Spatial Heterogeneity in Population Trends of Waterfowl Breeding on the Arctic Coastal Plain, Alaska

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Region 7 Migratory Birds

Brandt Meixell, USGS ASC

David Douglas, USGS ASC

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U.S. FISH & WILDLIFE SERVICE

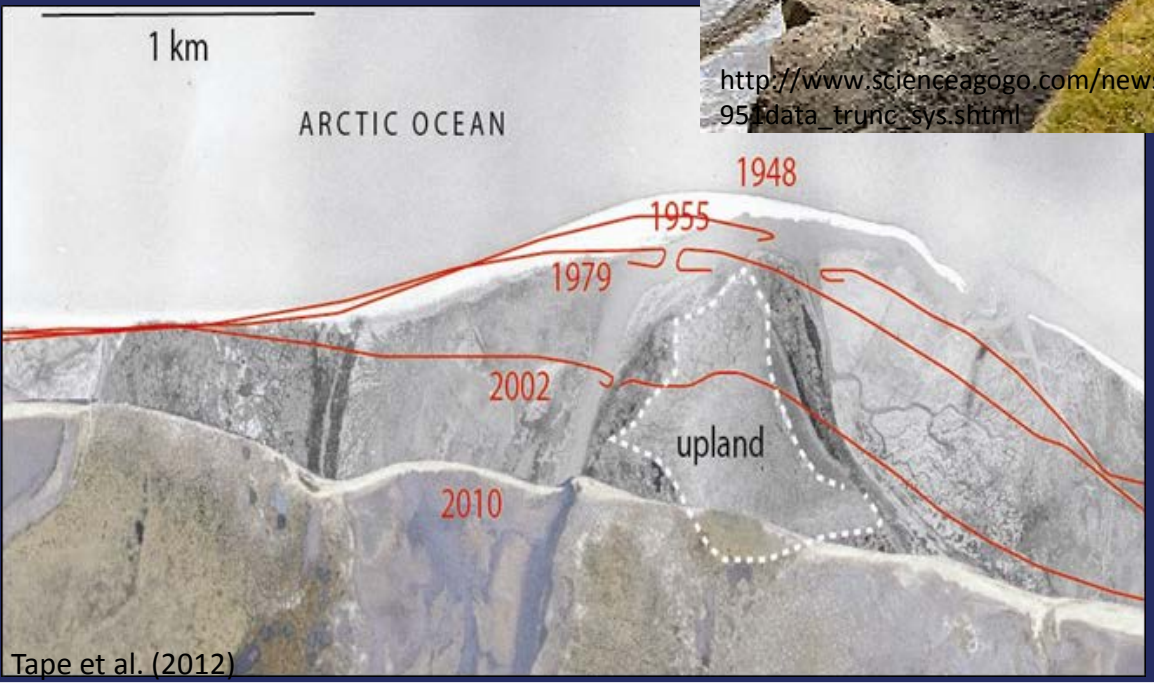
Changing Arctic Ecosystems

USGS High Powered Computing Center

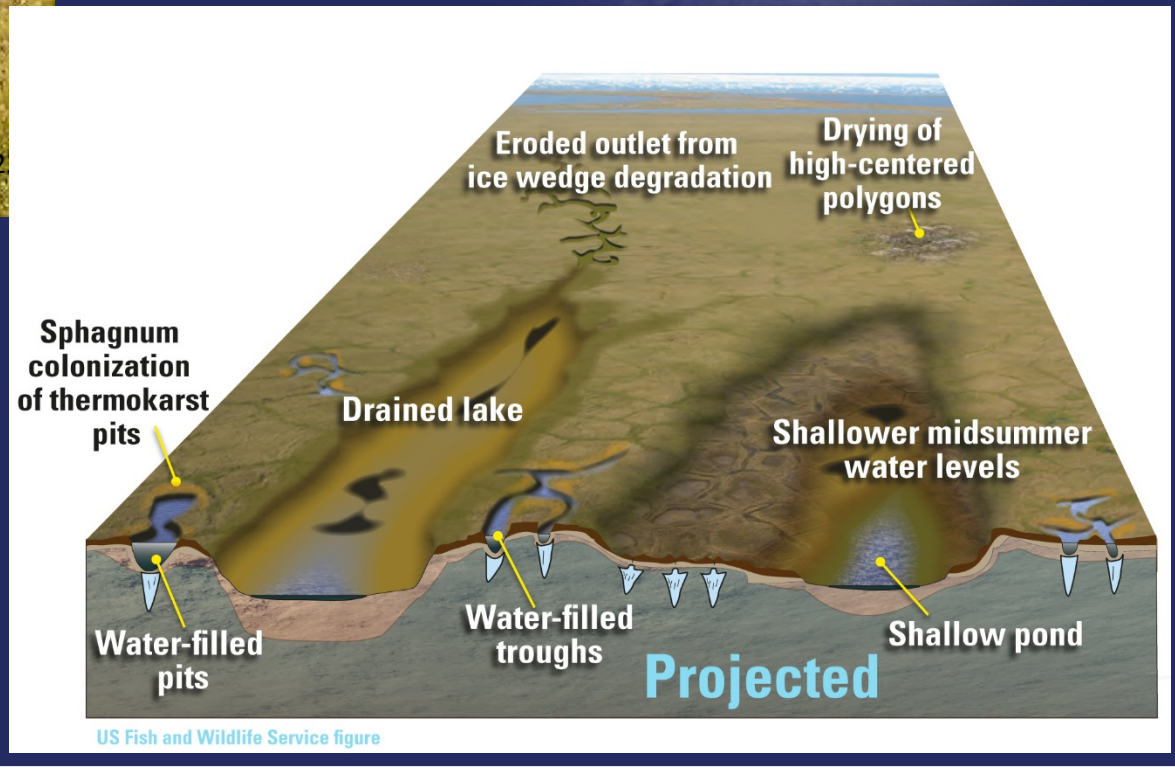
Photos: Thomas Riecke, Brandt Meixell, and the internet

Changes to the Landscape

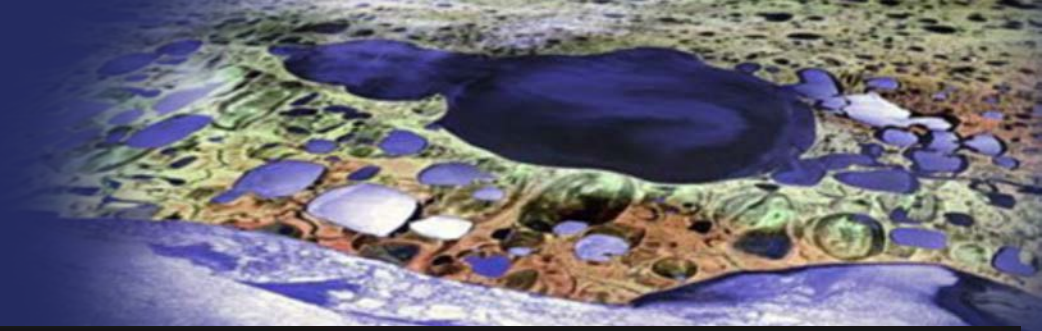
http://www.scienceagogo.com/news/200911142
951data_trunc_sys.shtml



Tape et al. (2012)



Waterfowl-thermokarst Associations



- **Shallow thermokarst lakes**

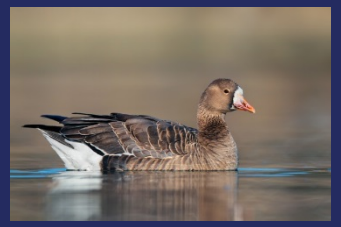
(Especially those with islands)

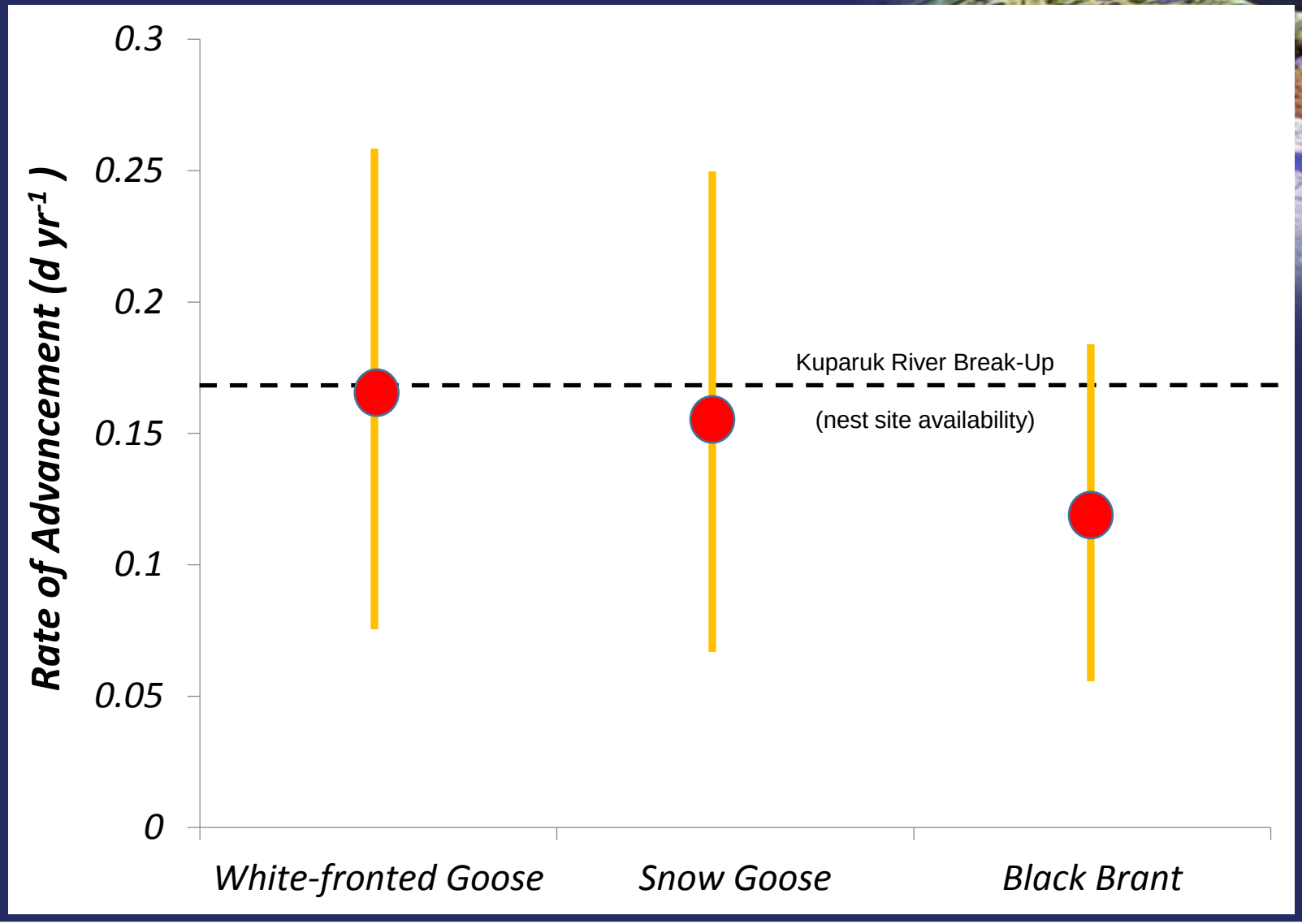
  - All waterfowl
  - Molting geese typically select larger, deeper lakes

