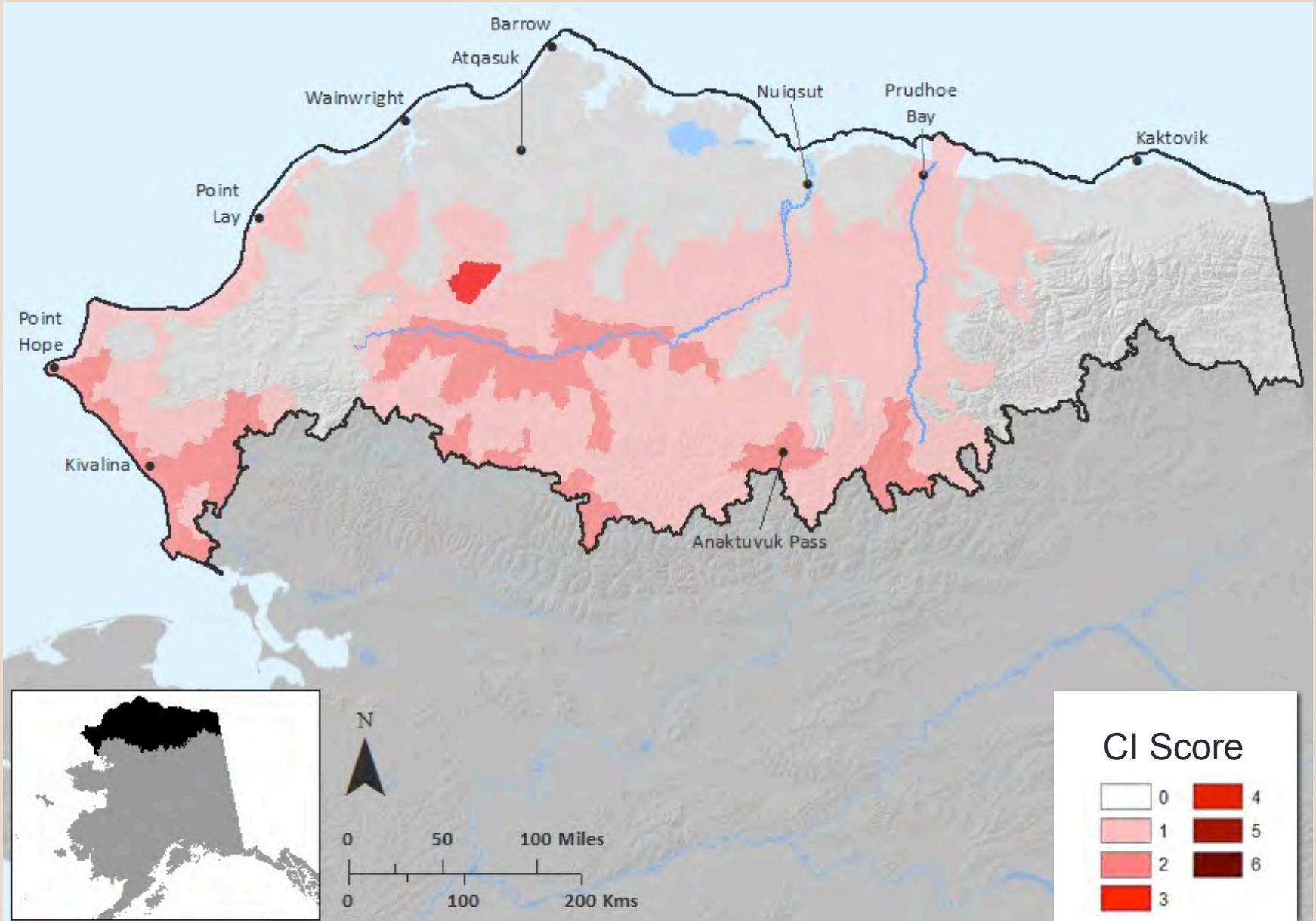
Near-Term Significant Change



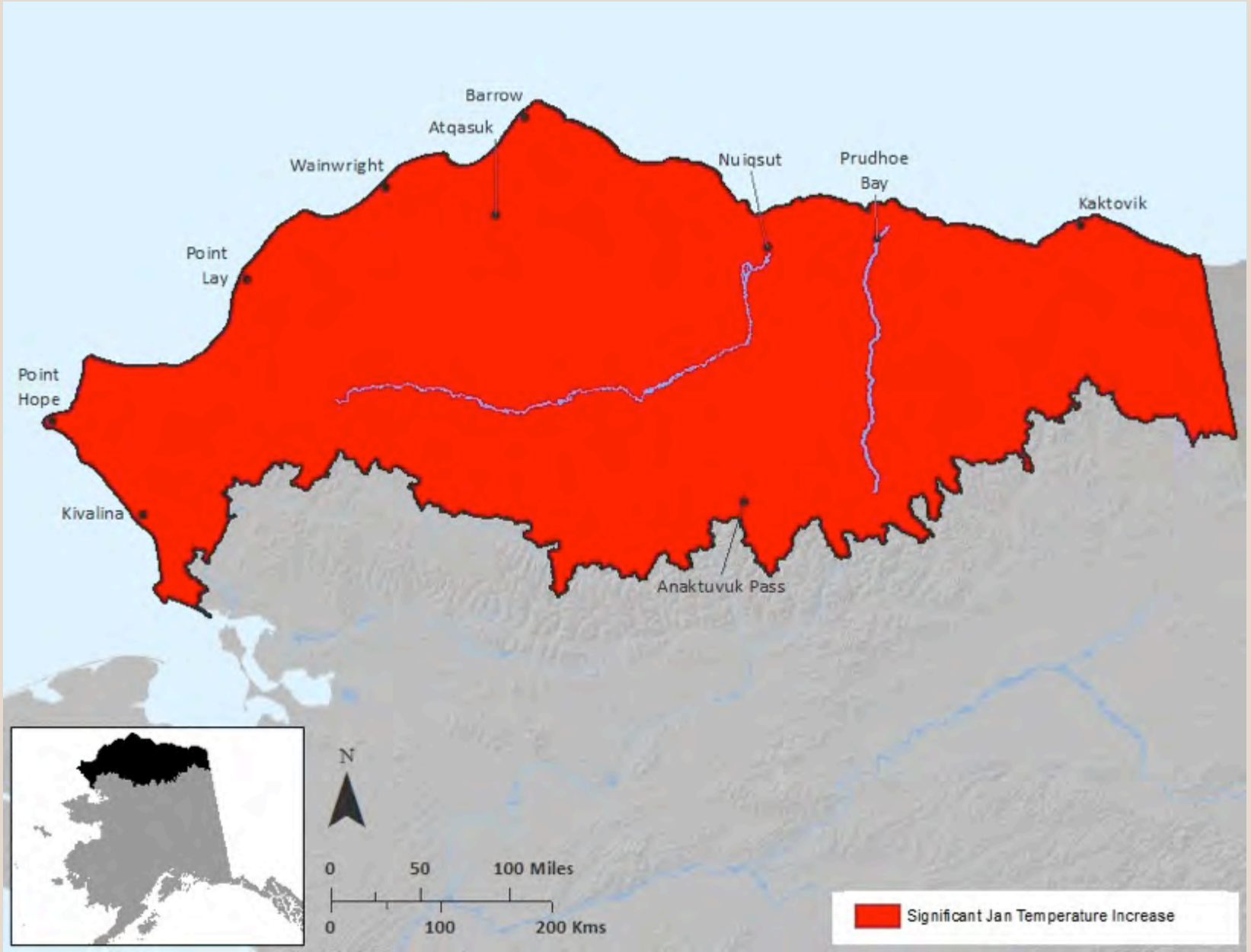
Near-Term Significant Change



Cumulative Impacts by 2025



Long-Term Significant Change



