Hotspots of Seabird Diversity at Sea

Martin Renner John F. Piatt Kathy J. Kuletz George L. Hunt, Jr.

Acknowledgements

NPPSD contributors:
Bill Sydeman, Bob Day, Kenn Morgan, Denny Zwiefelhofer, Alaska Maritime NWR, many others

Gary Drew, Robert O'Malley, Mayumi Arimitsu, Franz Mueter, Mike Litzow

NORTH PACIFIC RESEARCH BOARD

USGS
science for a changing world

NSF

SAFS
SCHOOL OF AQUATIC and FISHERY SCIENCES

“Biodiversity”

- BUZZ but often unclear definitions
- global and local diversity
- simple concept with troublesome details
- conservation and ecological importance
  - niches, competition, resilience to change
  - marine reserves, indicators of change, fisheries interactions

Objectives

- describe patterns of pelagic seabird diversity
- show effects of scale and methods
- which environmental factors correlate with seabird diversity?
- map change over time

Difficulties

- non-linear relation to survey effort
- weight on evenness vs richness

➡ rarefied richness

➡ consensus-index

Measures of diversity

- raw species richness
- rarefied richness by individuals
- combining richness and evenness
  - Shannon diversity index
  - Simpson diversity index
  - consensus of Shannon and Simpson

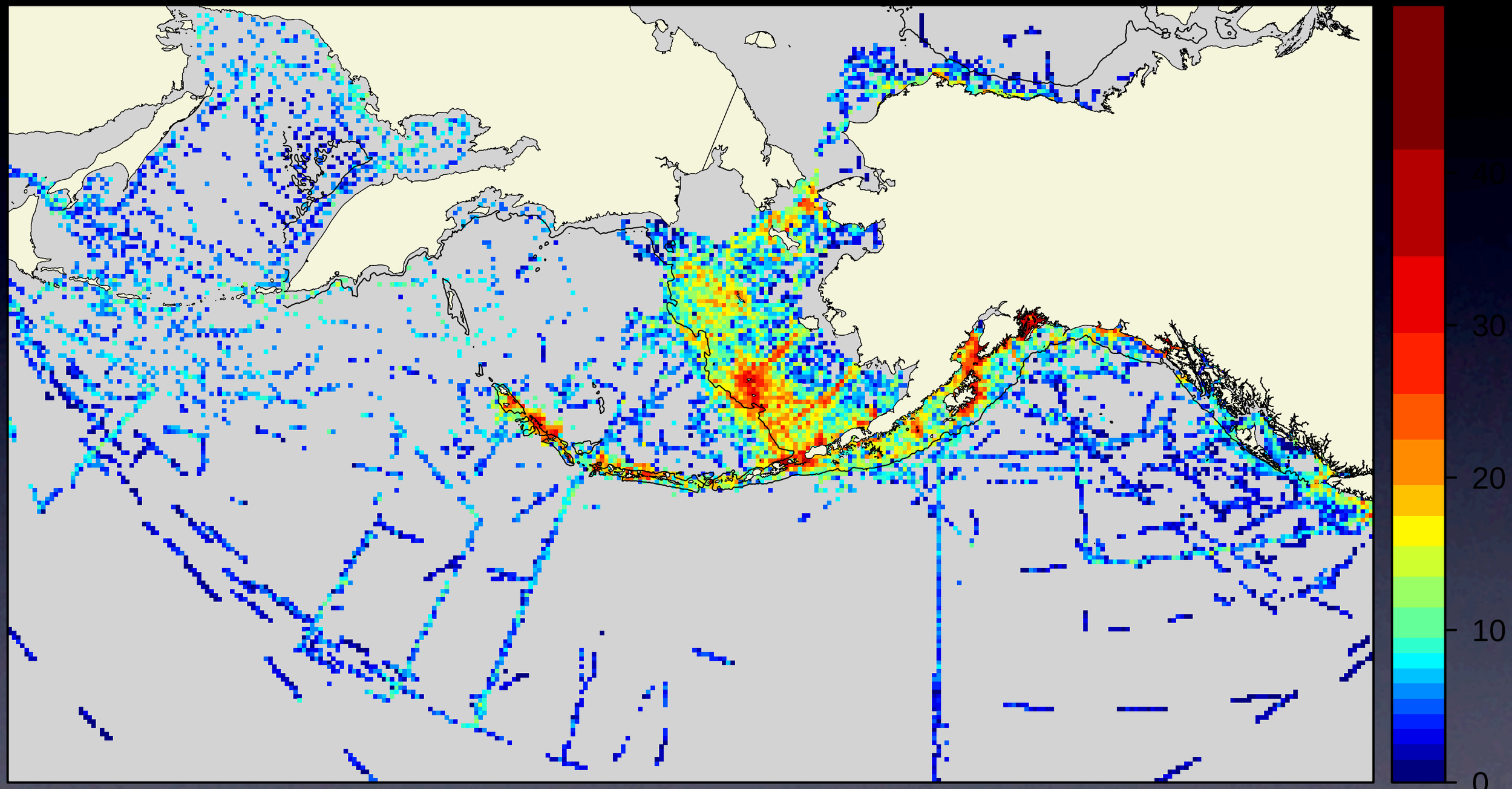
North Pacific Pealgic Seabird Database

- BC to Alaska and Russia
- opportunistic coverage
- used 1975–2009, May–August
- excluded aircraft or container vessels
- >100 thousand records, >10 Mio birds

Grid Scale

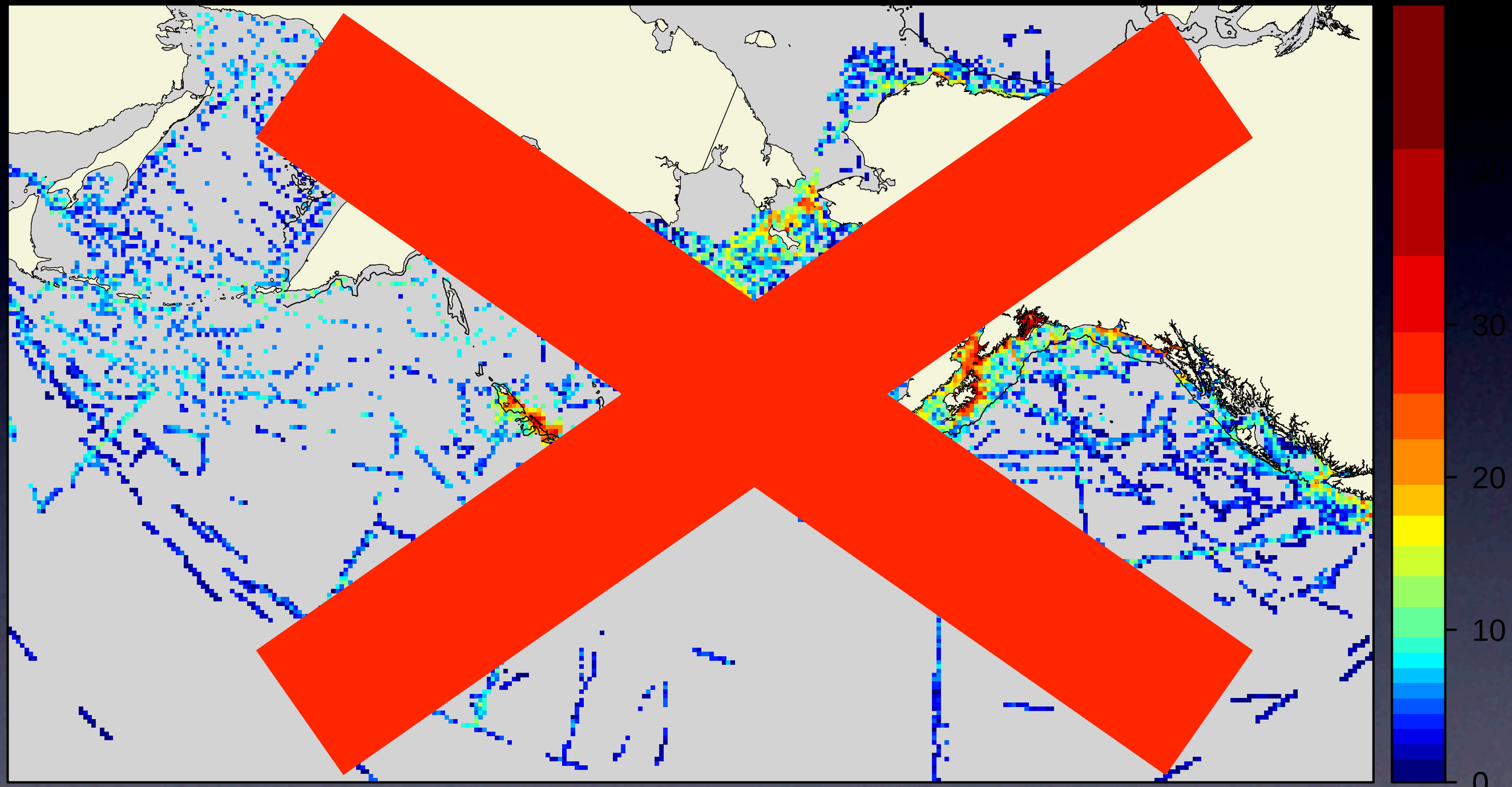
- 5 km – 1000 km
- compromise between data and locational accuracy: 20 km
- affects correlations