- **Coastal erosion and subsidence**
  - Geese
- **Pits, water tracks, and troughs**
  - Snow geese preferentially fed on cottongrass near these features (Hupp and Robertson 1998)
- **Uplands, low center polygons, wet meadows, and strangmoor**
  - Snow geese (Hupp and Robertson 1998)

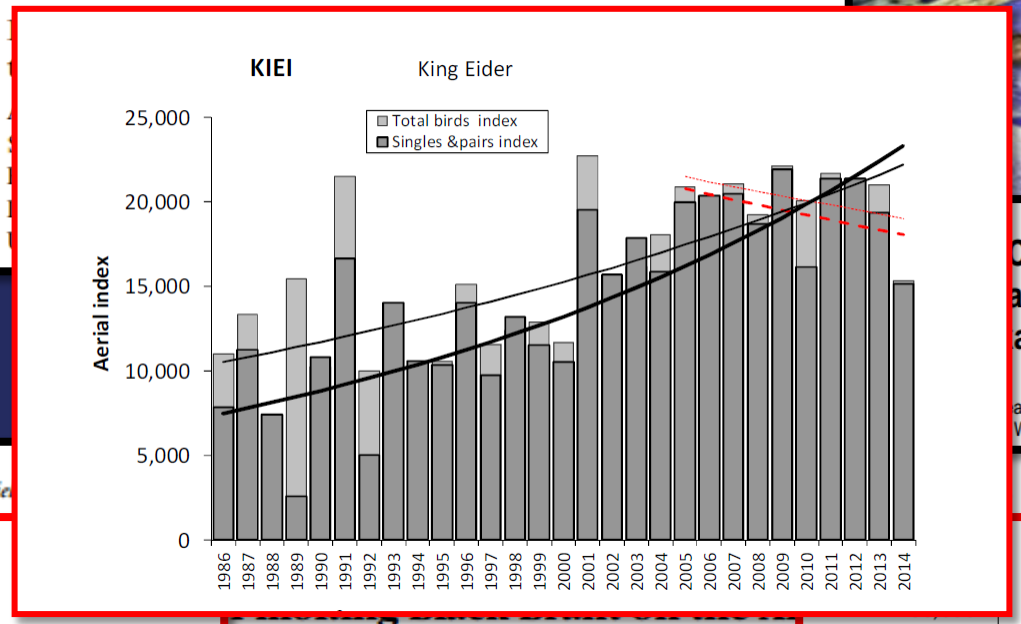
Rate of Advancement for First Arrival, 1973-2013

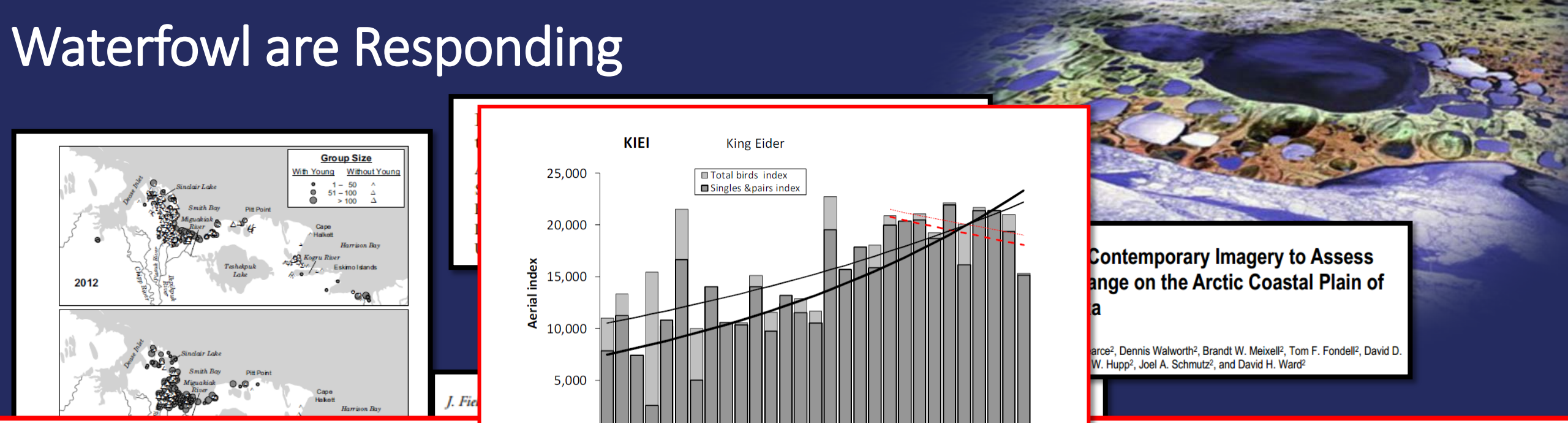
Data from Jim and Teena Helmericks; slide from D. Ward

