Why?
Why not?
How after all?

Merging marine tracking and survey data

Martin Renner

Thanks!

- Rosana Paredes, Rob Suryan
- Kathy Kuletz, George Hunt, John Piatt, Gary Drew
- PICES

My biases

- seabirds
- ship surveys
- spatial-temporal models of distribution and abundance

What do I want?

What do I want?

- distribution

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- distribution
- distribution of **density**

What do I want?

- distribution
- distribution of **density**
- **predict** density (past or future), rather than what we saw in instance X at 300m x 3km location Y.

Why?

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- Both positional data, providing distributional information

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- Locations for presence-only habitat model

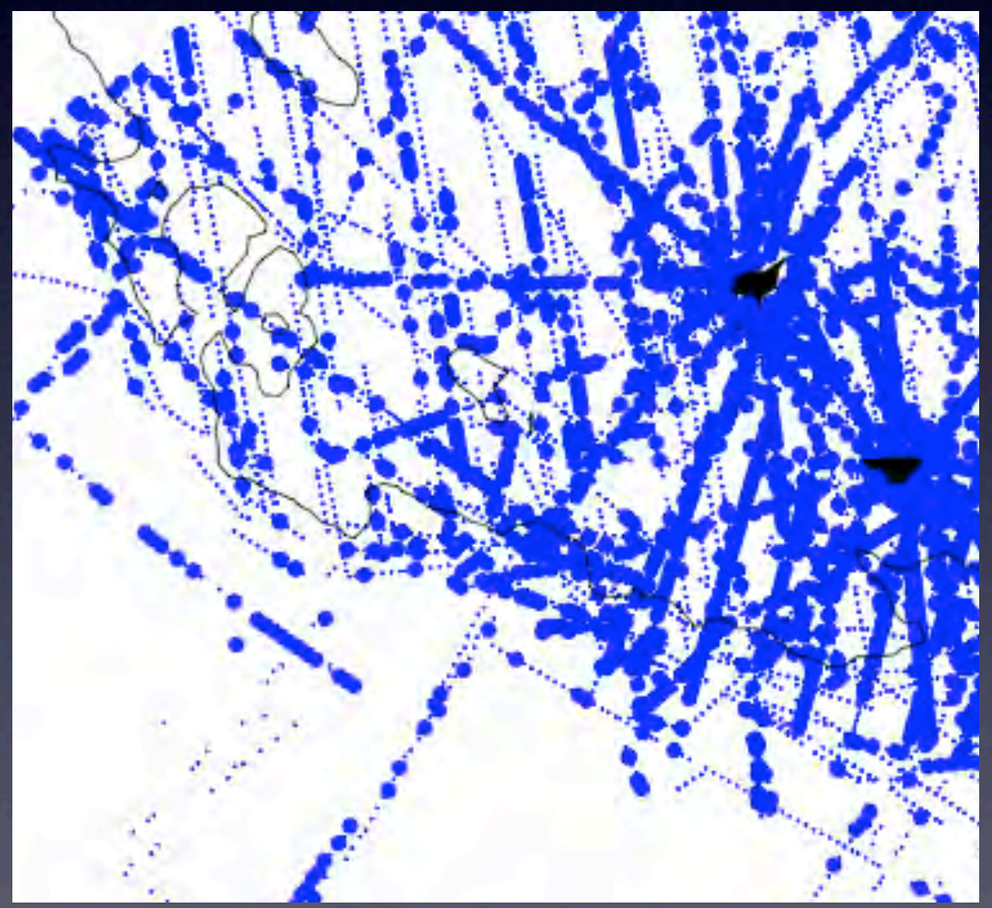
Why?

- Both positional data, providing distributional information
- Locations for presence-only habitat model
- Both can provide densities. Right?

Two sources of locations

BLKI GPS track

BLKI survey locations



presence-only	distribution (1/), seasonality	✓
presence-absence	p (occurance)	?
density	density surface	??

Why not?

Why not?

- P/A: easy; but **density**?

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- Different mechanisms => different analysis

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- Different mechanisms => different analysis
- Non-breeders missing
- Is sampling representative?