Observed Richness



(species/20 km grid cell)

Observed Richness



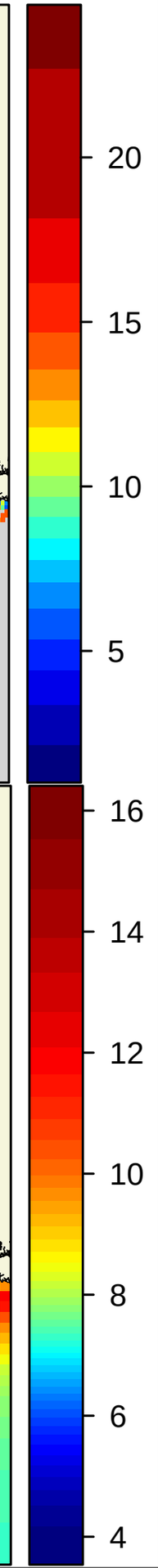
(species/20 km grid cell)

Rarefied Species Richness

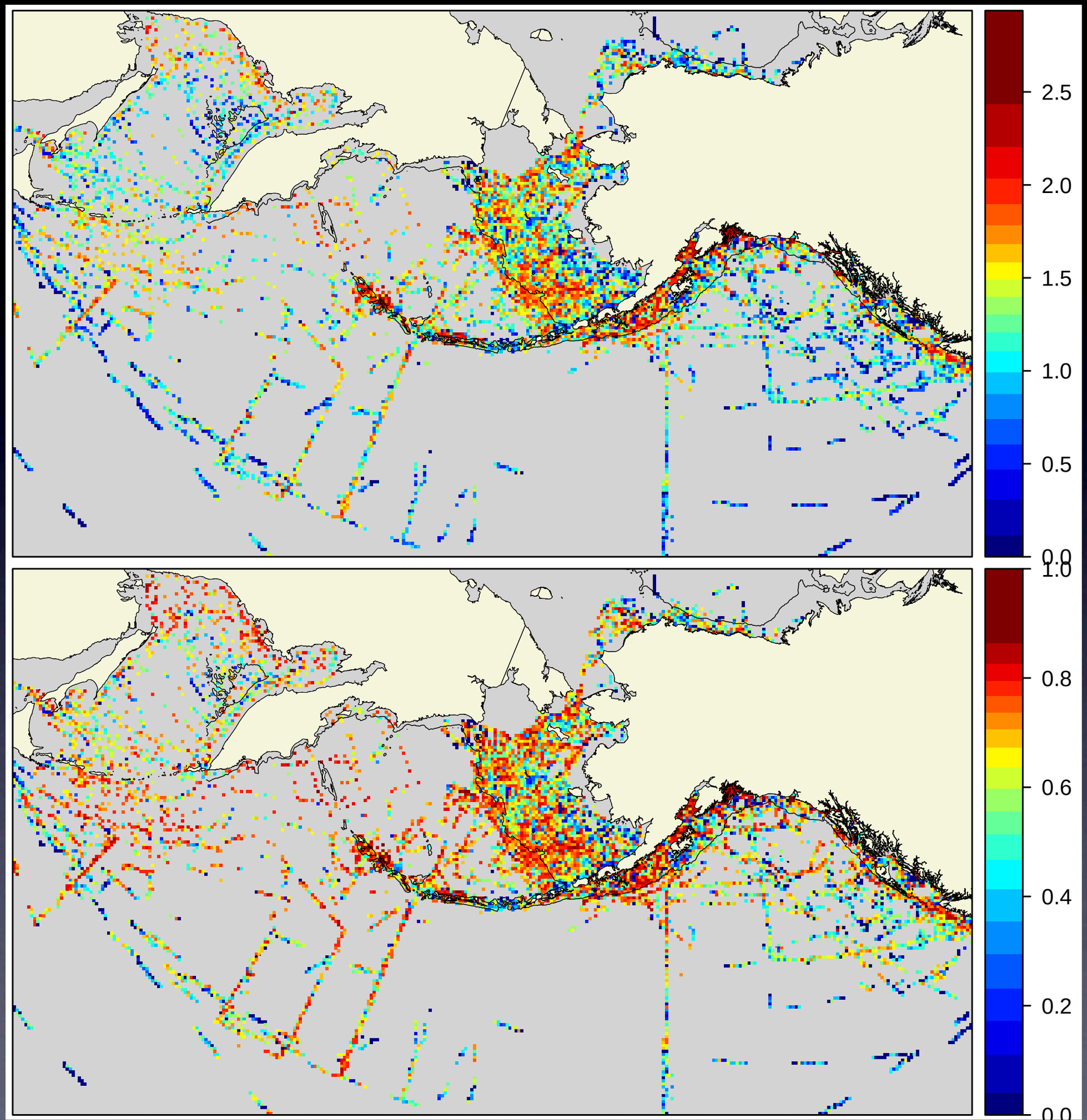
$$\frac{\text{species}}{100\ \text{birds}}$$