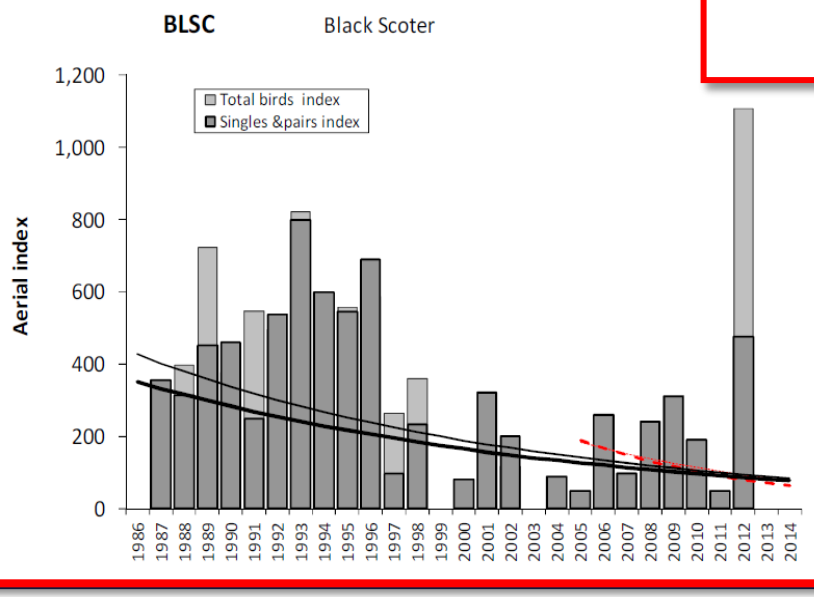


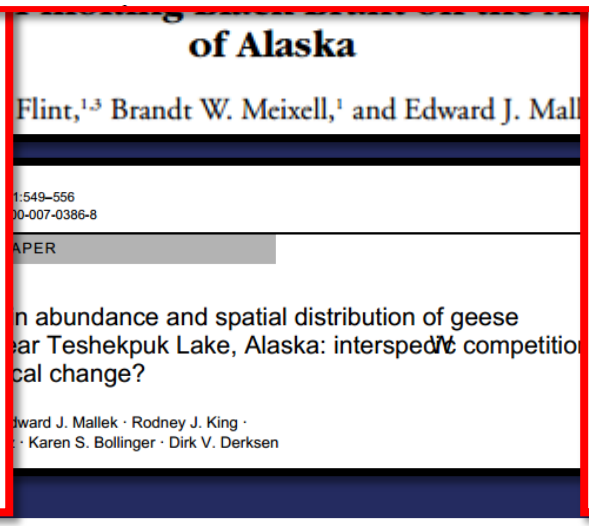


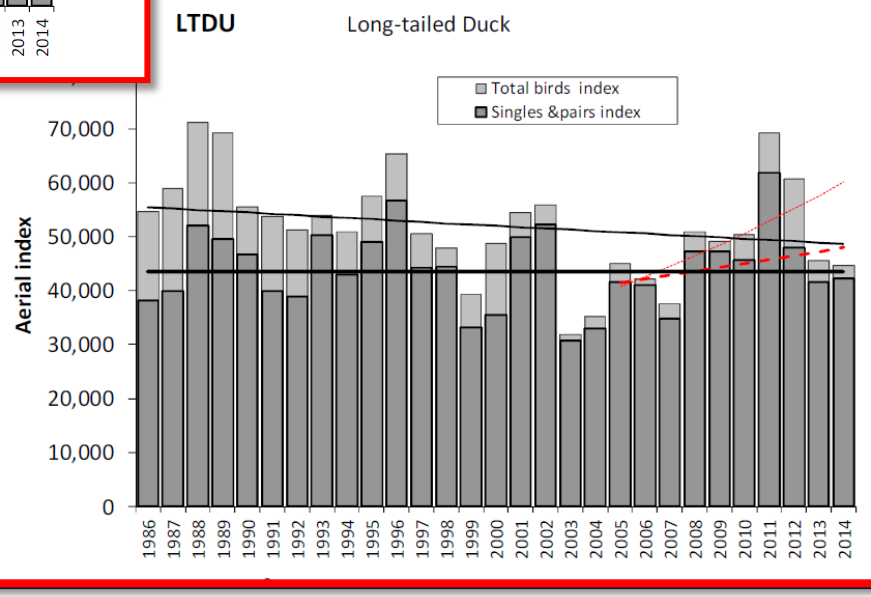
Waterfowl are Responding











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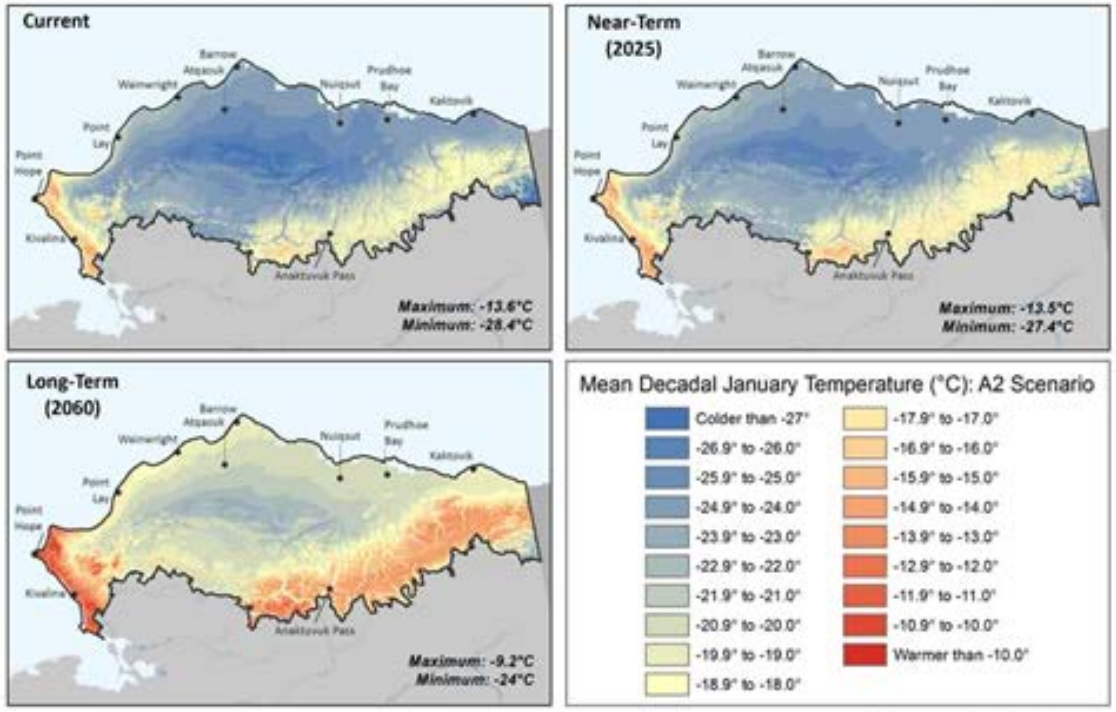
Climate Modeling by SNAP @ UAF

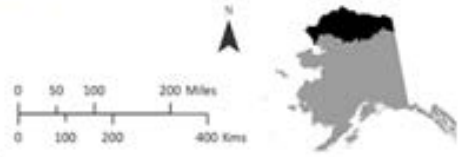
(Courtesy of Nancy Fresco)

By 2060, a predicted 10-16 day increase in growing season length on the ACP

Climate



Significant long-term warming is predicted across the REA, particularly in the winter. Inland areas will experience more summer warming than coastal areas, whereas winter warming will be greatest to the east, with a shift of about 8°F by the 2060s.



BLM Rapid Ecoregional Assessment

Unresolved Questions

Larned et al. 2007; greater white-fronted geese

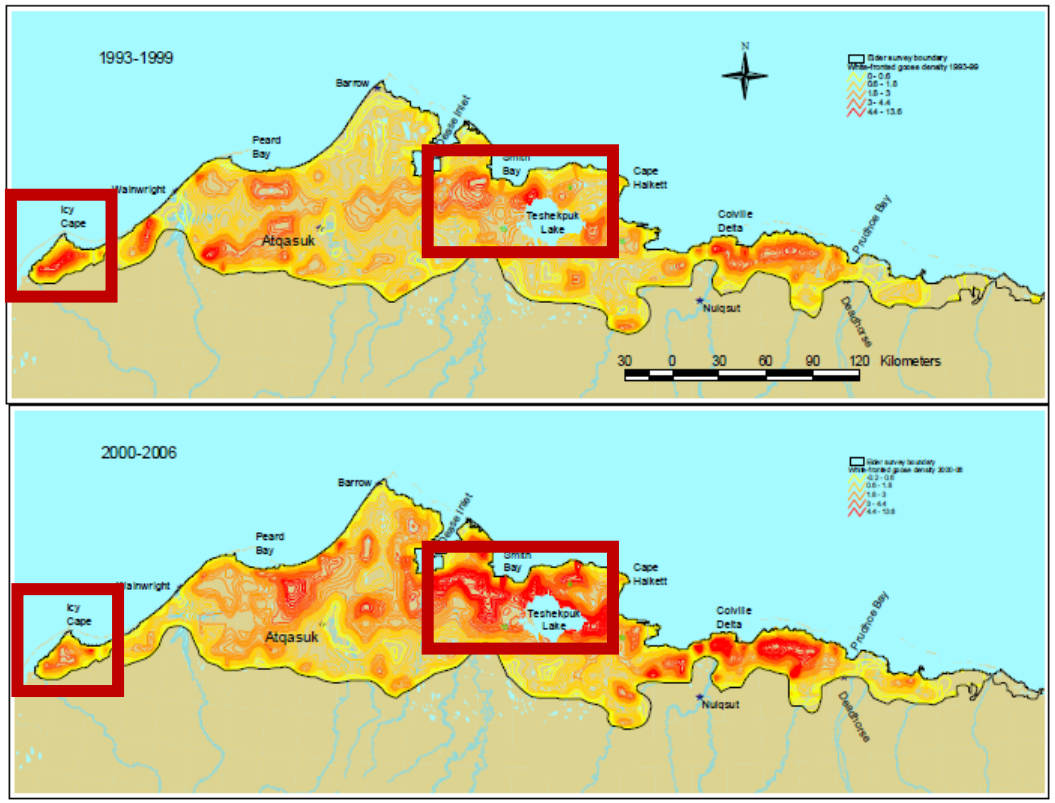
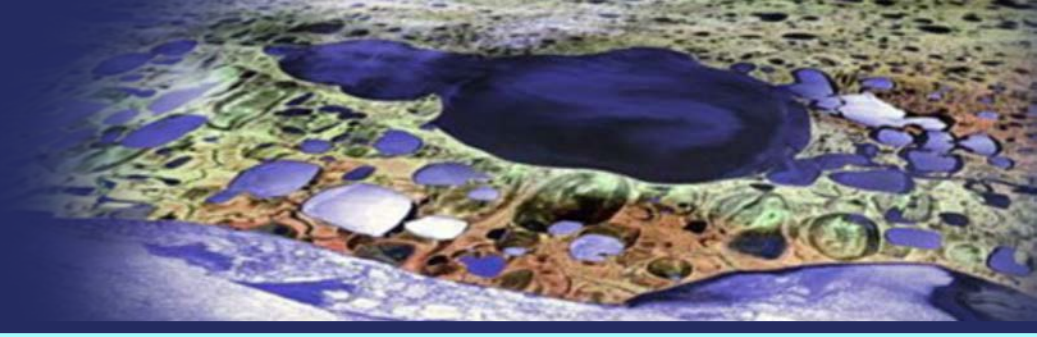


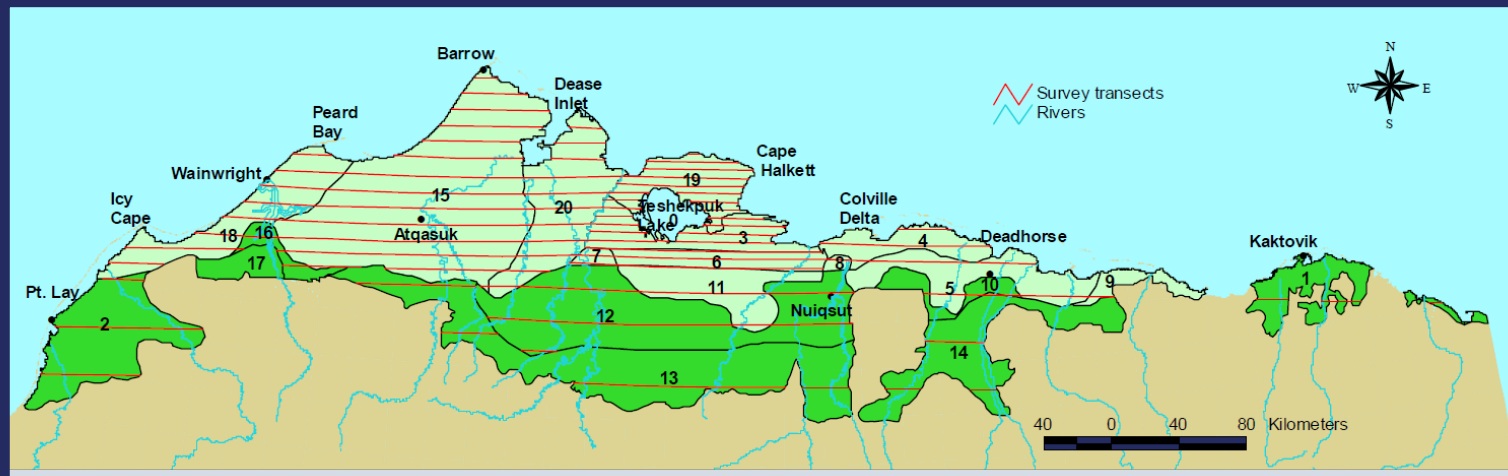
Figure 31. Mean white-fronted goose breeding densities, Alaska Arctic Coastal Plain, 1993-99 (above) and 2000-06 (below).