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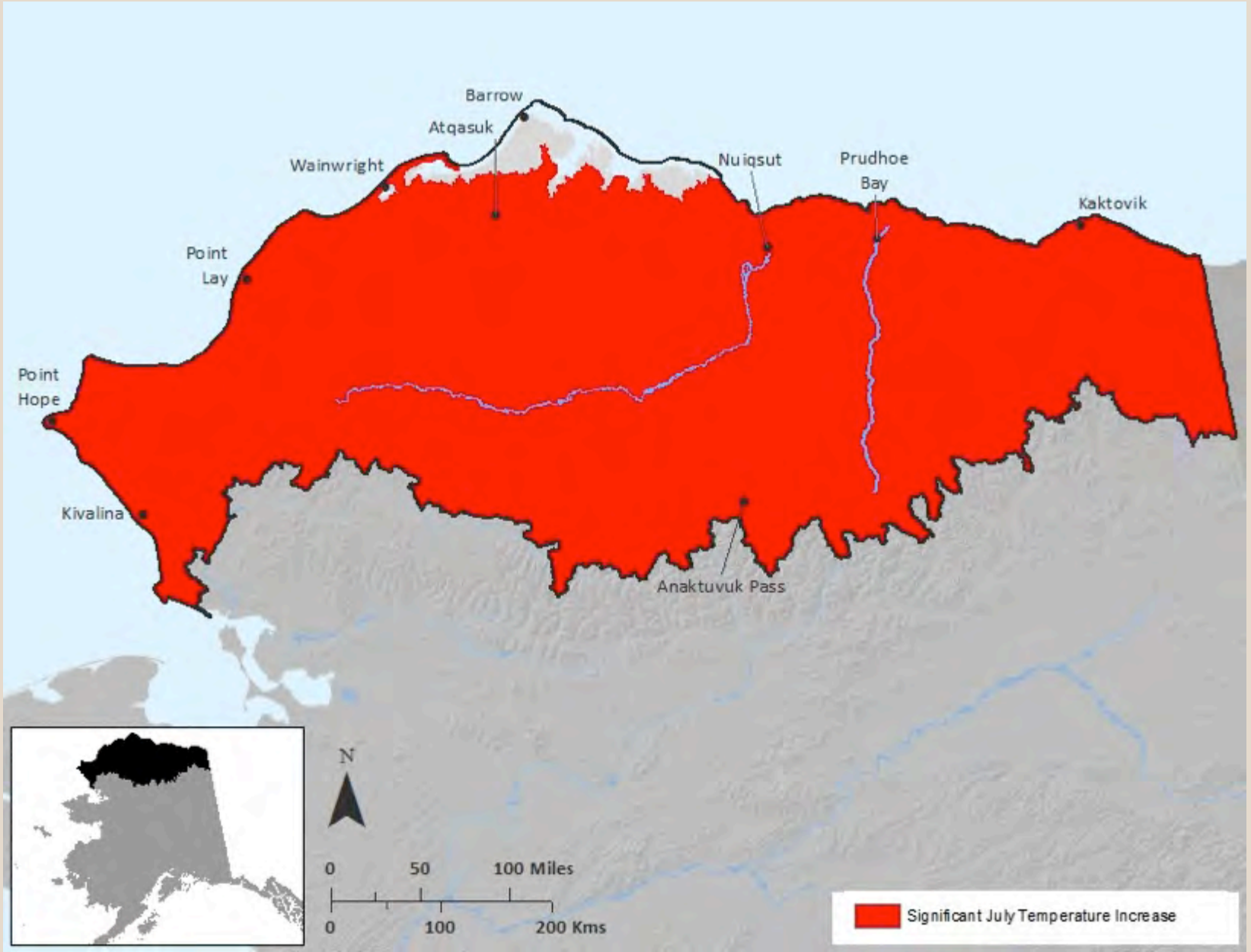

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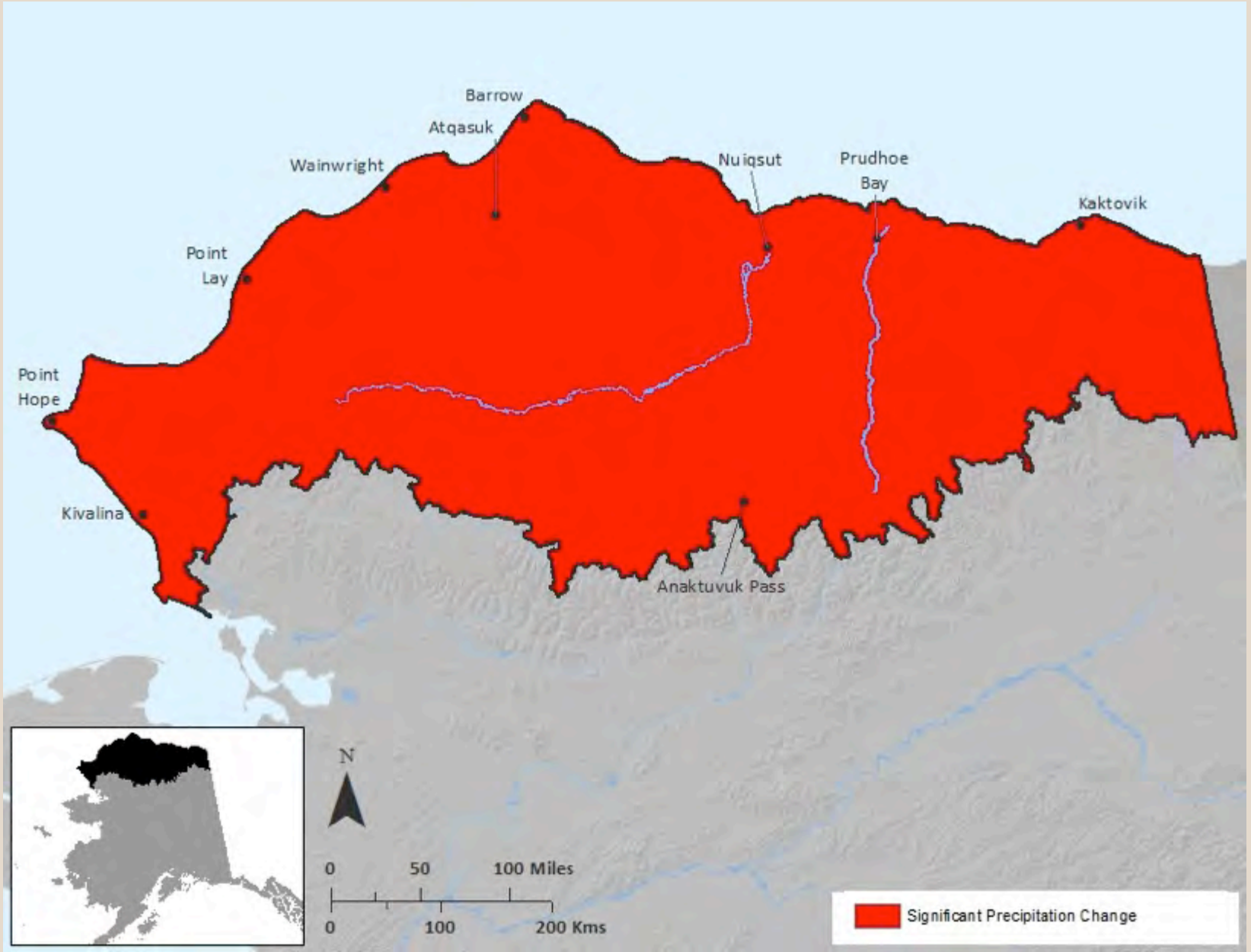