raw

kriged



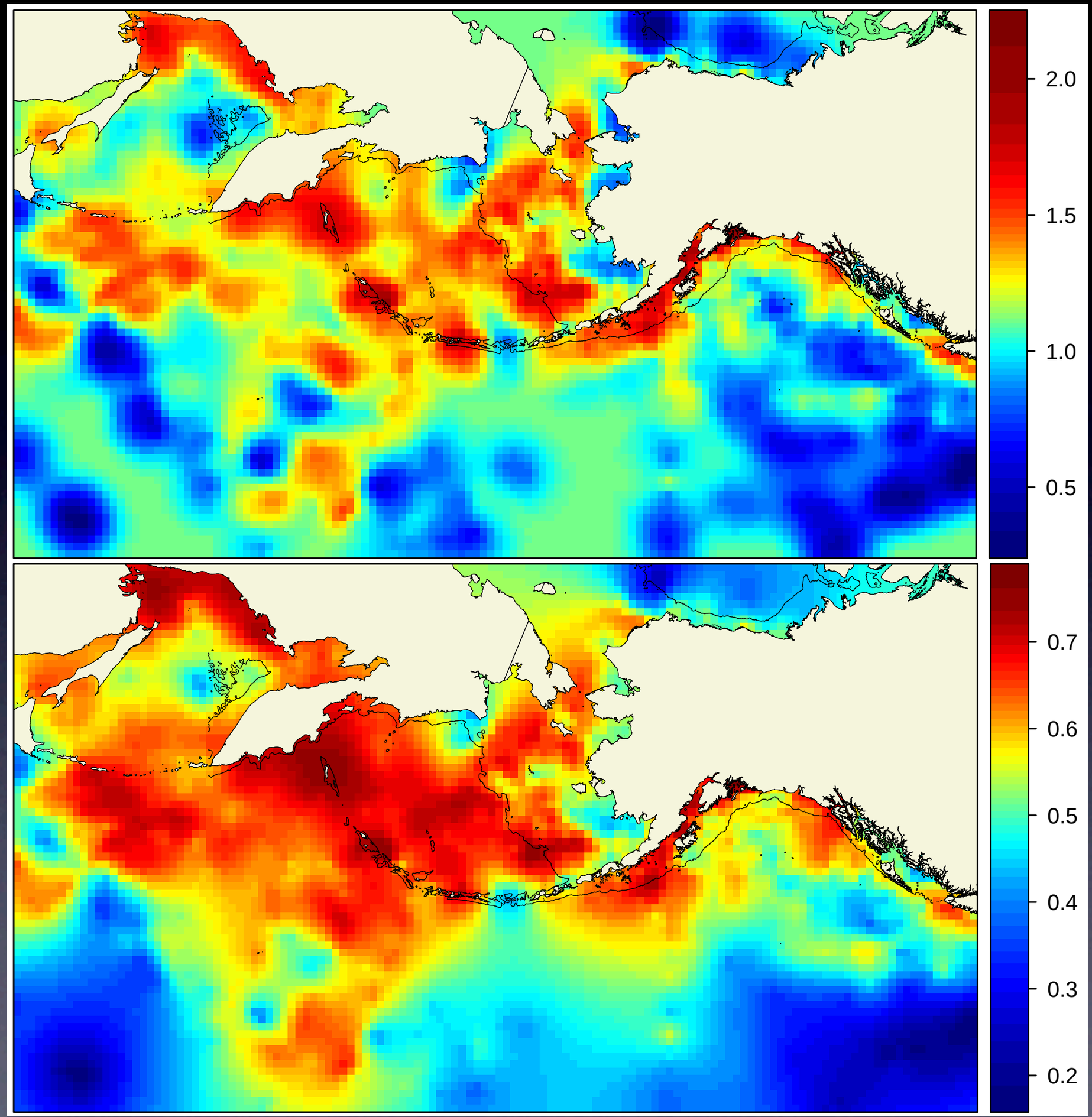
Shannon



Simpson

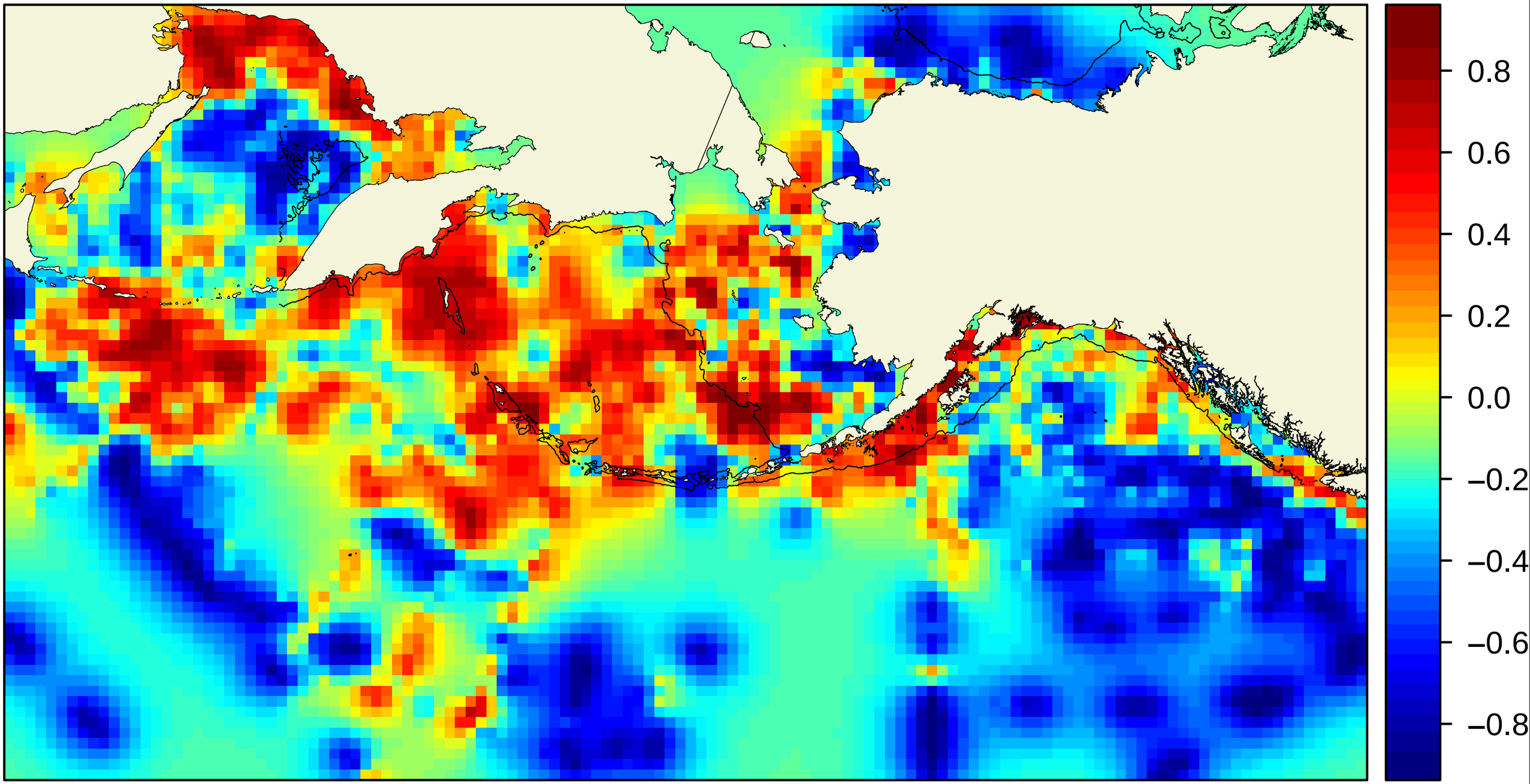
Shannon

evenness



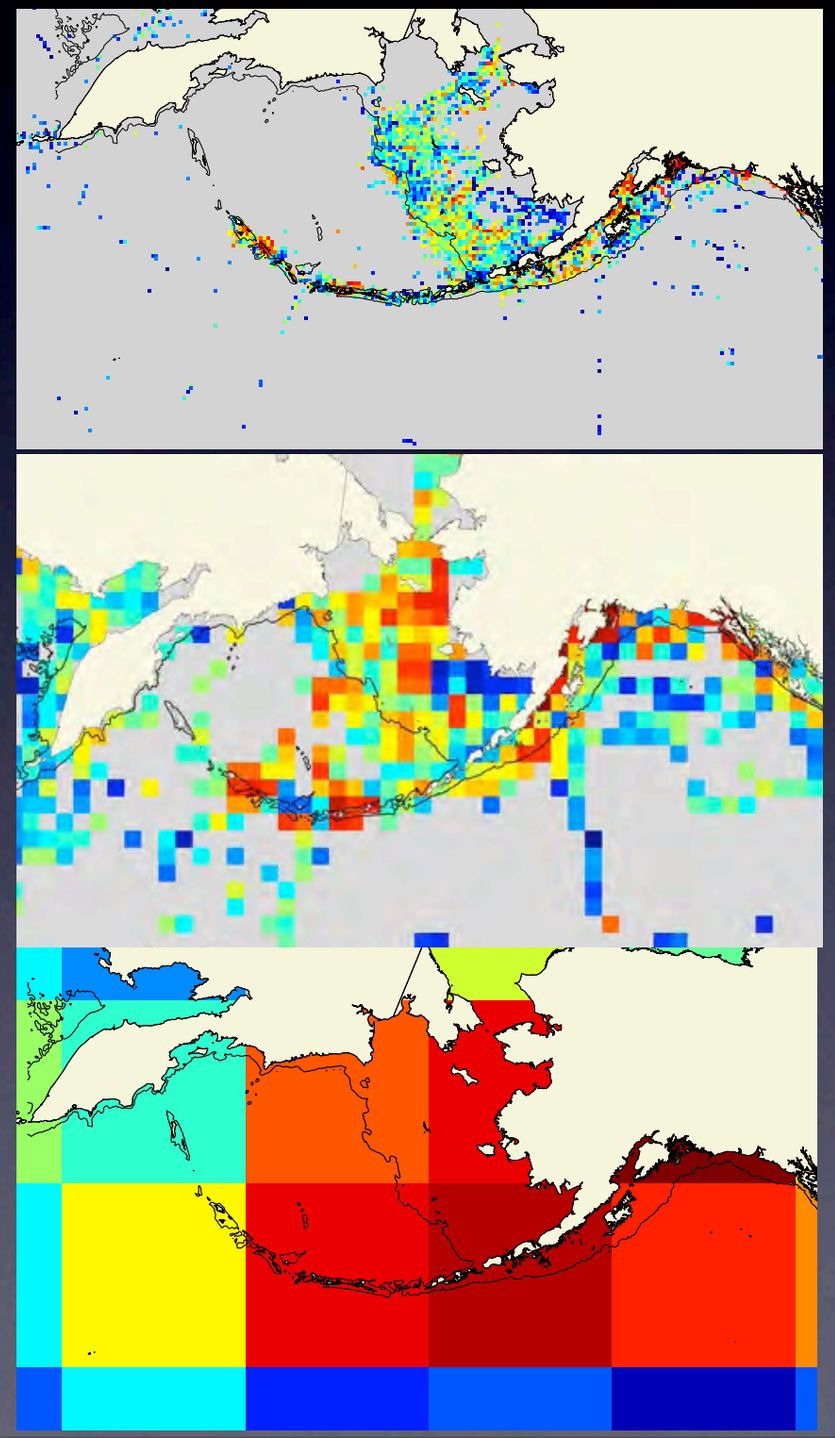
Simpson evenness

Consensus diversity