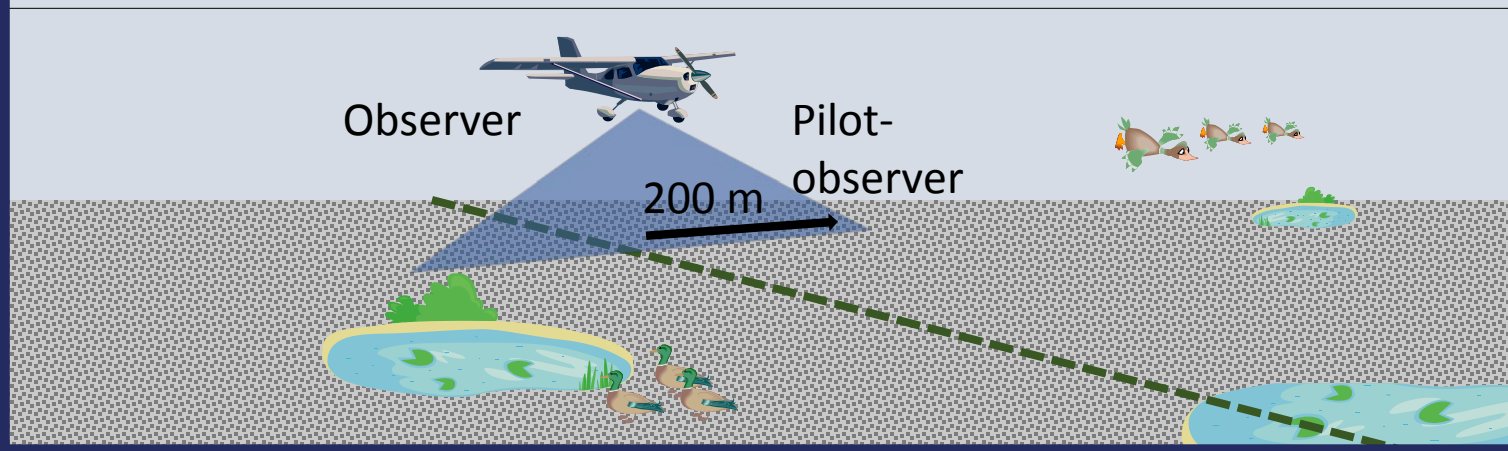
- Is population change homogenous across the ACP?
  - If not, what mechanisms might explain spatial variation in trends?
- What habitats are breeding waterfowl selecting?

USFWS ACP Breeding Waterfowl Aerial Survey



- 1986 to present
- Early June to mid-July
- Counts all waterfowl and waterbirds along east-west transects





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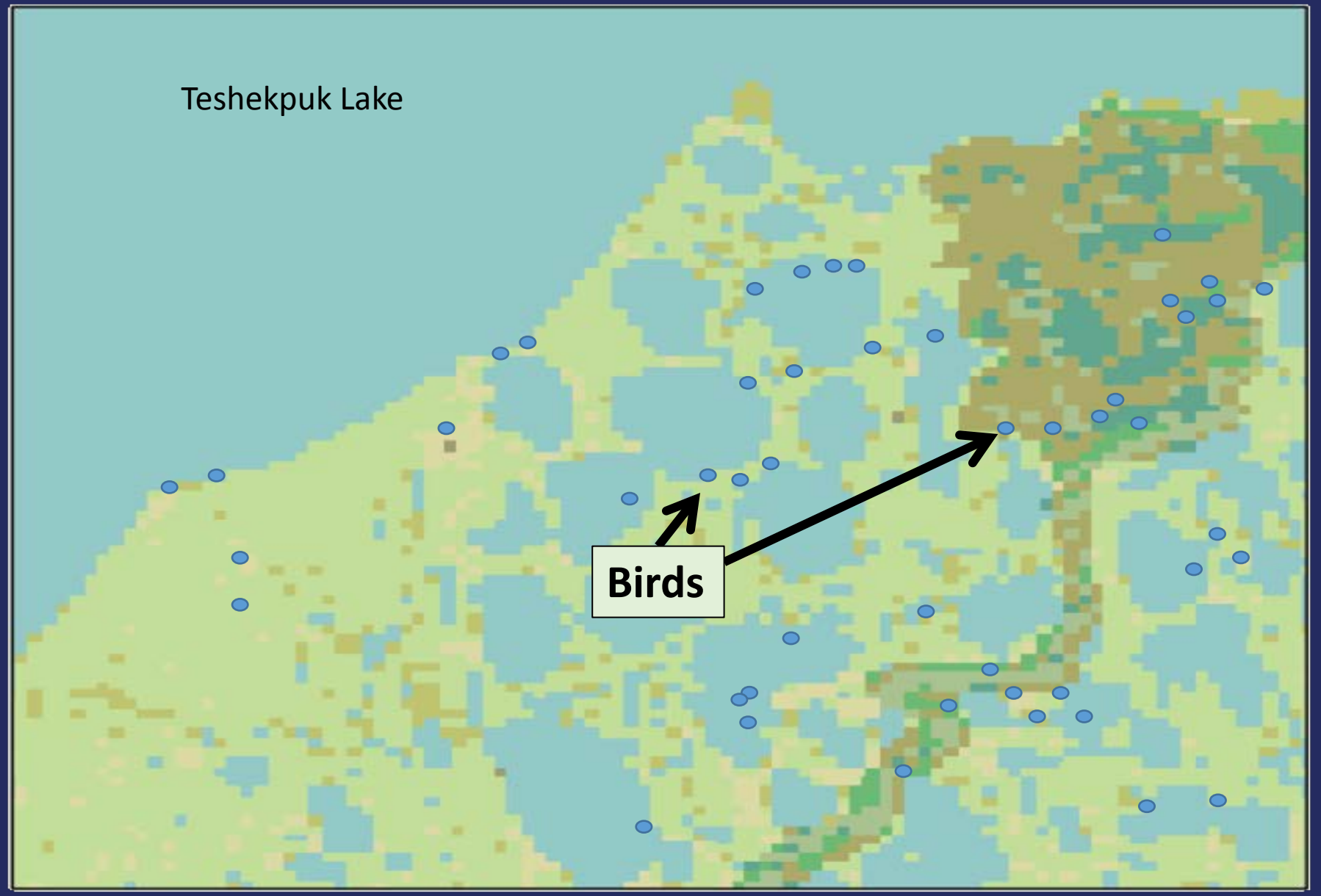
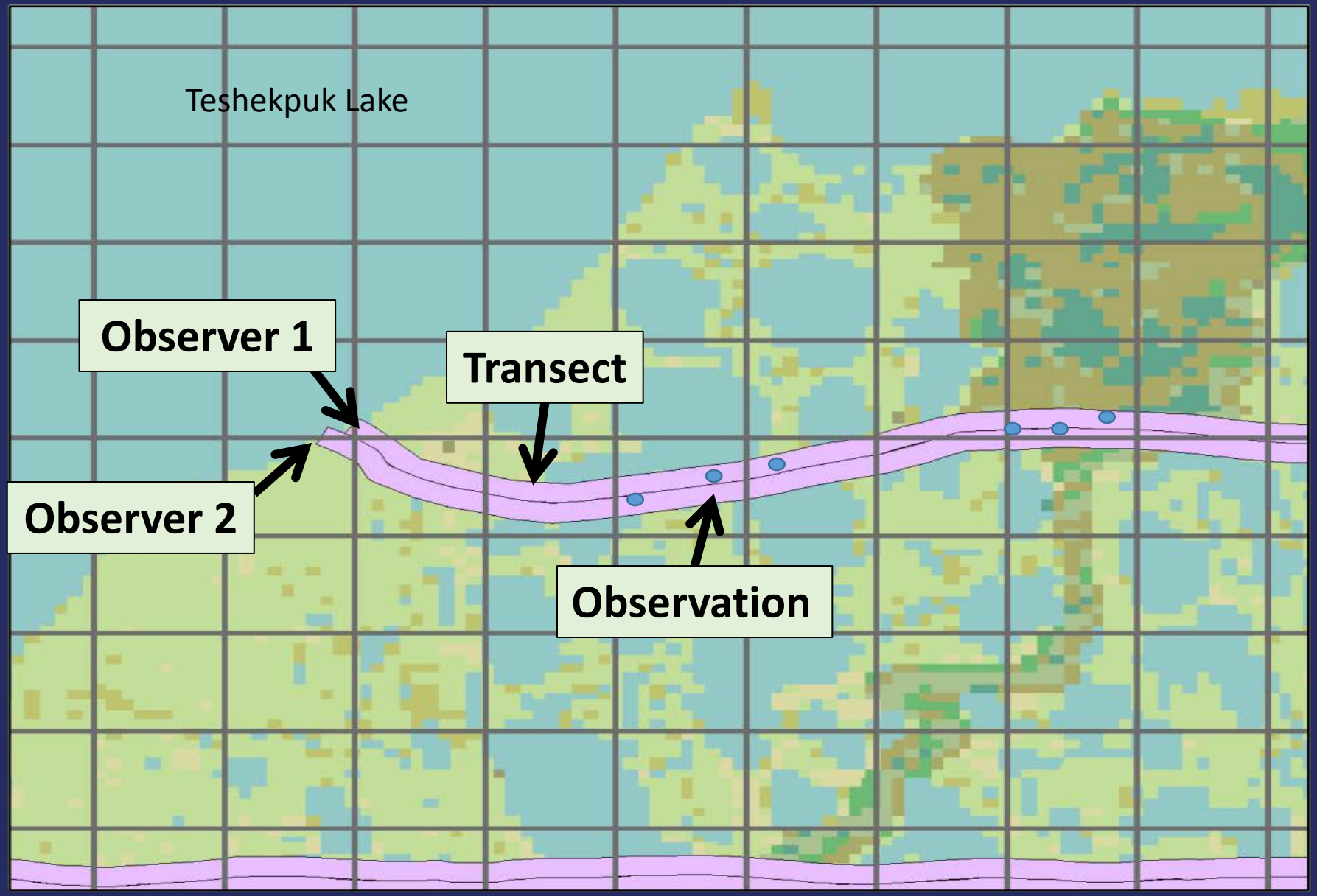
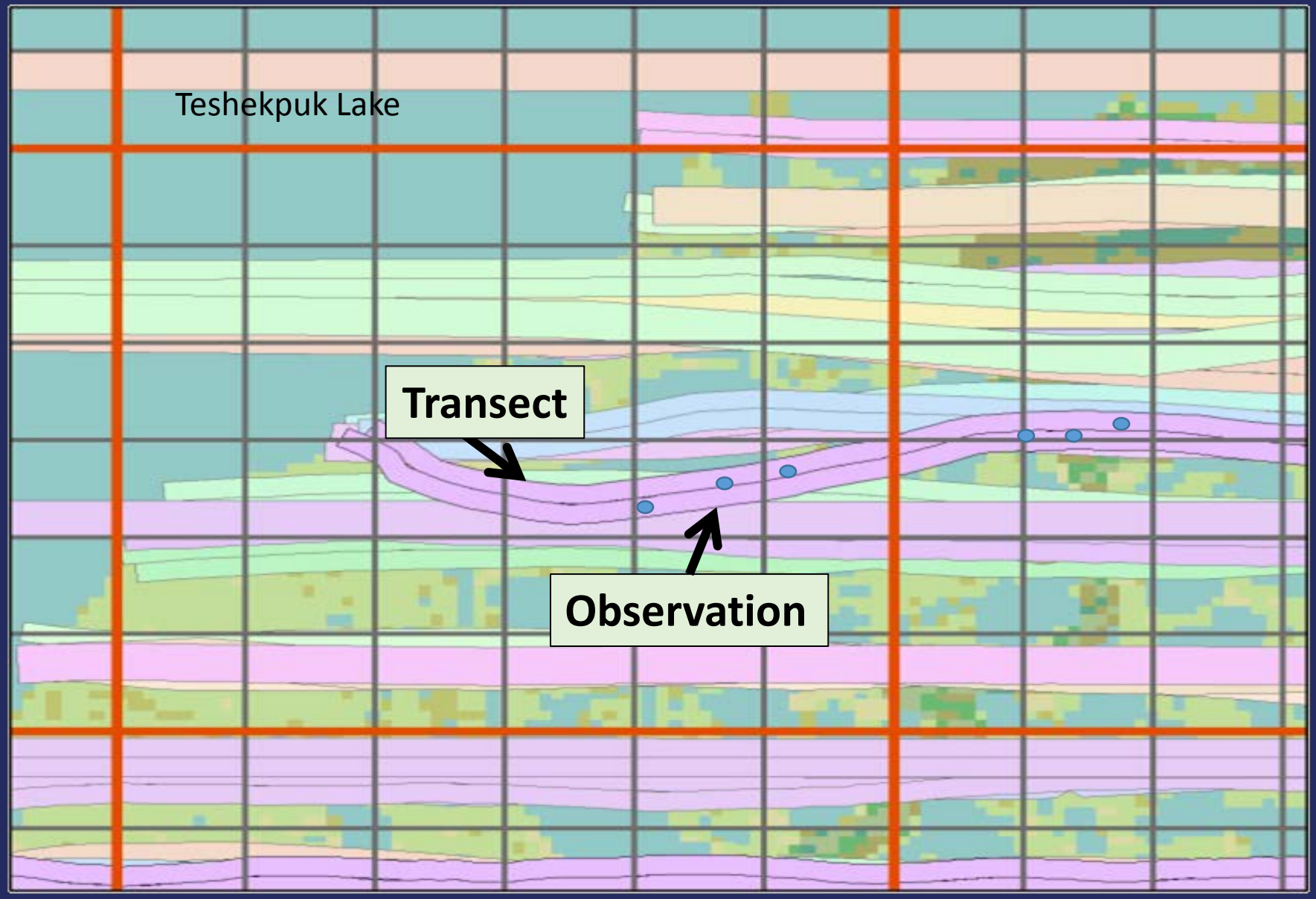
Teshekpuk Lake