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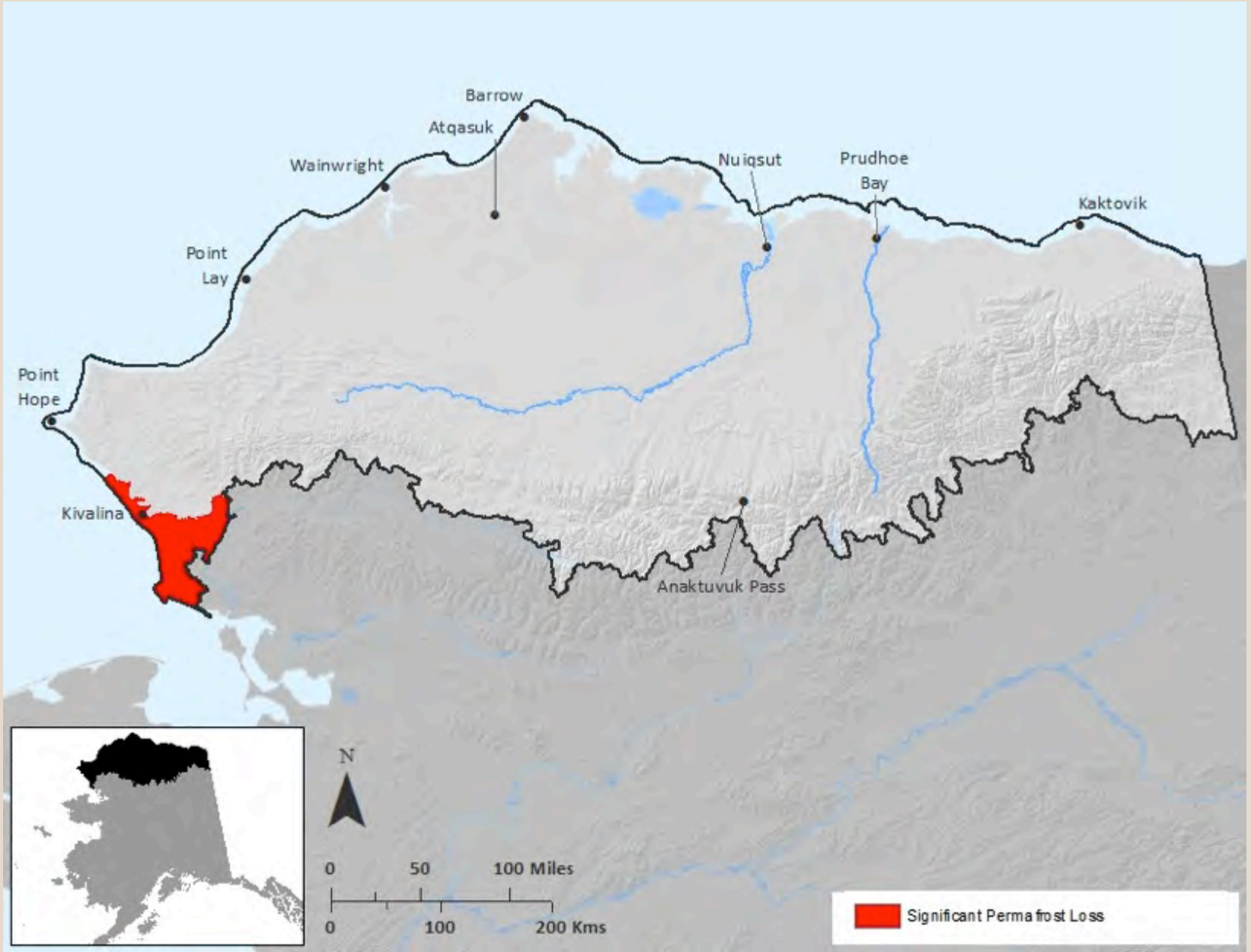

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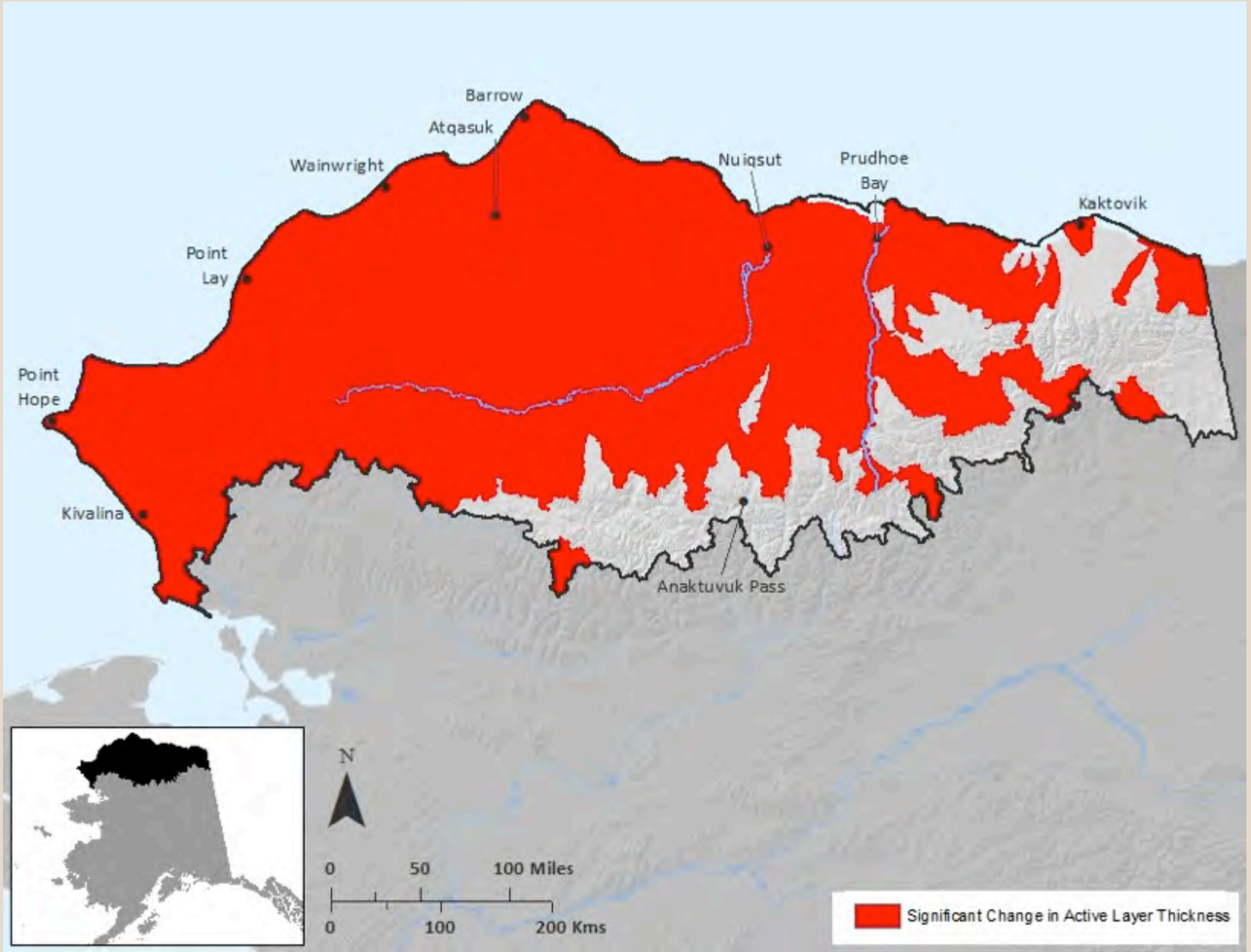