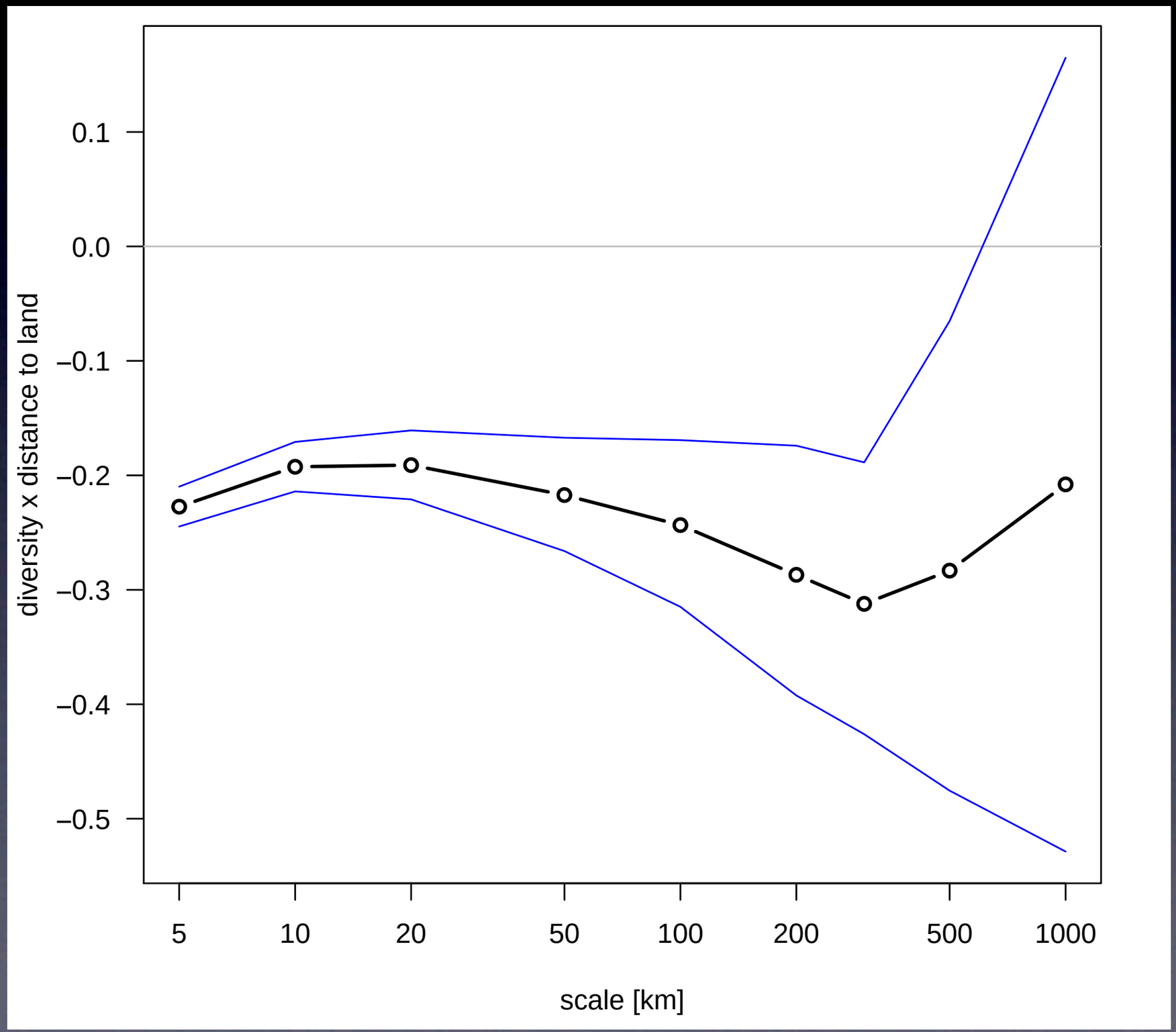


Scale-dependent Correlations

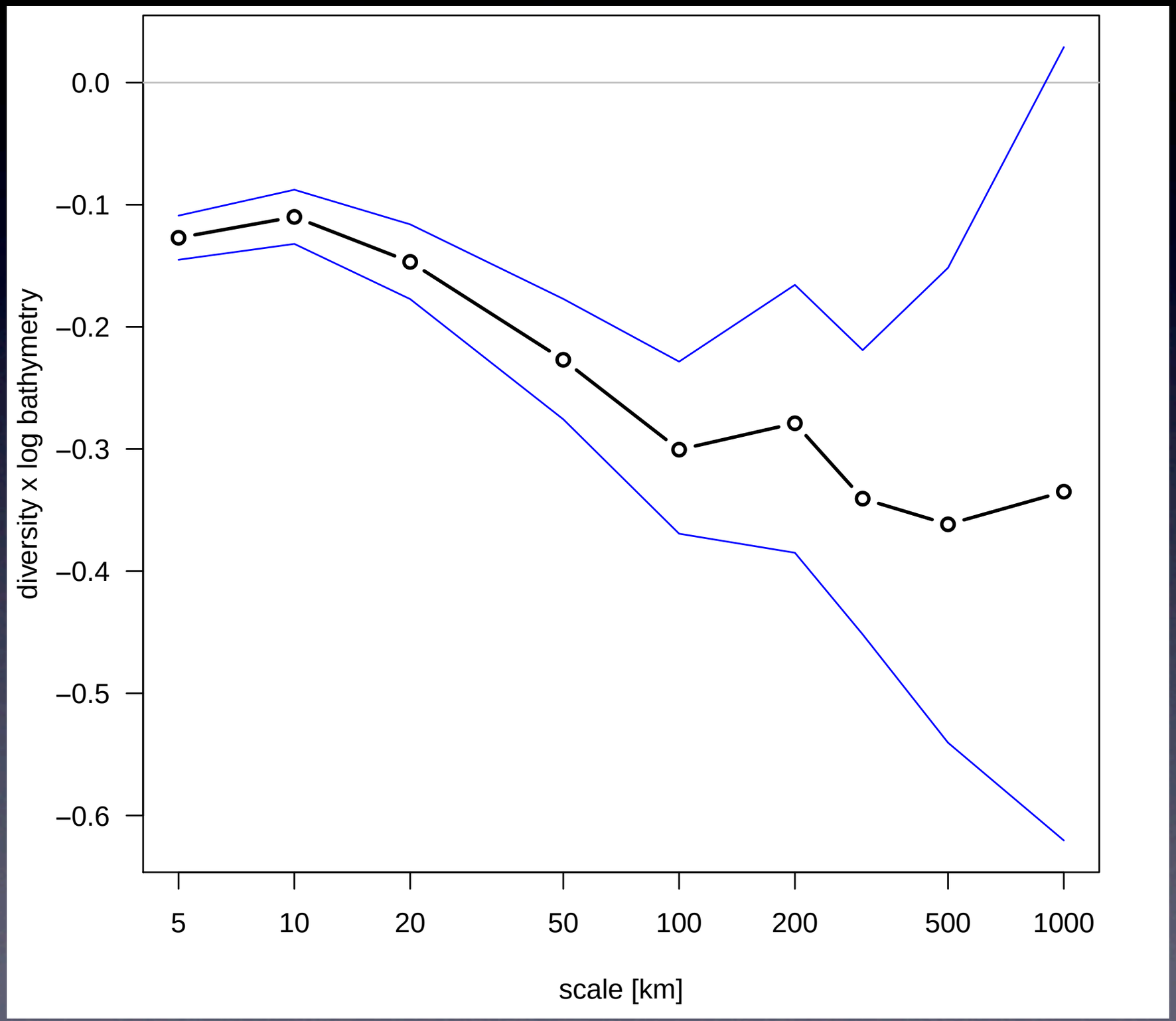
- distance from land
- sea surface temperature
- bathymetry
- primary productivity
- total seabird density