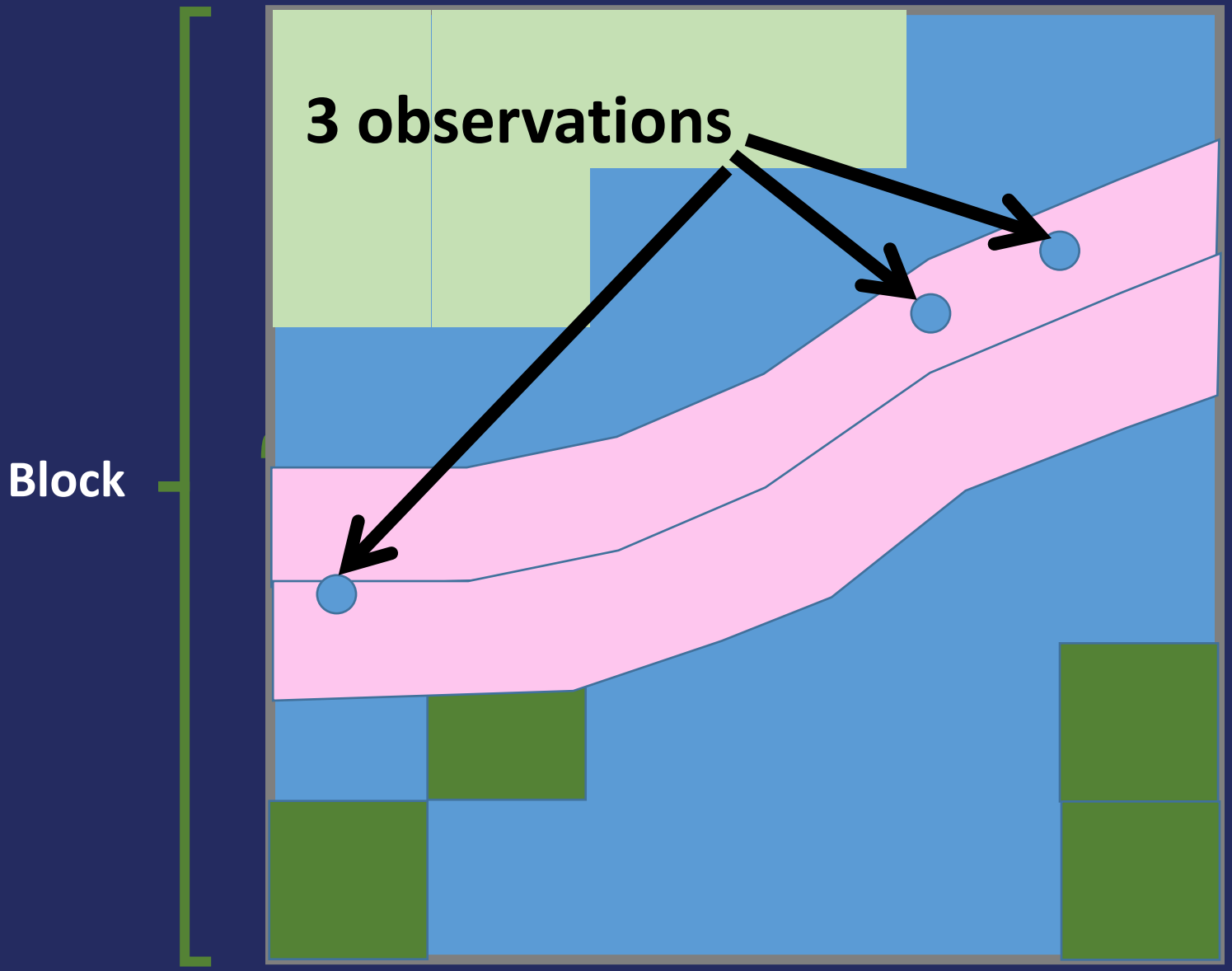

Teshekpuk Lake
Birds


Teshekpuk Lake
Observer 1
Observer 2
Transect
Observation

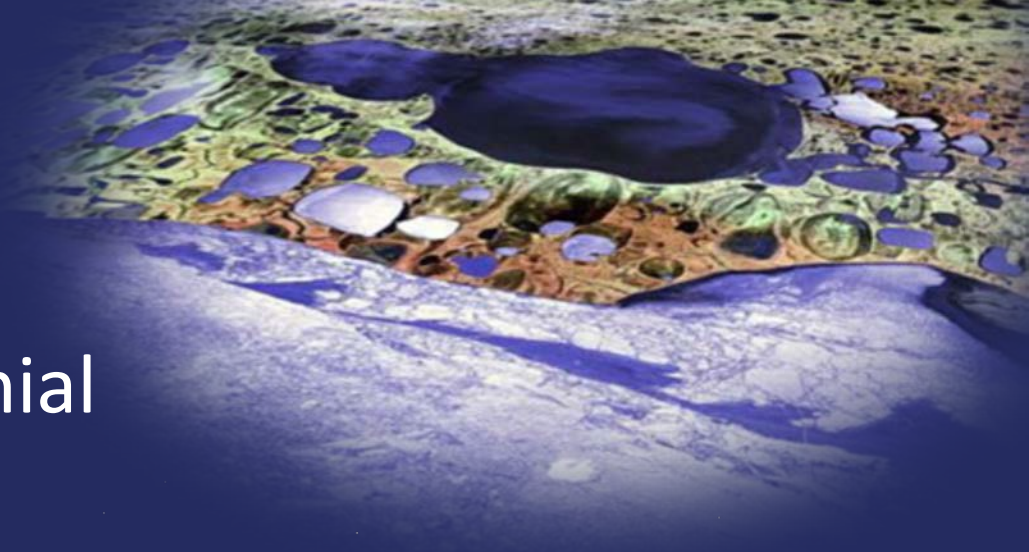
A transect is not a transect through time…