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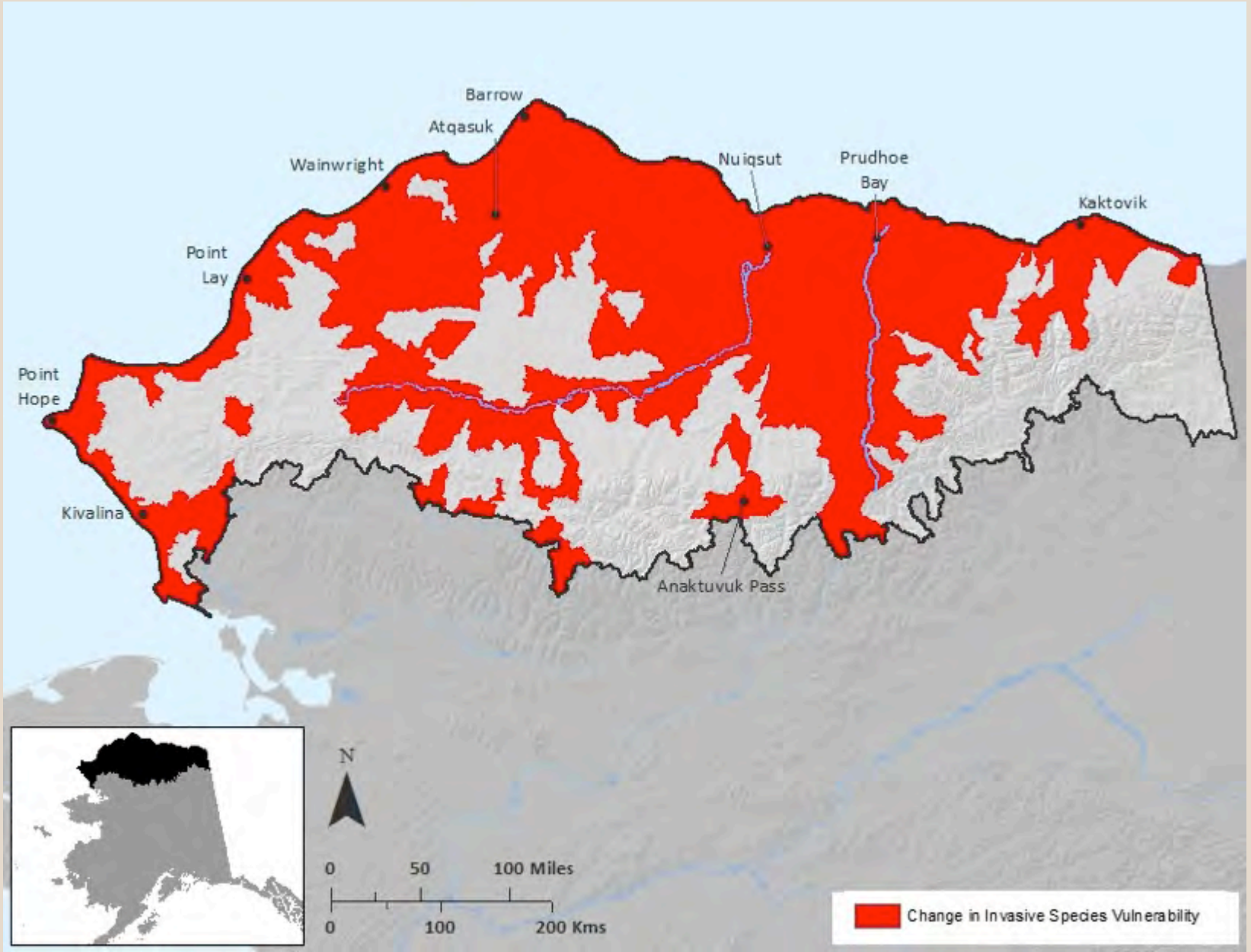
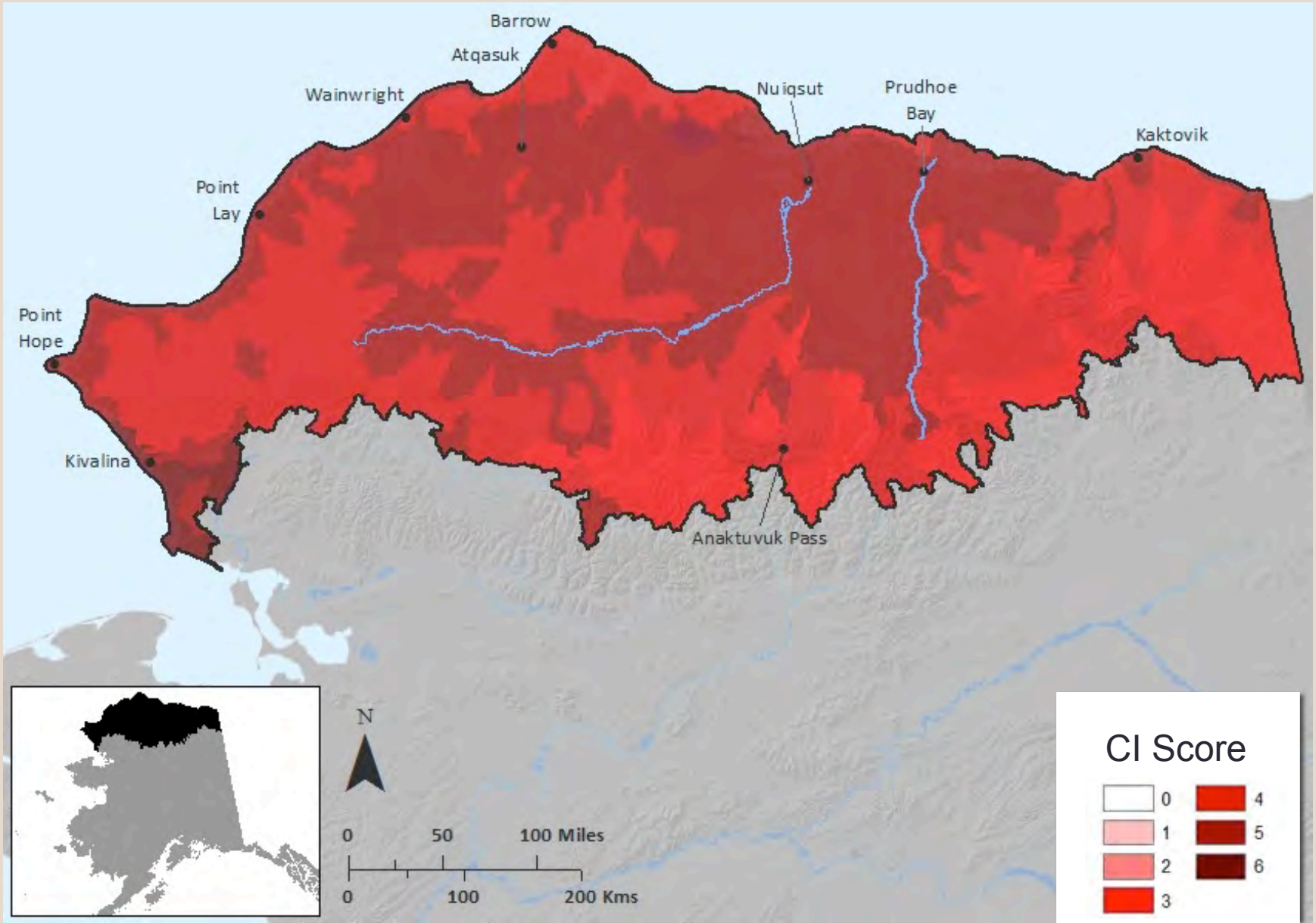