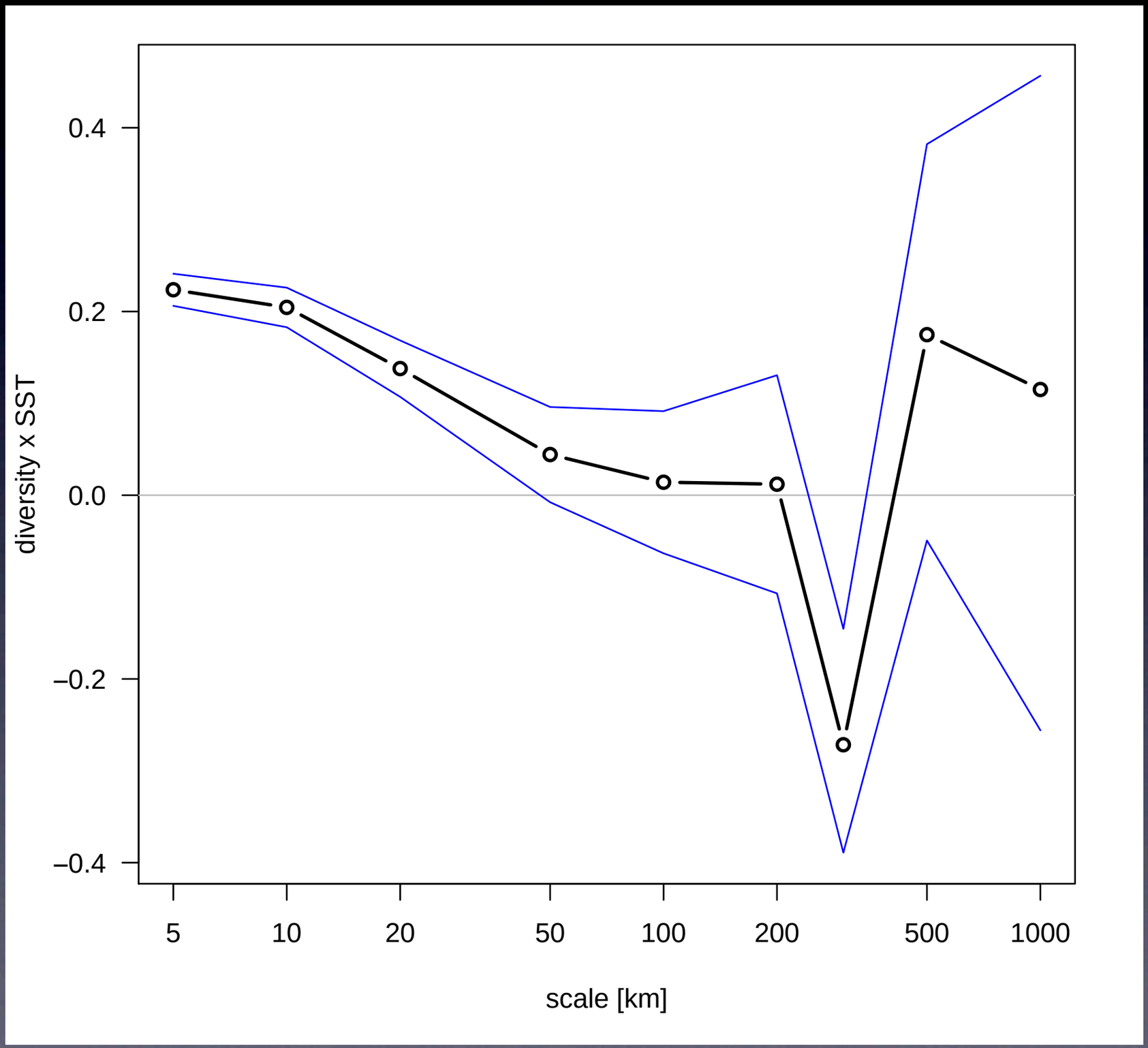
Distance to Land



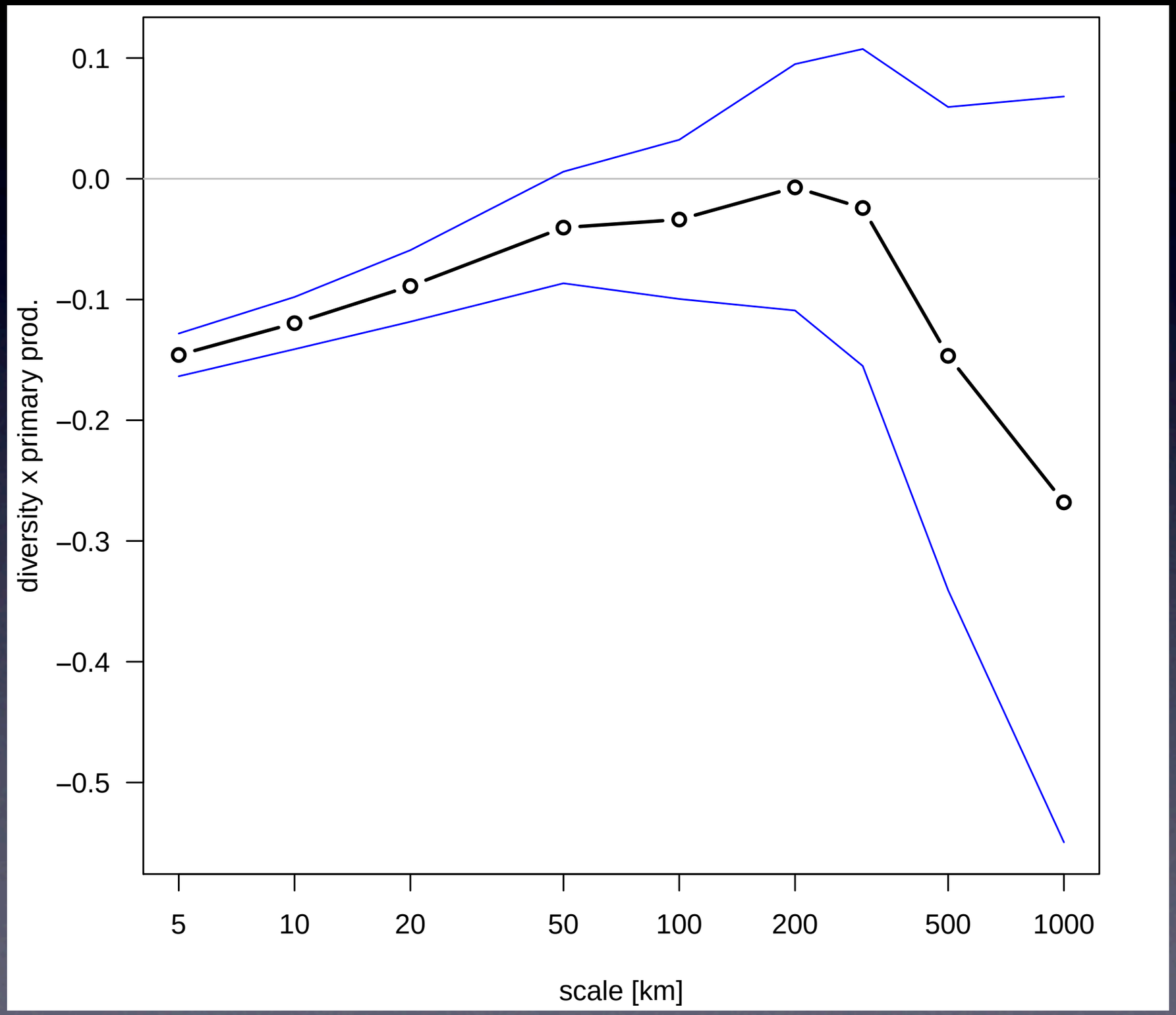
Bathymetry


0.0
−0.1
−0.2
−0.3
−0.4
−0.5
−0.6
diversity x log bathymetry
5
10
20
50
100
200
500
1000
scale [km]