Analysis

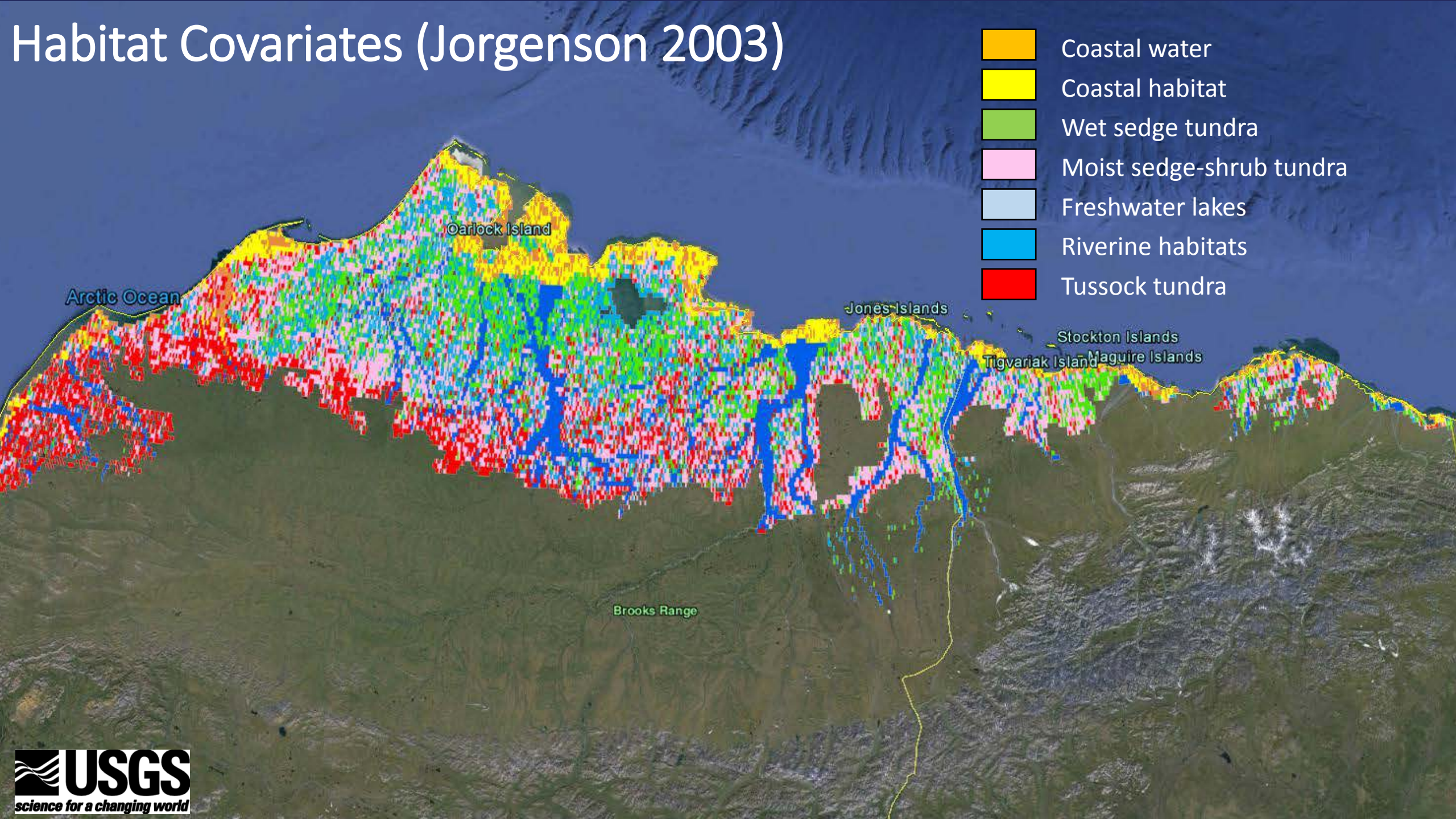


Analysis



- Hierarchical zero-inflated Negative Binomial Regression models
  - Links occupancy and abundance models to better account for zero counts
  - Bayesian framework
  - 15 km x 15 km cells
  - 1992-2014

Habitat Covariates (Jorgenson 2003)



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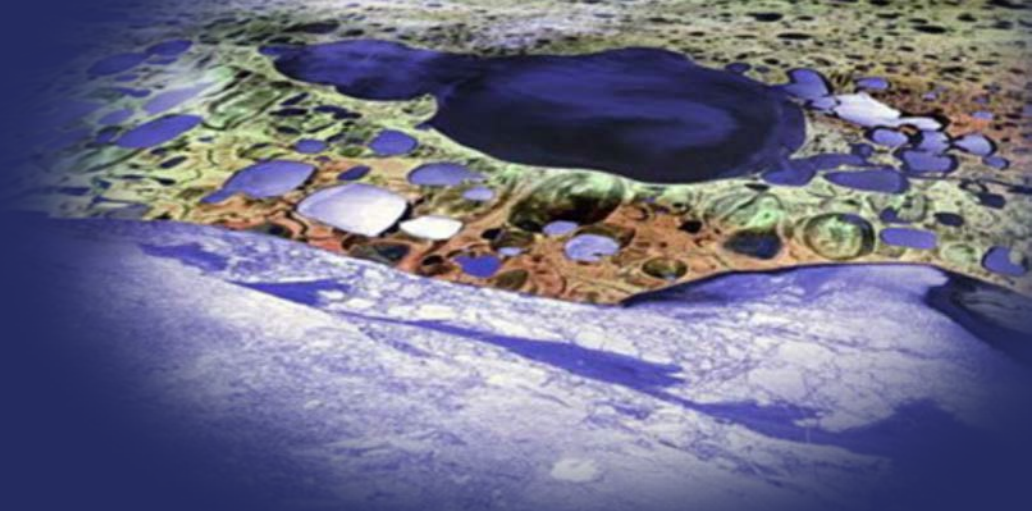
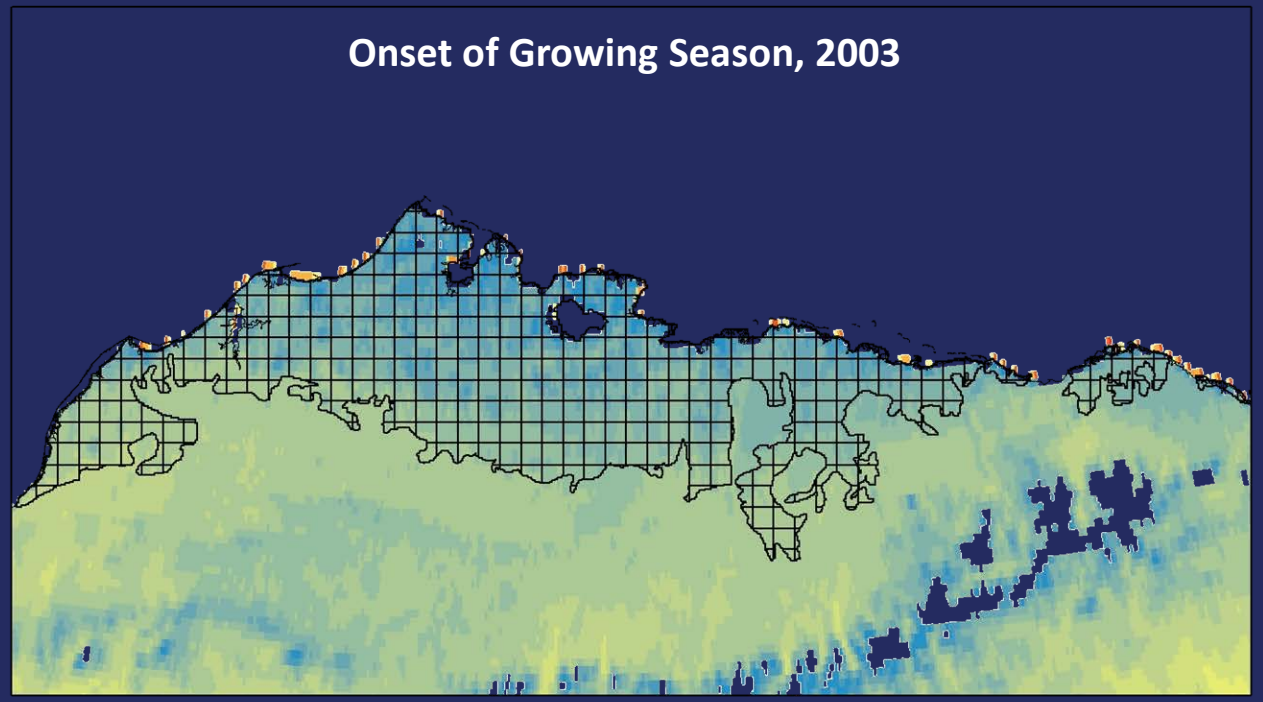
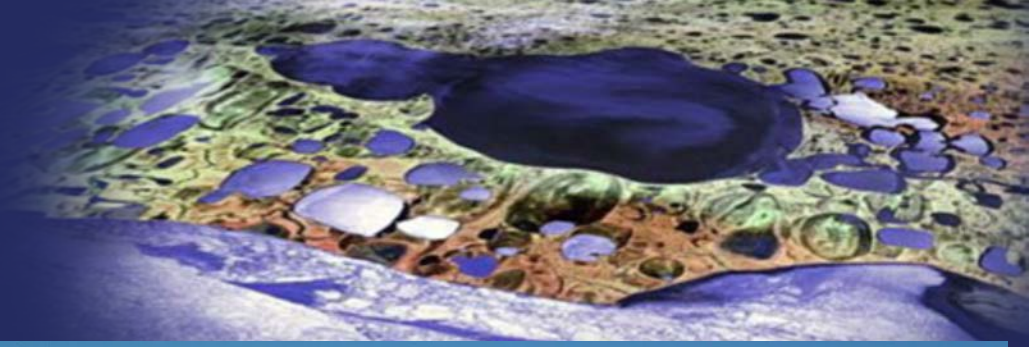
Additional Model Terms