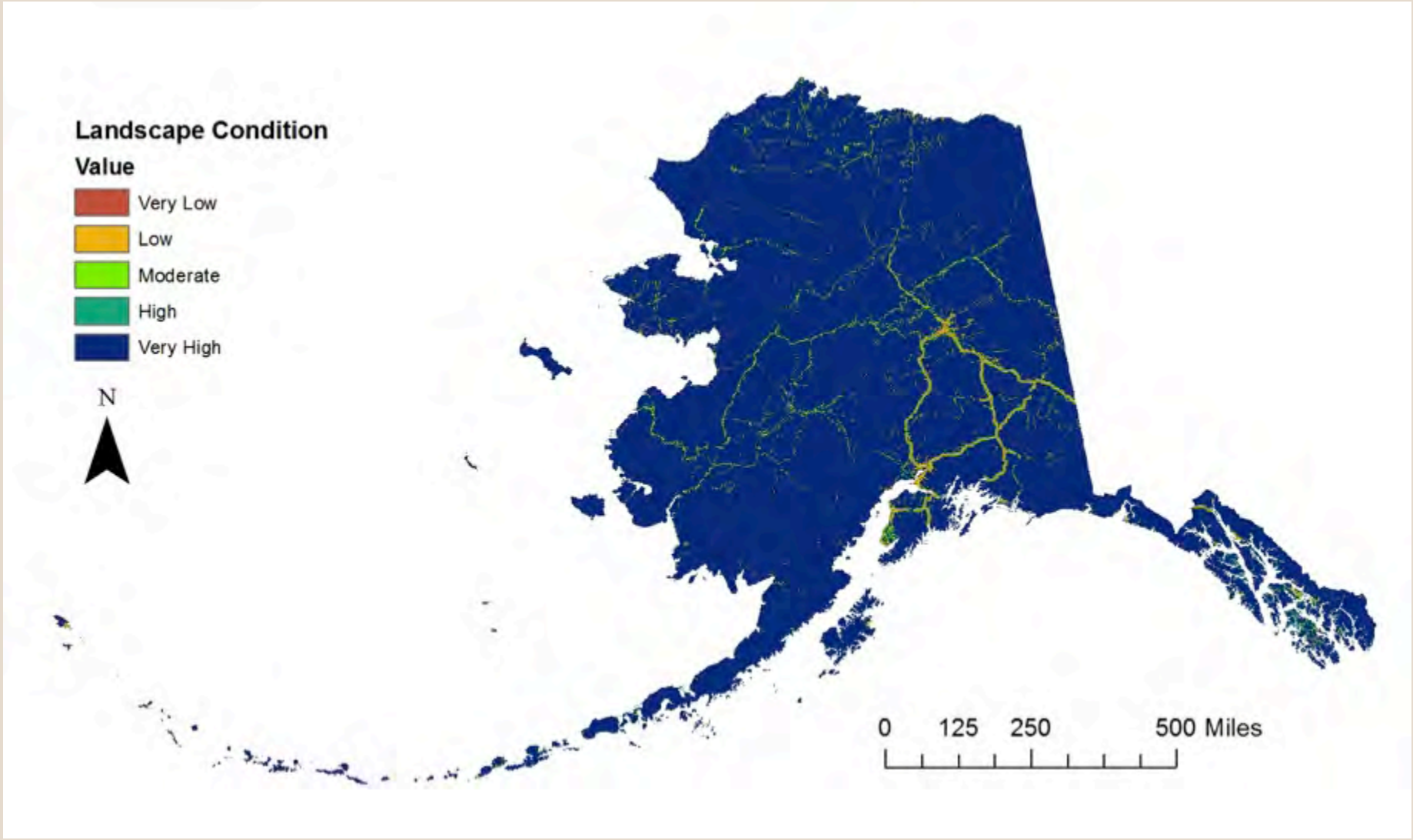
Cumulative Impacts by 2060



Role of CIM in ABC Recommendations

- This tool highlights areas that are most likely to experience rapid and fundamental change
  - Monitor to understand the mechanistic changes occurring with the cumulative impacts
  - Compare to key ecosystem resources, focal species, etc