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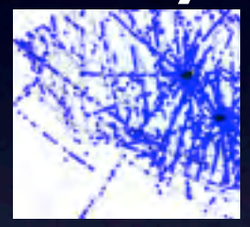

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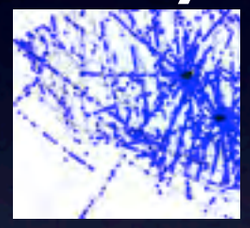

kernel-density

Two sources of locations

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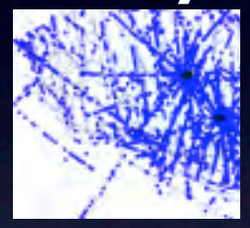

kernel-density

additional steps

Two sources of locations

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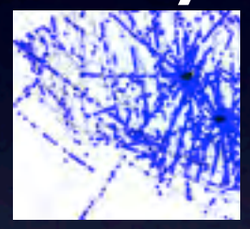

kernel-density

additional steps

=> conditional density

Two sources of locations

BLKI GPS track

kernel-density

additional steps

=> conditional density

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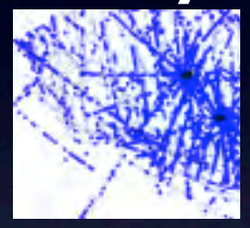

abundance model
and/or kriging

Two sources of locations

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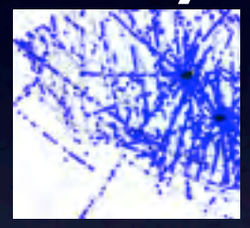
kernel-density

additional steps

=> conditional density

BLKI survey locations



abundance model
and/or kriging

=> density surface

What's needed?

densities from tracking data

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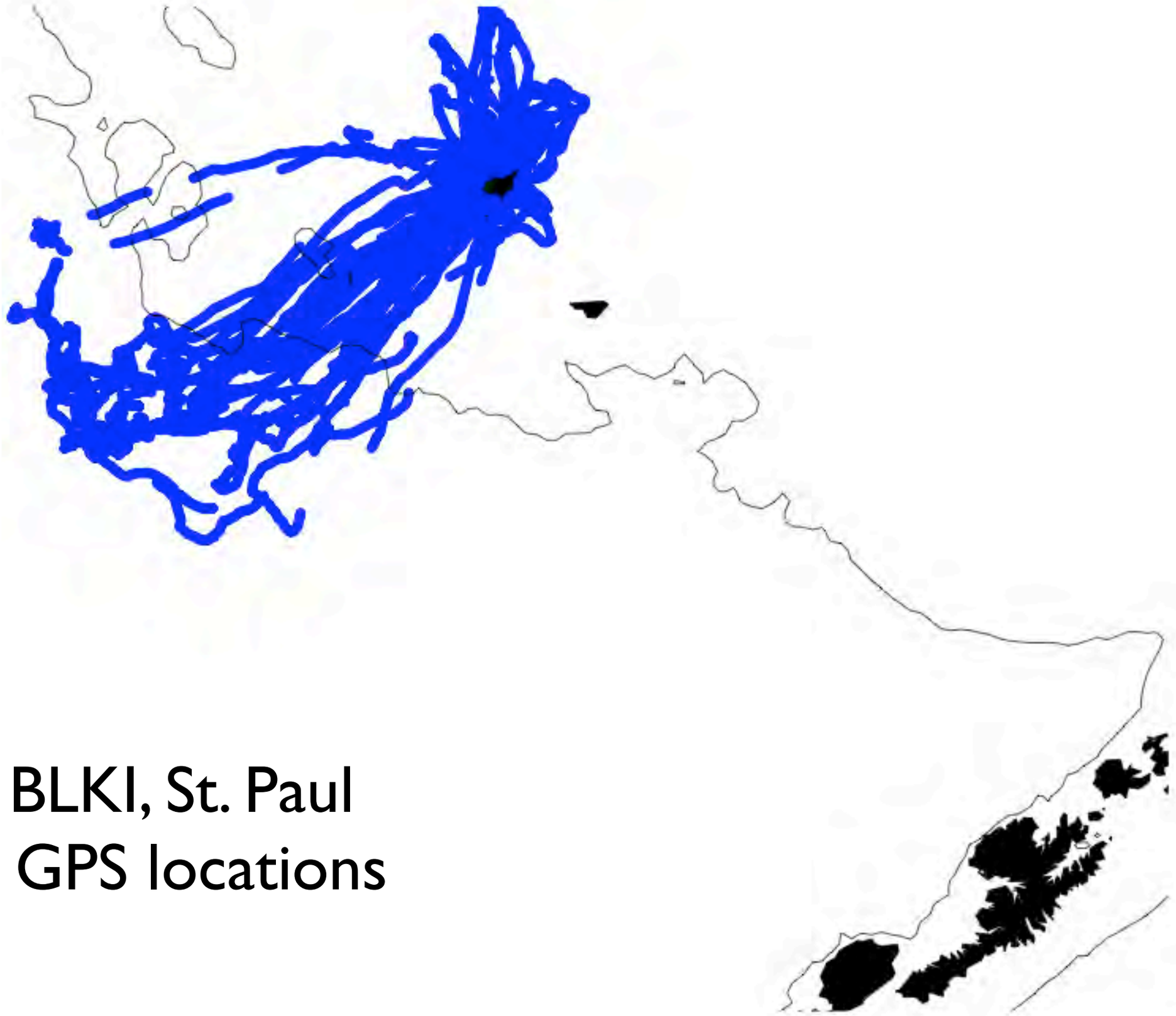
densities from tracking data