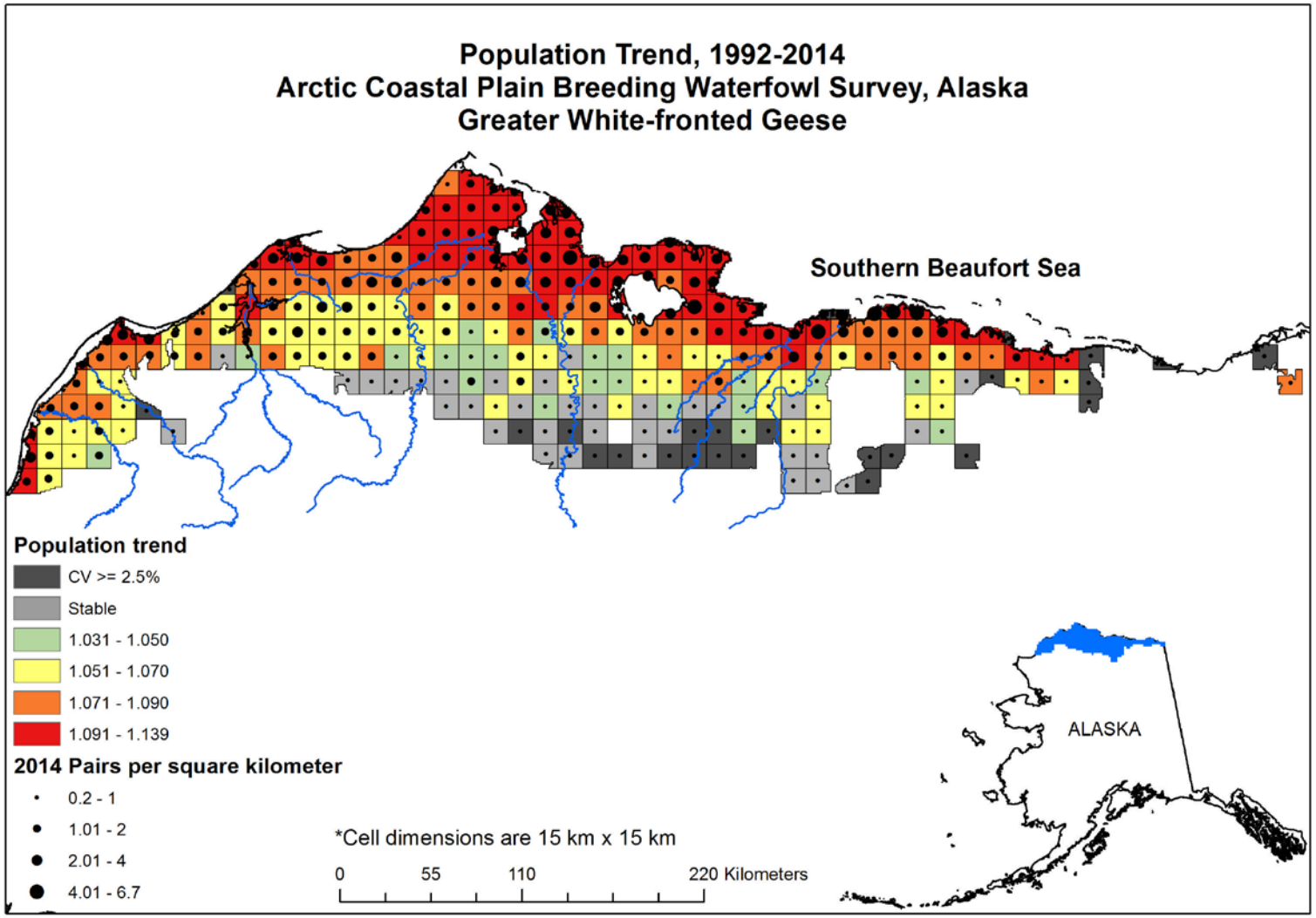
- Onset of growing season per NASA MODIS imagery (~5 km by 2.5 km)
- Date of survey minus mean onset of spring for each cell
  - 1992-2014
  - Linear and quadratic

Greater White-fronted Geese

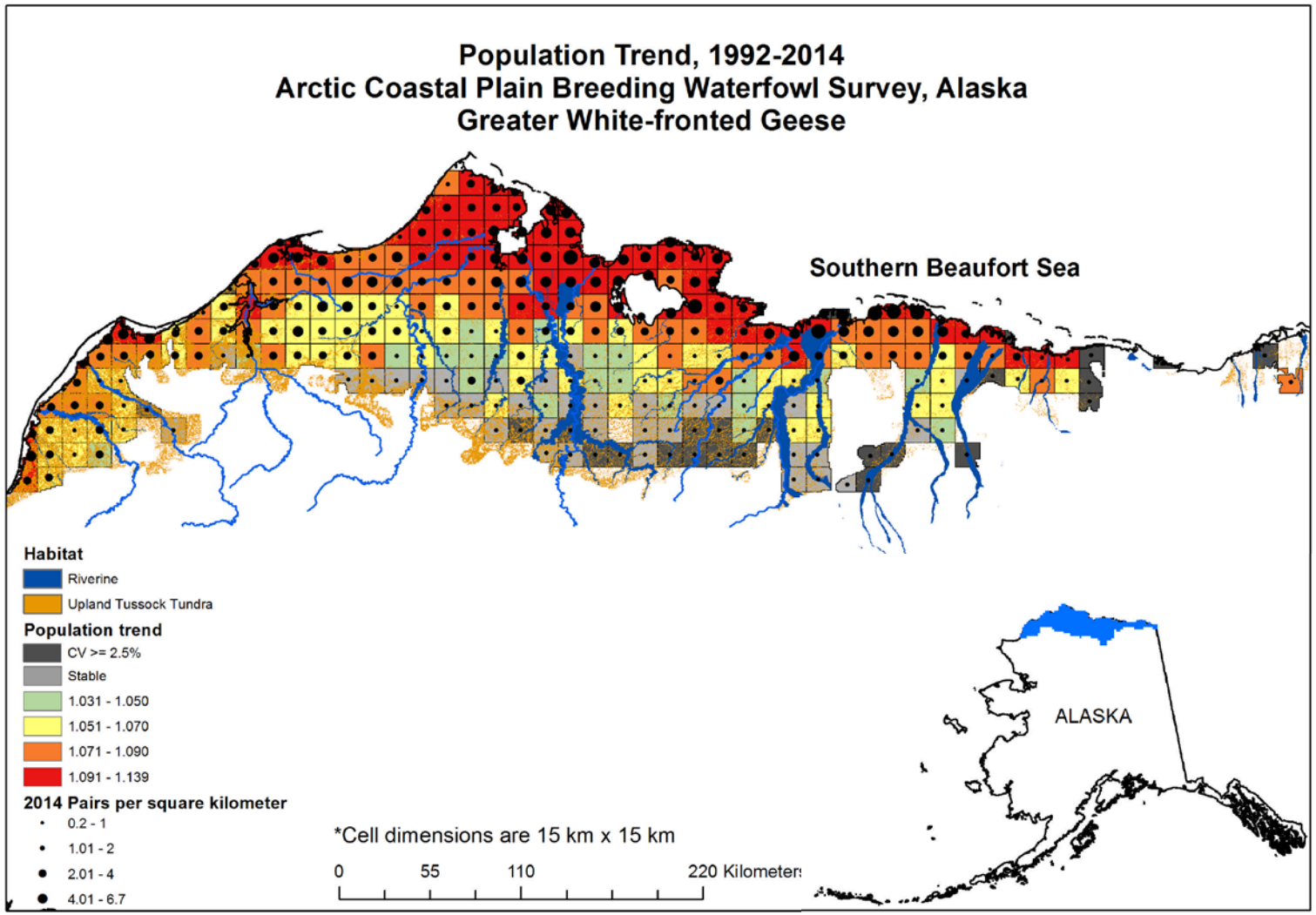


- Habitat
  - Abundance
    - Coastal habitats
    - Freshwater lake area
    - Distance to the coast
- Geometric mean Change$_{1992\text{-}2014}$
  - 7.4 %
  - 95% CI: 5.7% - 9.3%
  - Block range: 0% to 13.9%
  - Trends
    - Distance to the coast
    - Tussock tundra
    - Riverine habitats