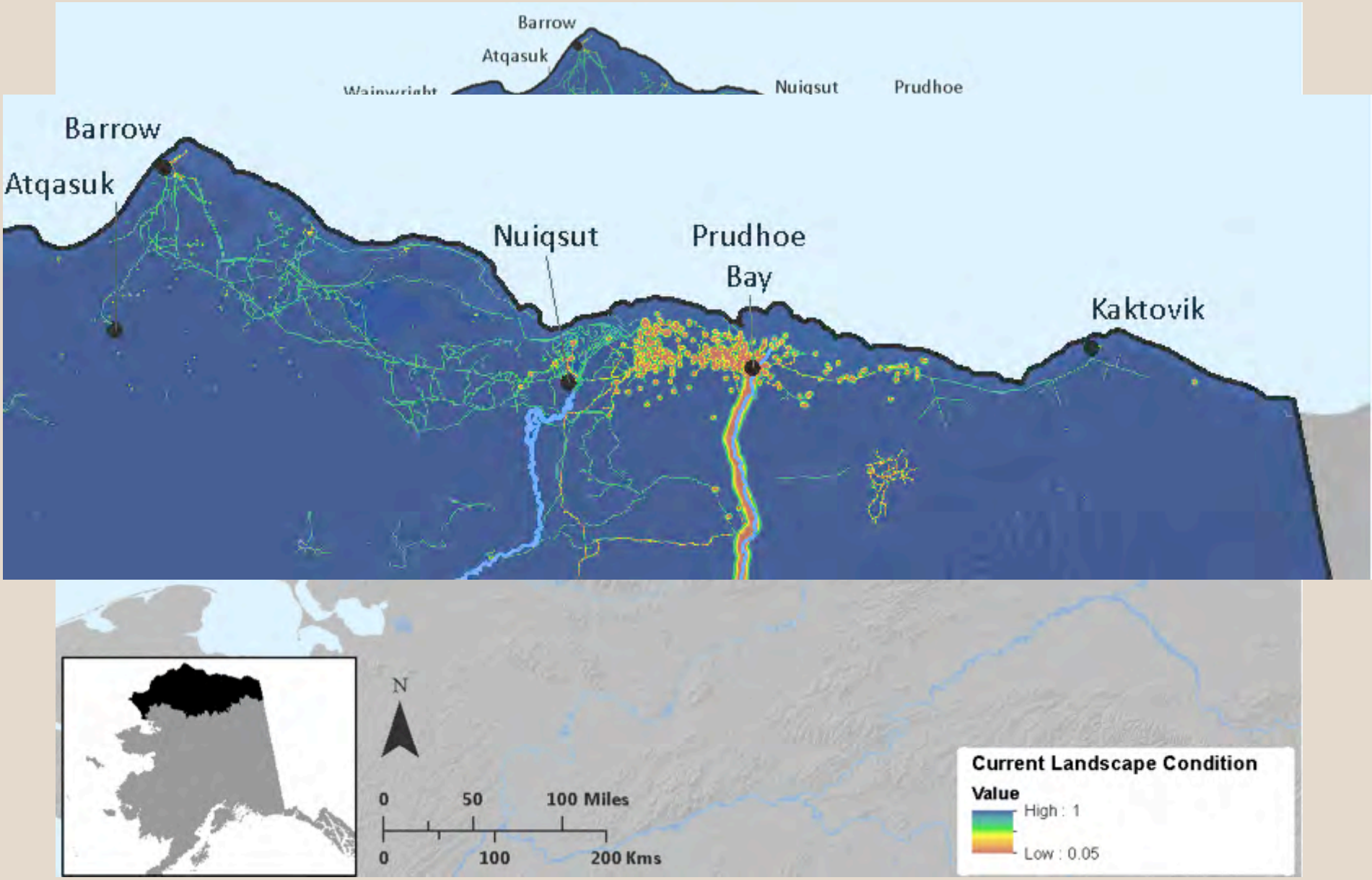
Landscape Condition Model



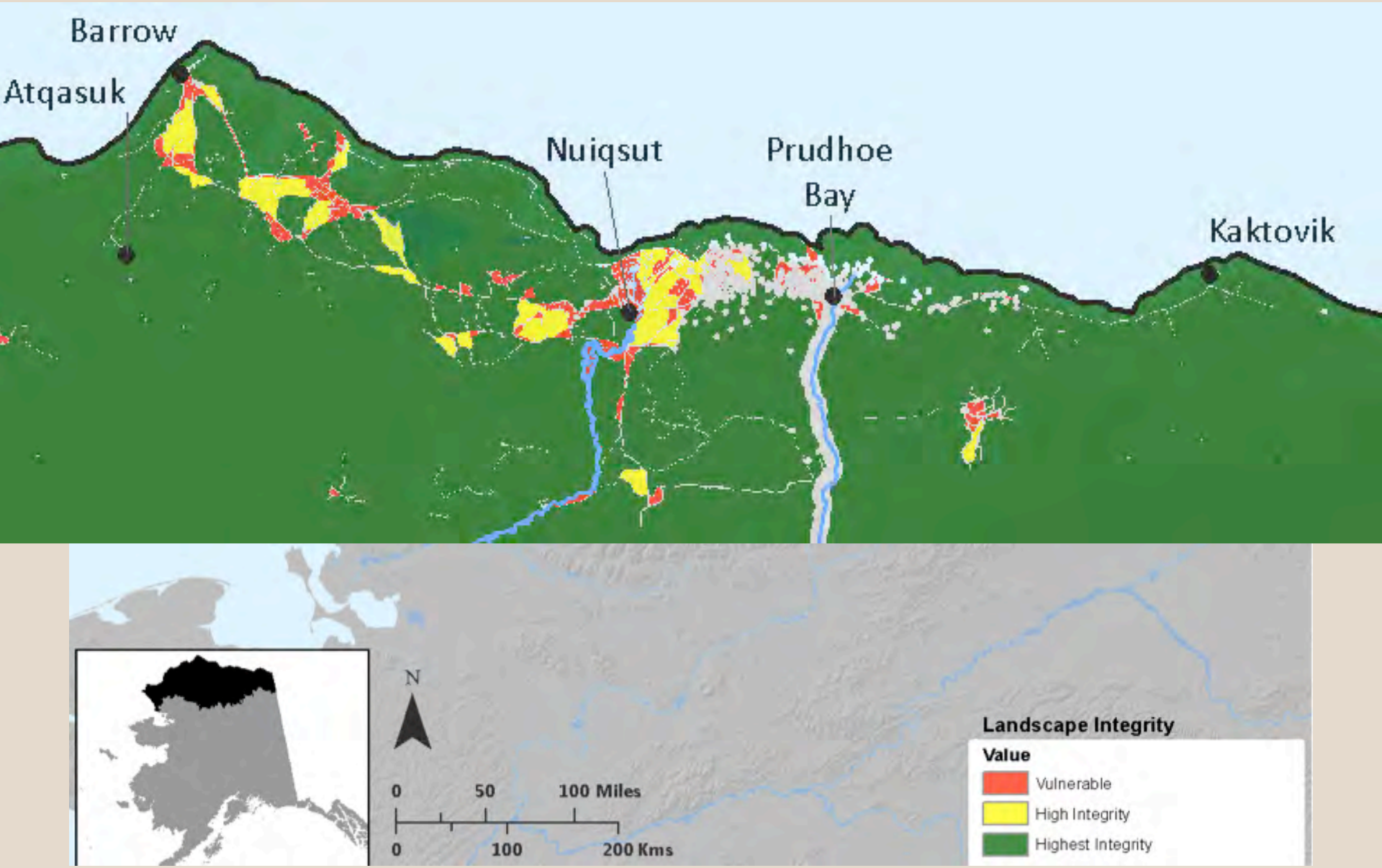
Landscape Condition Model

Theme	Data Source	Site Impact Score	Presumed Relative Stress	Decay Score	Impact Approaches Negligible
Transportation					
Dirt roads, 4-wheel drive	ESRI StreetMap 2010	0.7	Low	0.5	200m
Local and connecting roads	ESRI StreetMap 2010	0.5	Medium	0.5	200m
Managed and Modified Land Cover					
Ruderal Forest & Upland	SW ReGAP, NW ReGAP, LANDFIRE EVT	0.9	Very Low	1	0m
Native Veg. with introduced Species	SW ReGAP, NW ReGAP, LANDFIRE EVT	0.9	Very Low	1	0m
Recently Logged	SW ReGAP, NW ReGAP, LANDFIRE EVT	0.9	Very Low	0.5	200m
Managed Tree Plantations	SW ReGAP, NW ReGAP, LANDFIRE EVT	0.8	Low	0.5	200m
Introduced Tree & Shrub	SW ReGAP, NW ReGAP, LANDFIRE EVT	0.5	Medium	0.5	200m
Introduced Upland grass & forb	SW ReGAP, NW ReGAP, LANDFIRE EVT	0.5	Medium	0.5	200m
Introduced Wetland	SW ReGAP, NW ReGAP, LANDFIRE EVT	0.3	High	0.8	125m
Cultivated Agriculture	SW ReGAP, NW ReGAP, LANDFIRE EVT	0.3	High	0.5	200m

Landscape Condition



Landscape Integrity



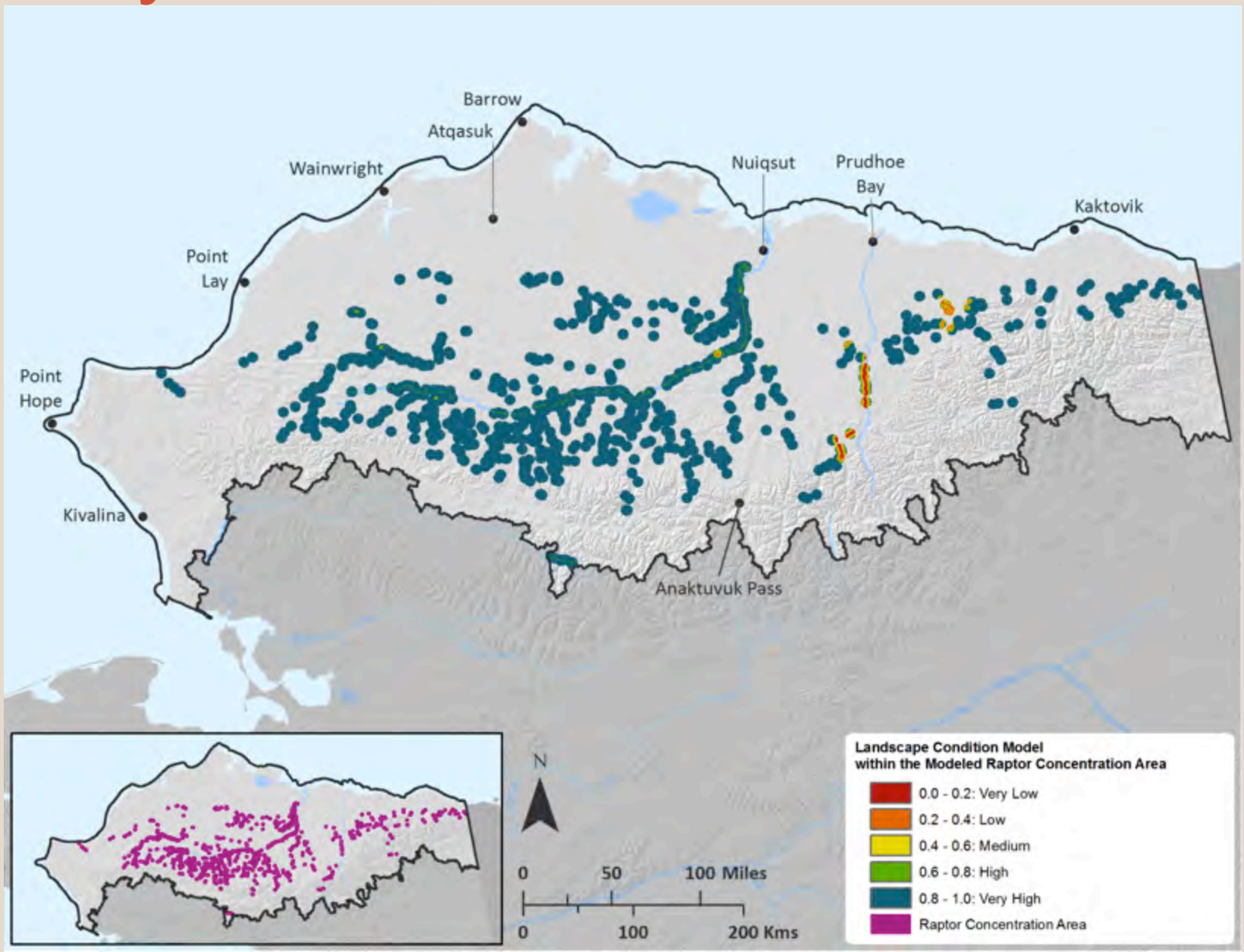
Conclusion

- Rapid Ecoregional Assessments providing much of the baseline requested by the ABA
- Cumulative impacts and landscape condition provide spatial information about important monitoring and conservation opportunities for managers
- Addresses the multiple levels of stressors into one comprehensive assessment