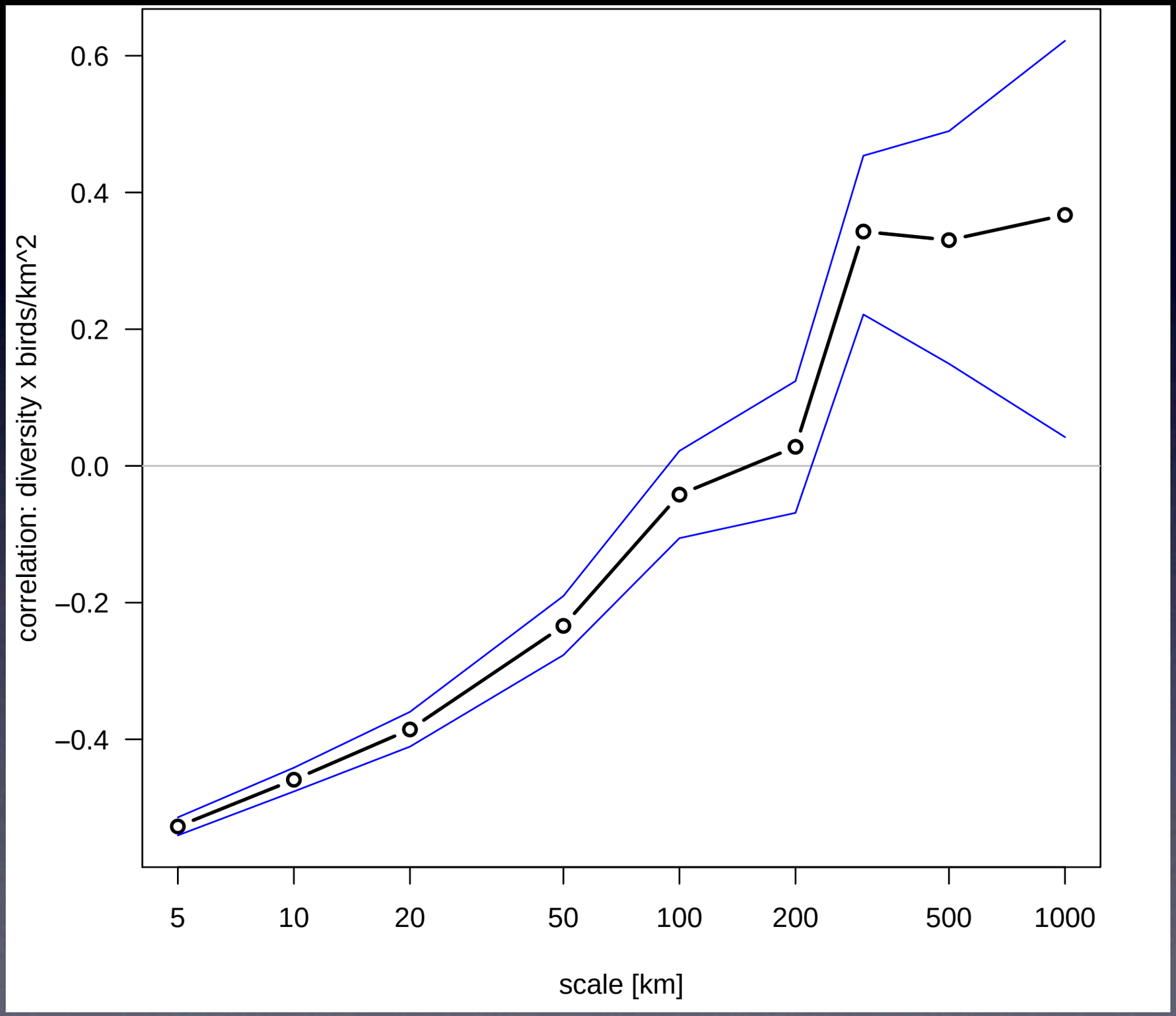
Sea Surface Temperature



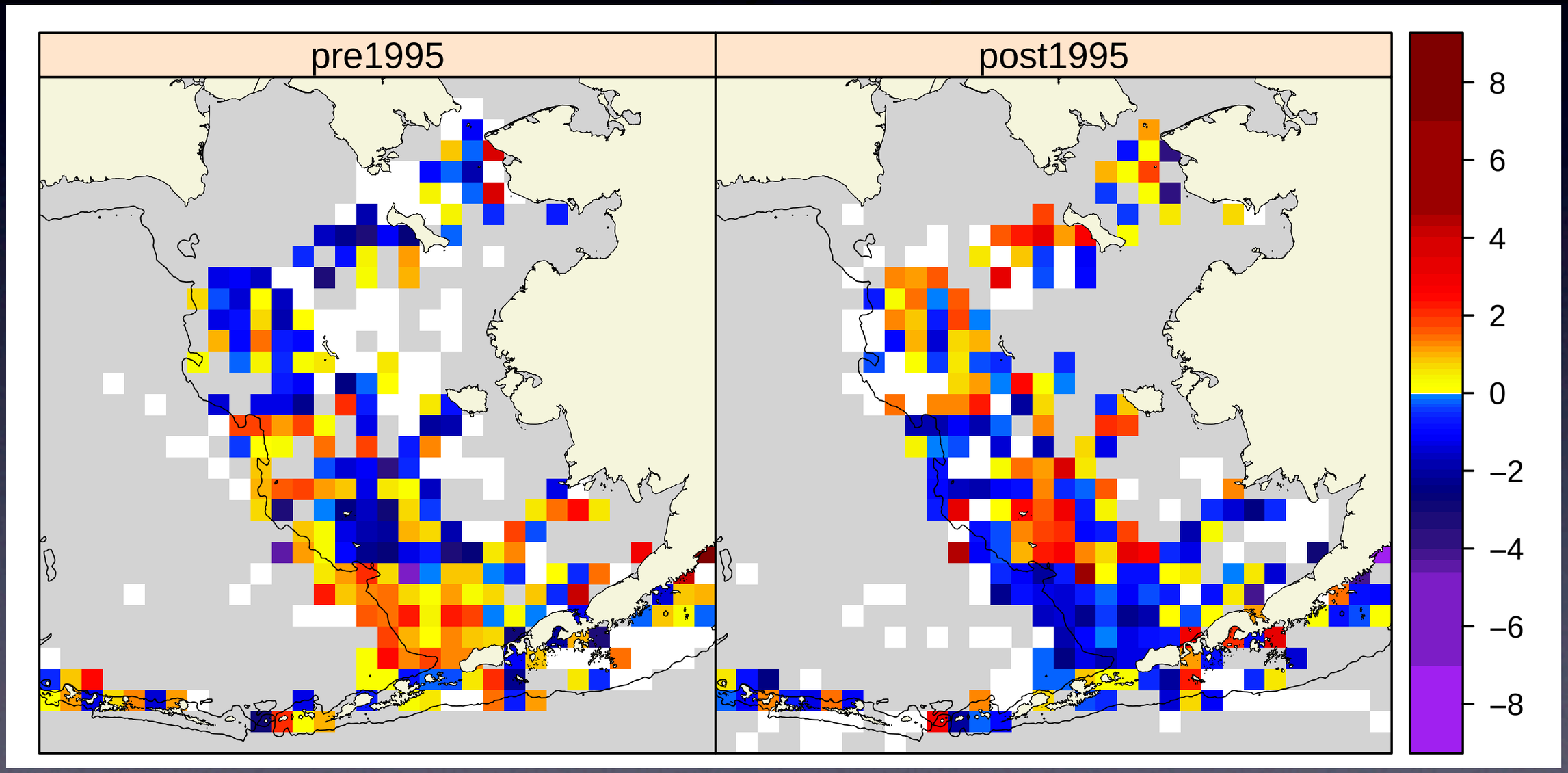
Primary Productivity



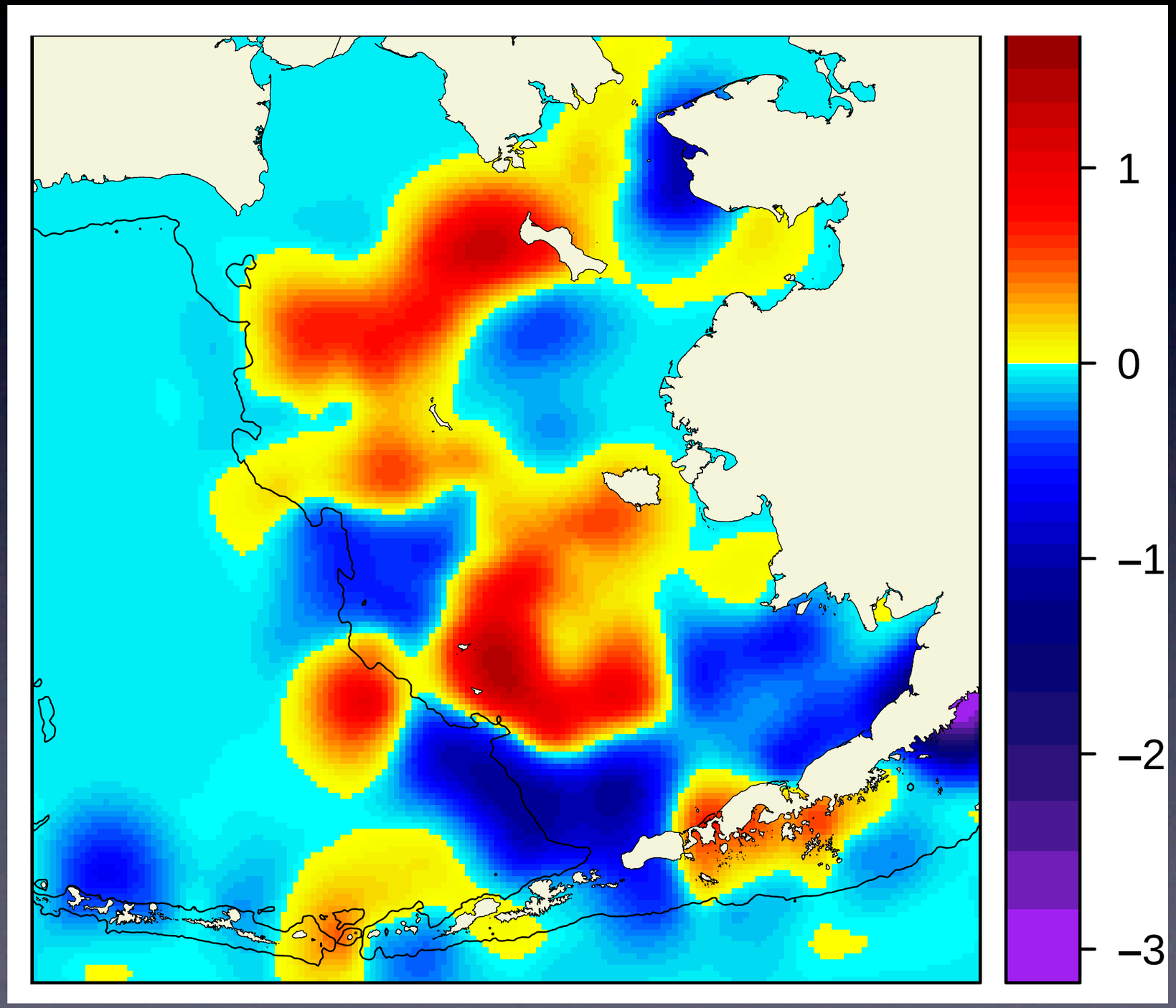
Total Density



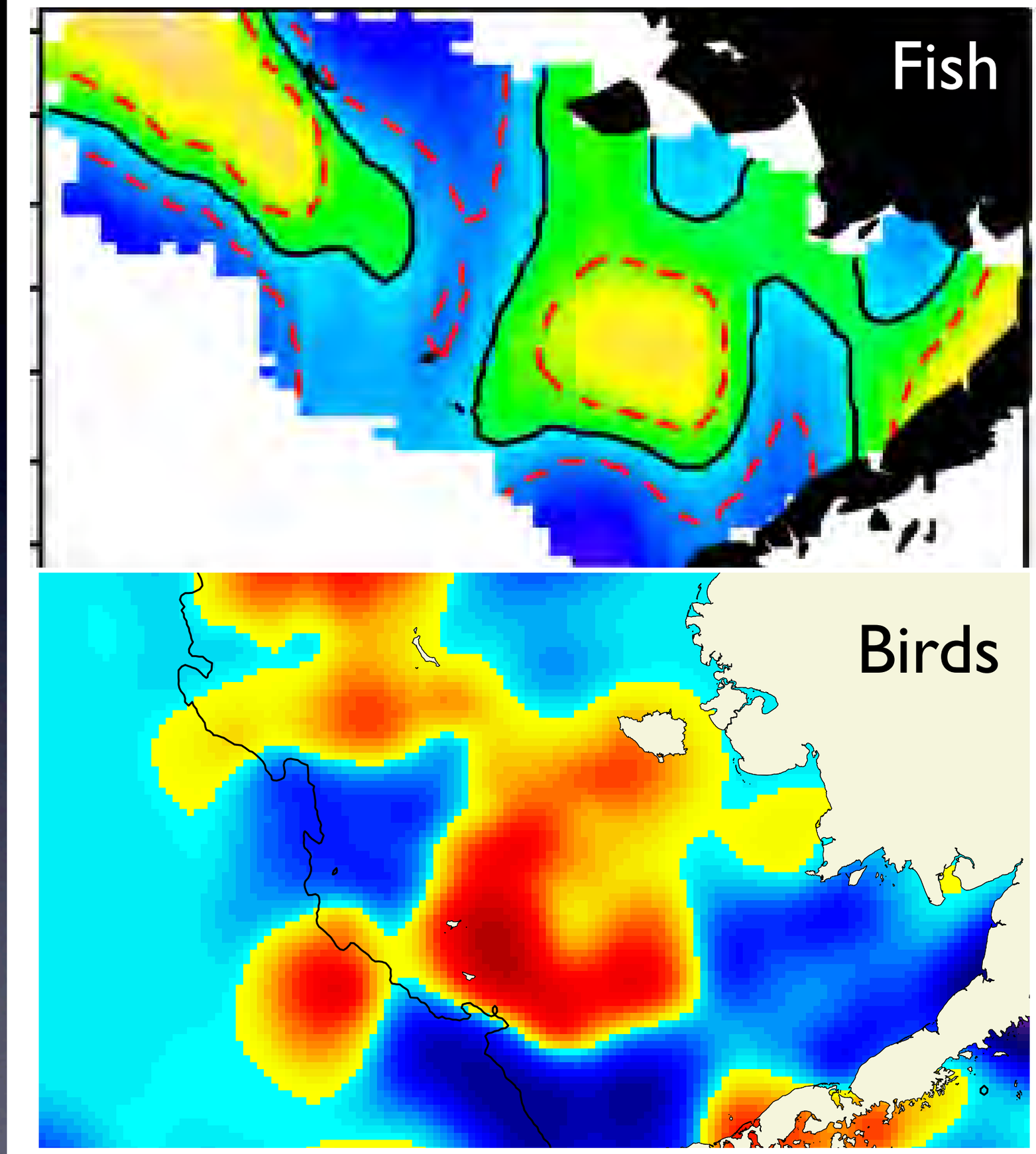