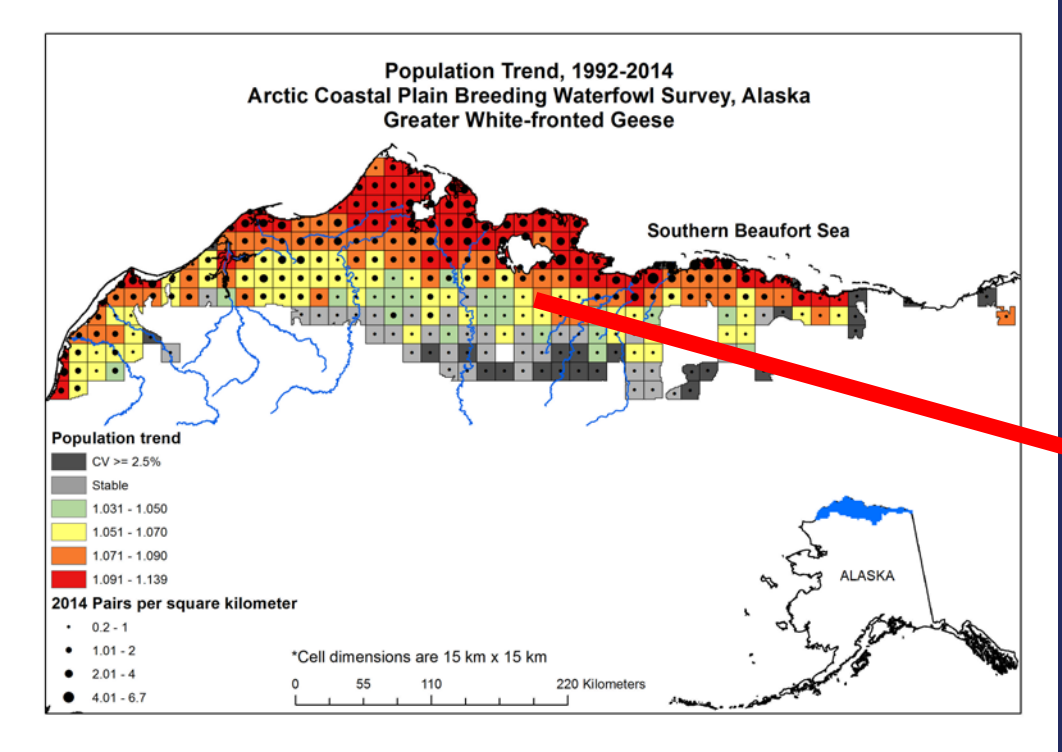
Greater White-fronted Geese



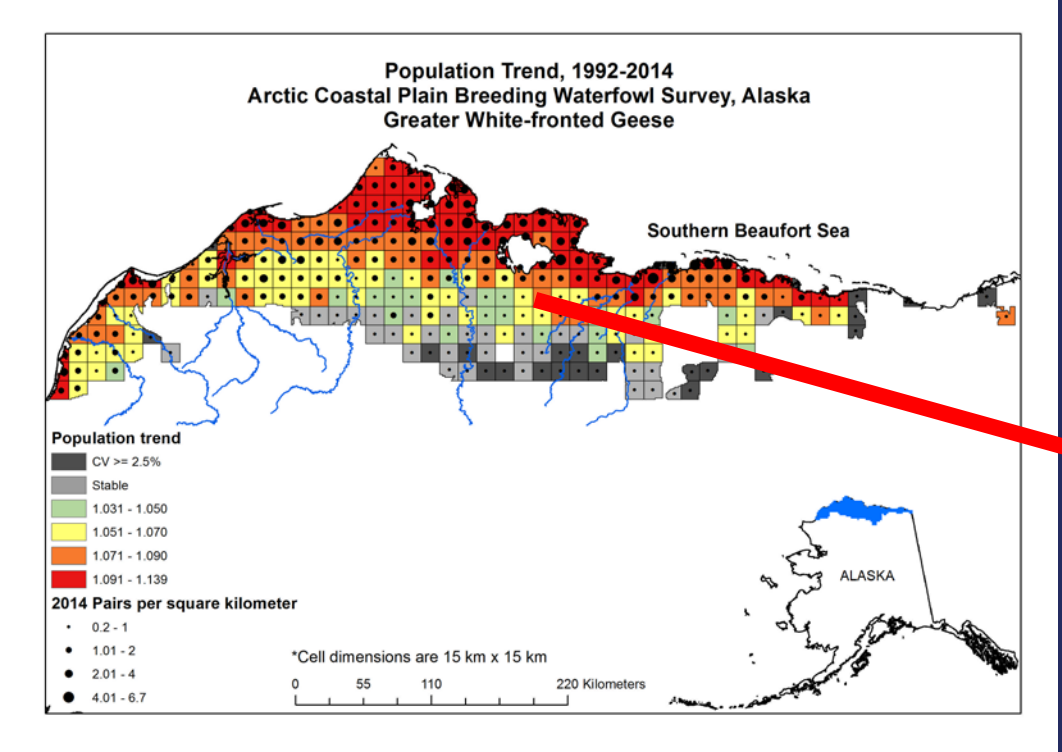
Greater White-fronted Geese

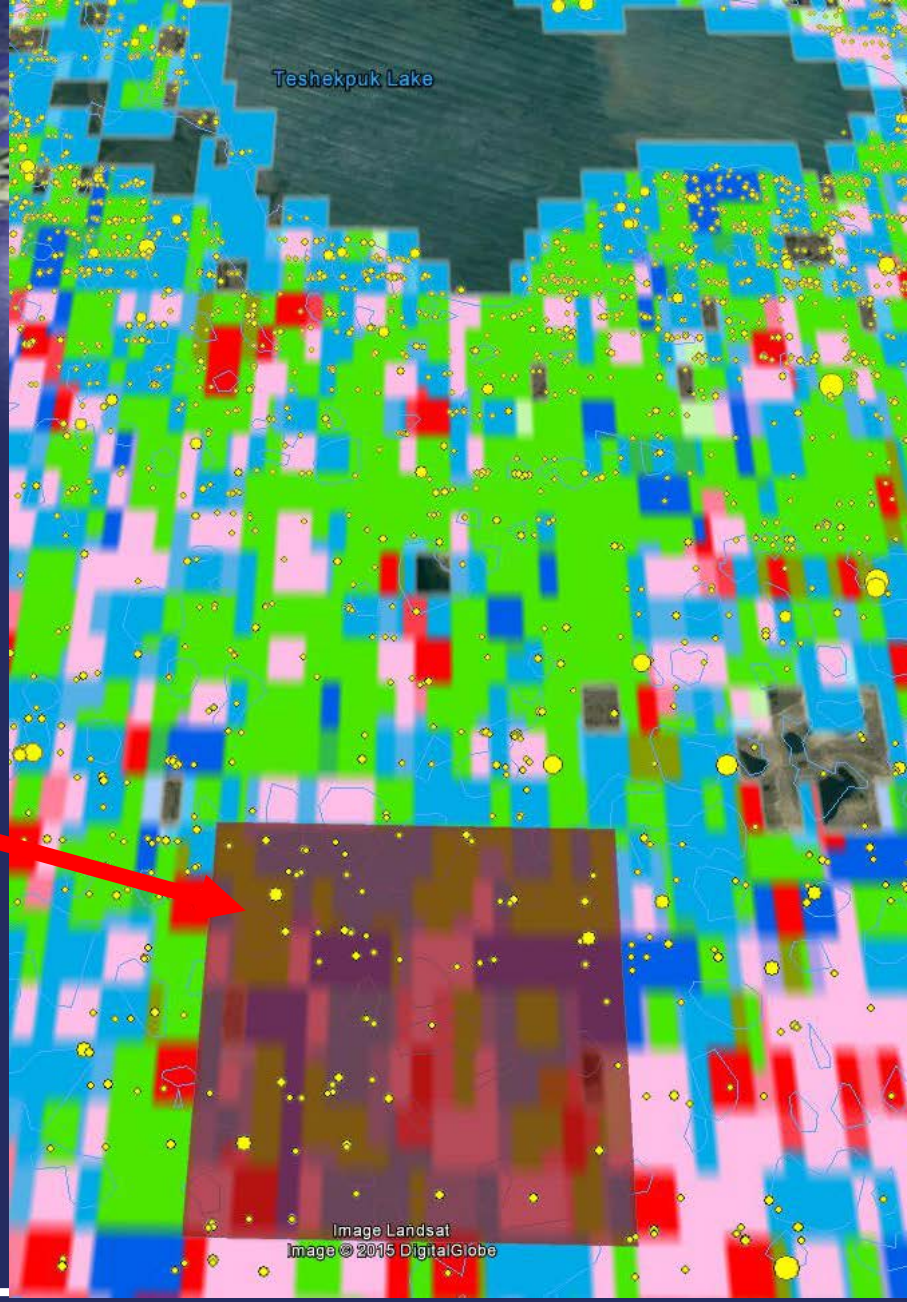


Ultimate Goals



Ultimate Goals





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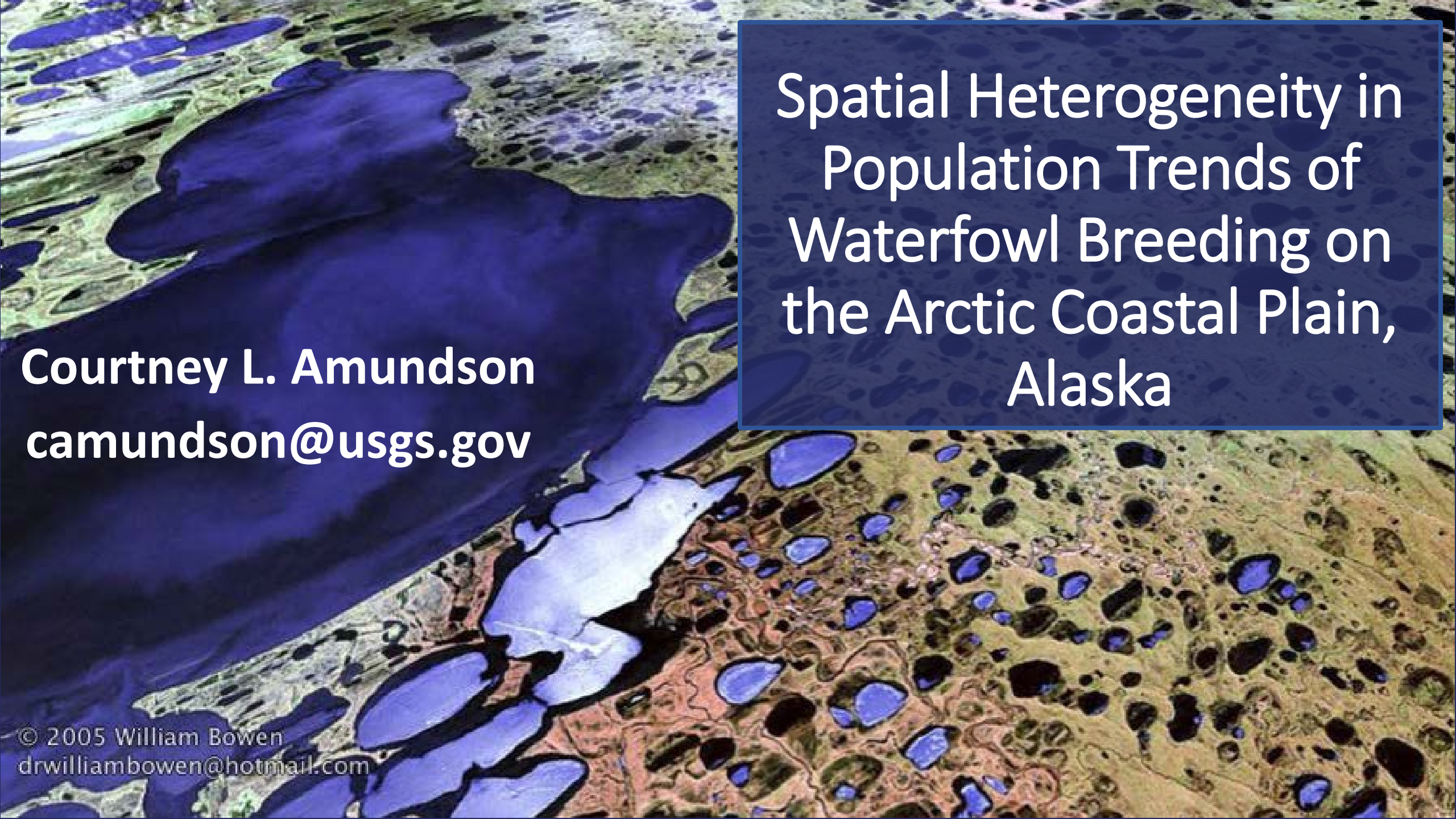

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