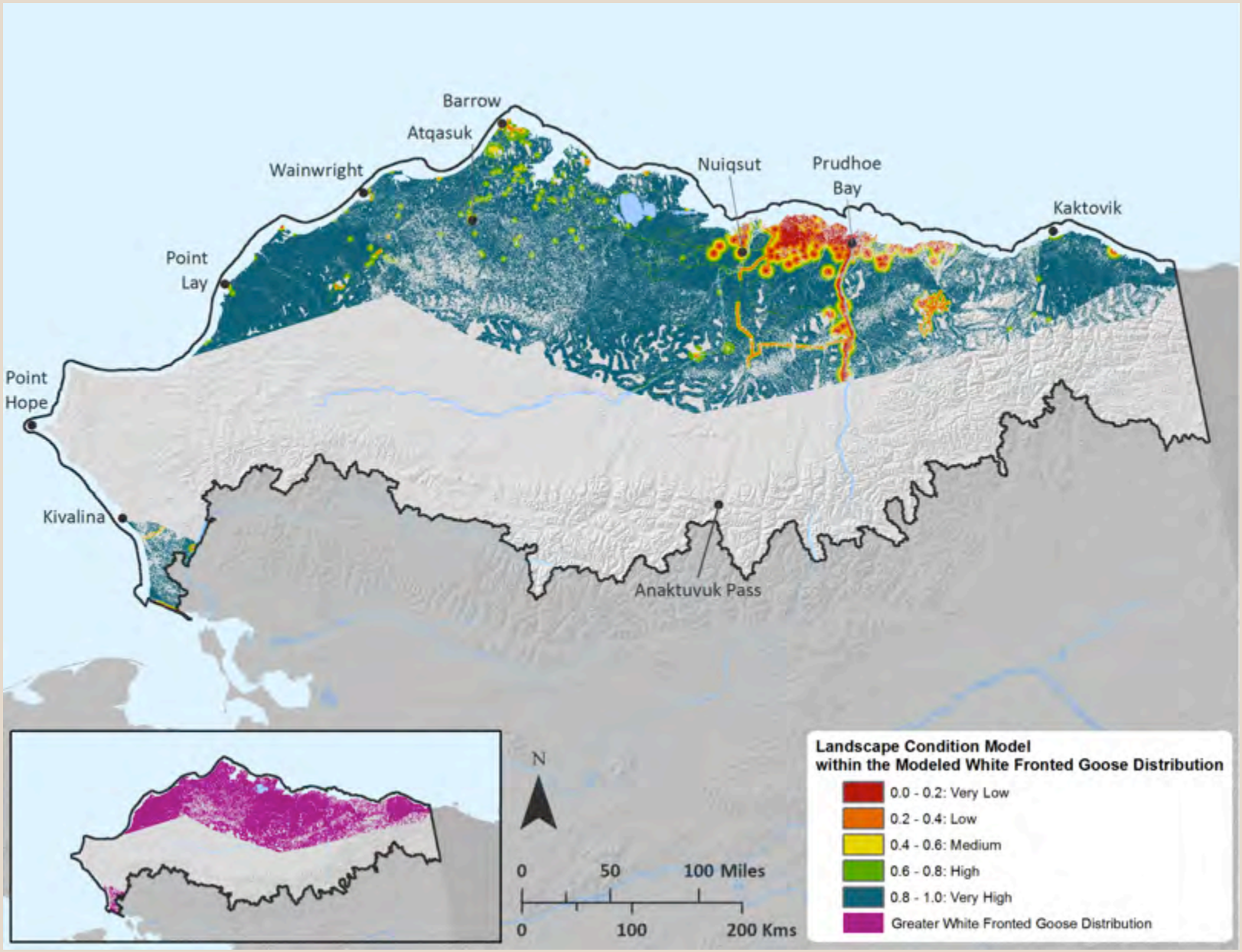
Thanks very much

Questions?

Ecosystem Intactness



Ecosystem Intactness



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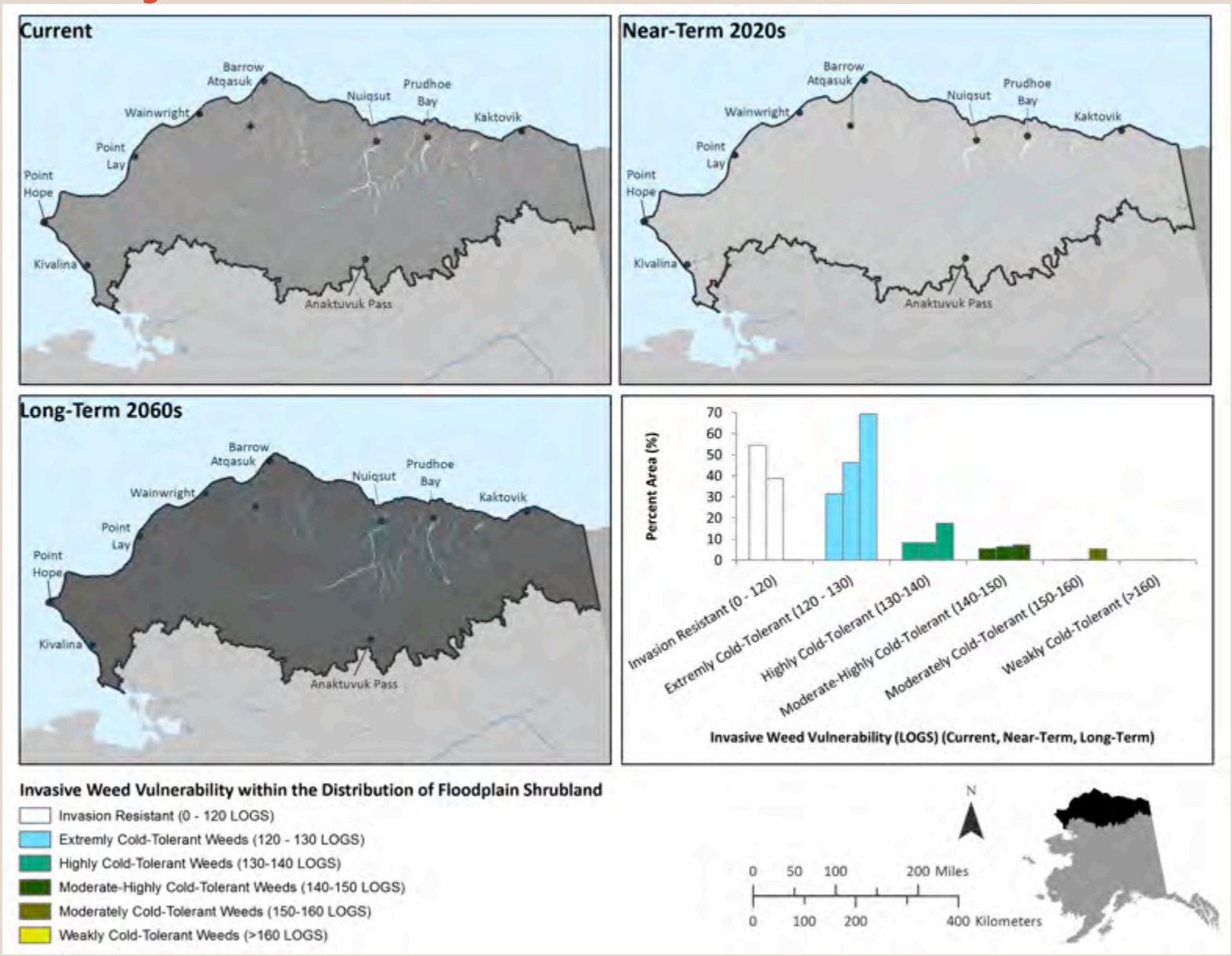