Change over time



Change over time



Mueter and Litzow, 2008



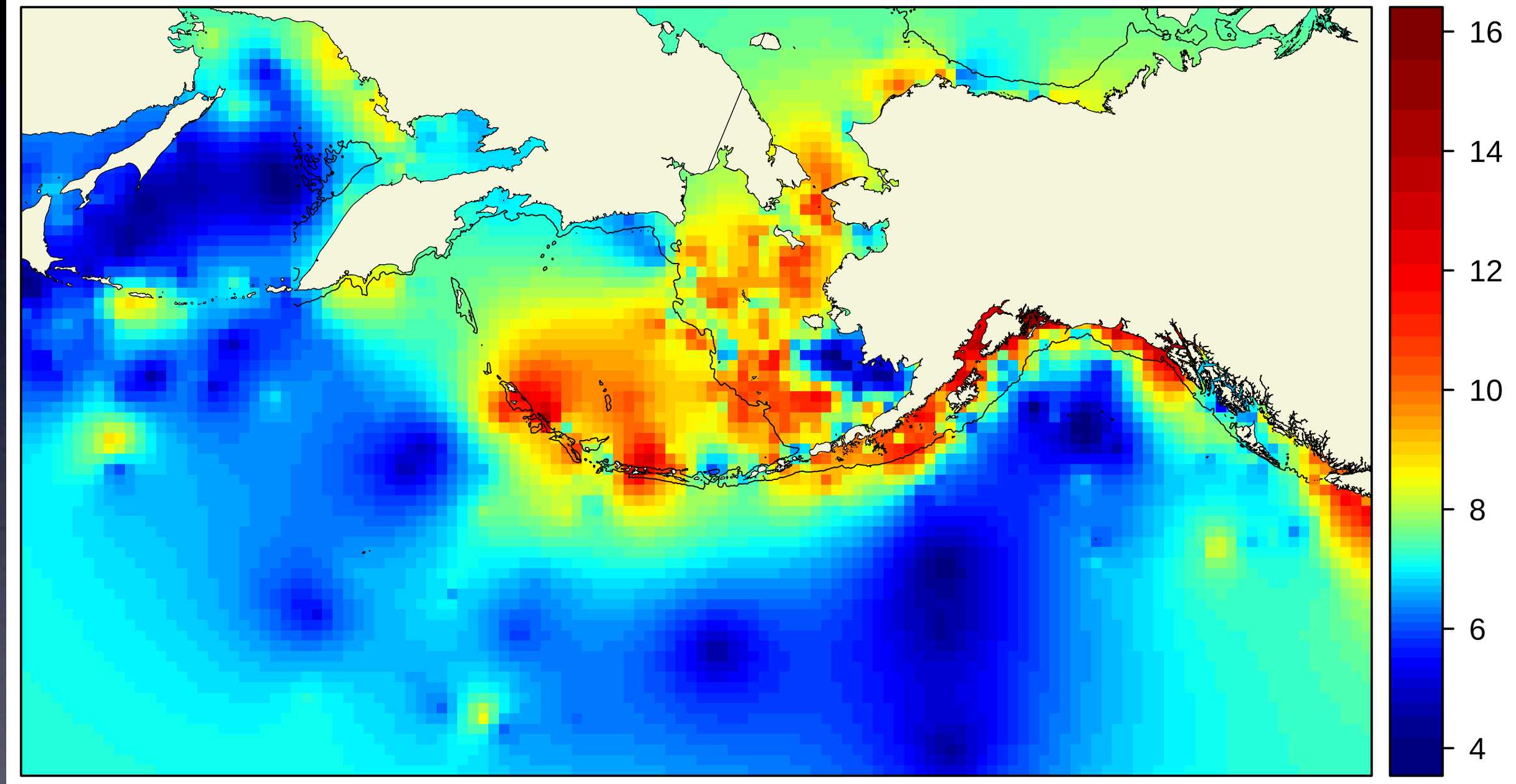
Outlook

- indicator species of change
- data-driven eco-regions
- mechanisms for change

Conclusions

- cannot use observed richness
- diversity is related to:
  - total density (scale-dependent)
  - distance to land (-) [and bathymetry]
  - SST (+)
  - primary productivity (+)
- resemblance with change in fish diversity

Conclusions



Rarefied diversity (species/100 birds)