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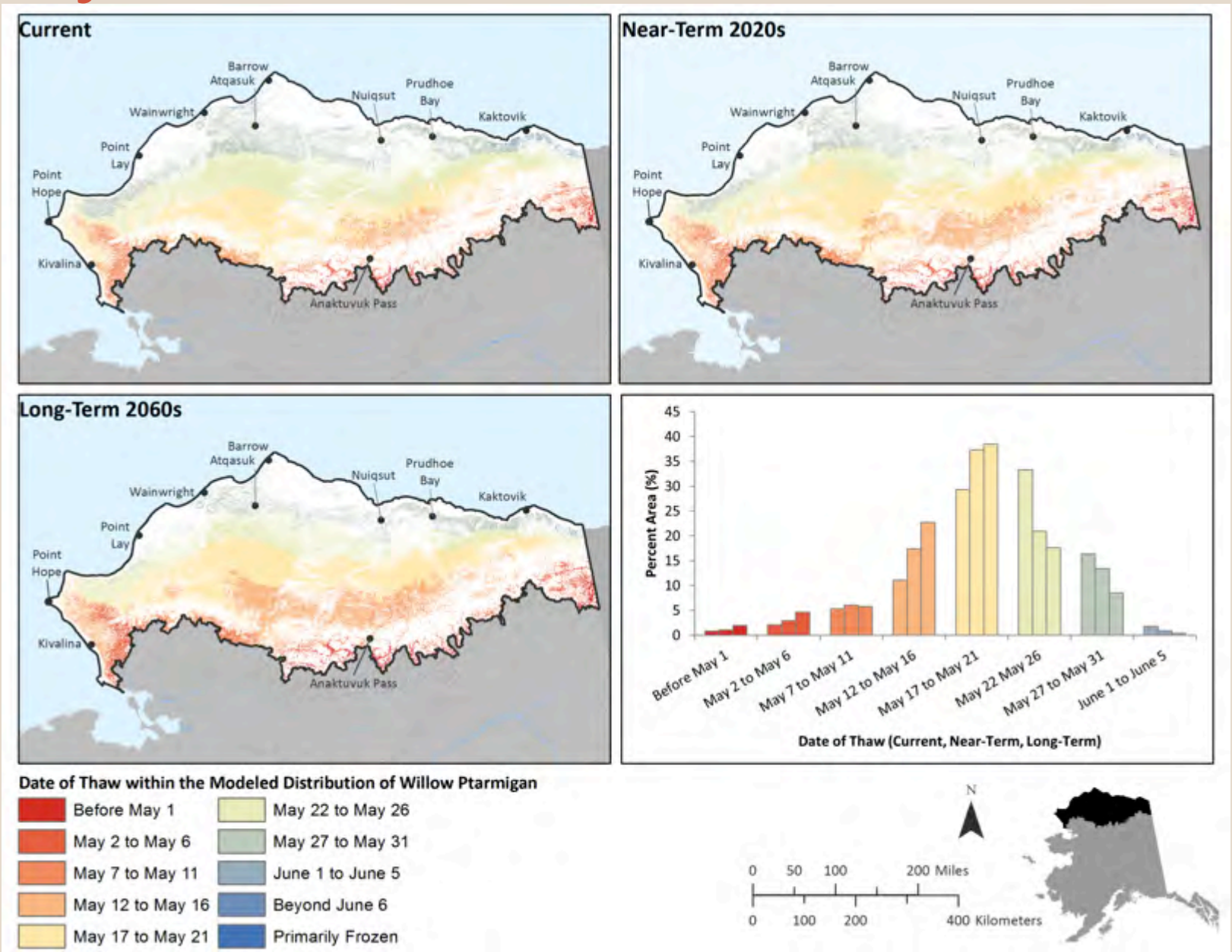

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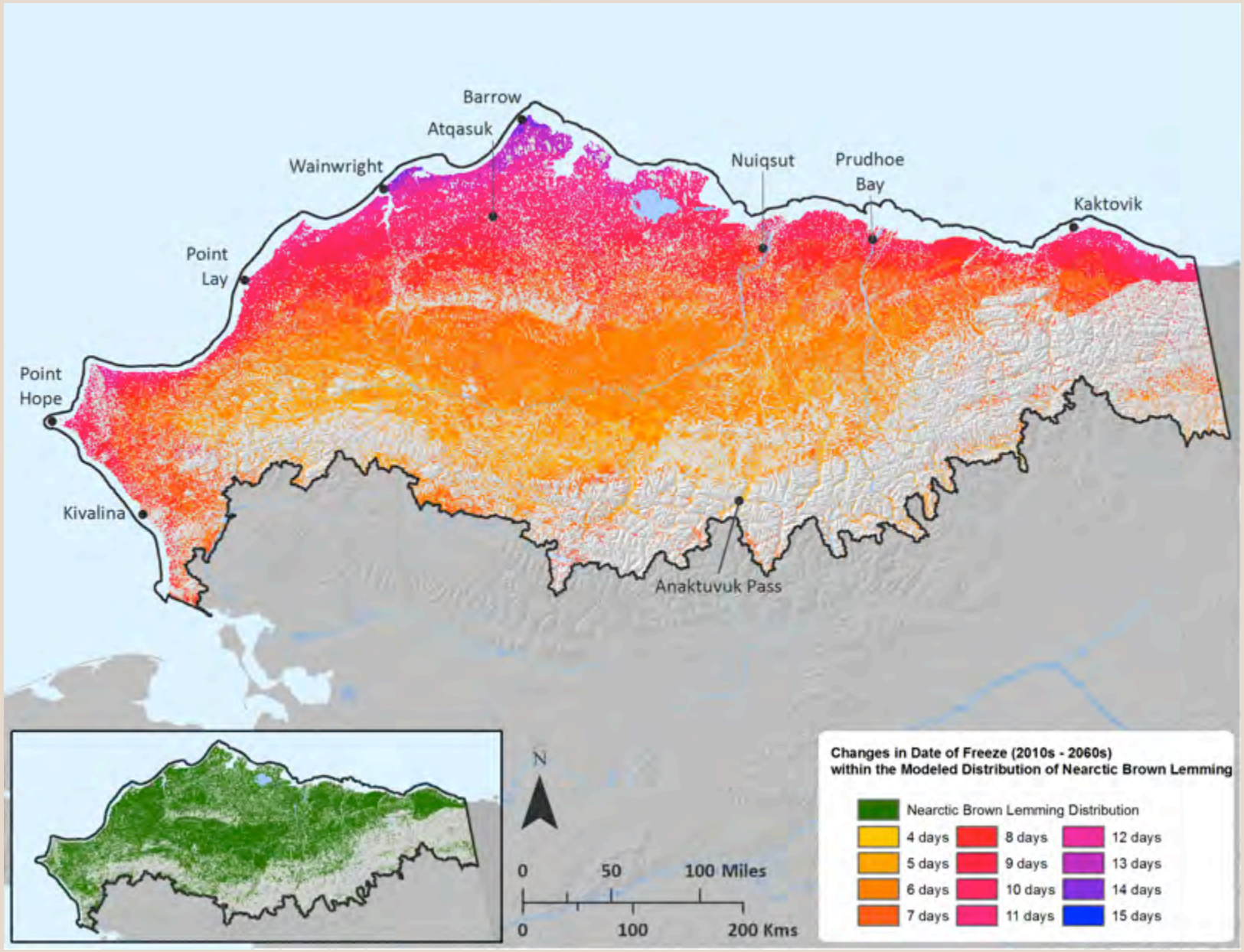

Ecosystem Intactness