- tracks
- estimate of total population (% tracked)
- representative sampling
- [Whitehead & Jonsen's 2013: bayesian model]

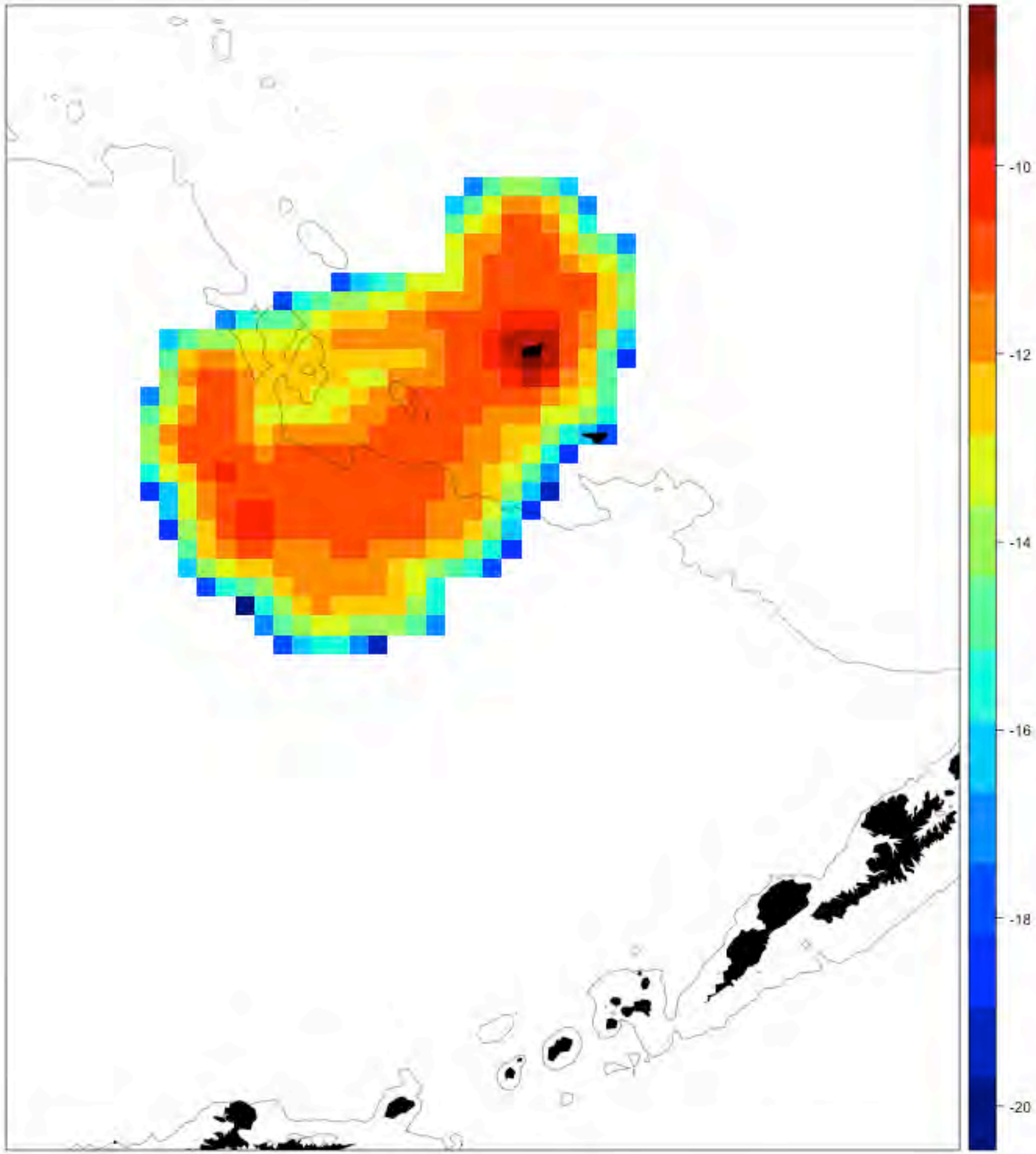
Let's play

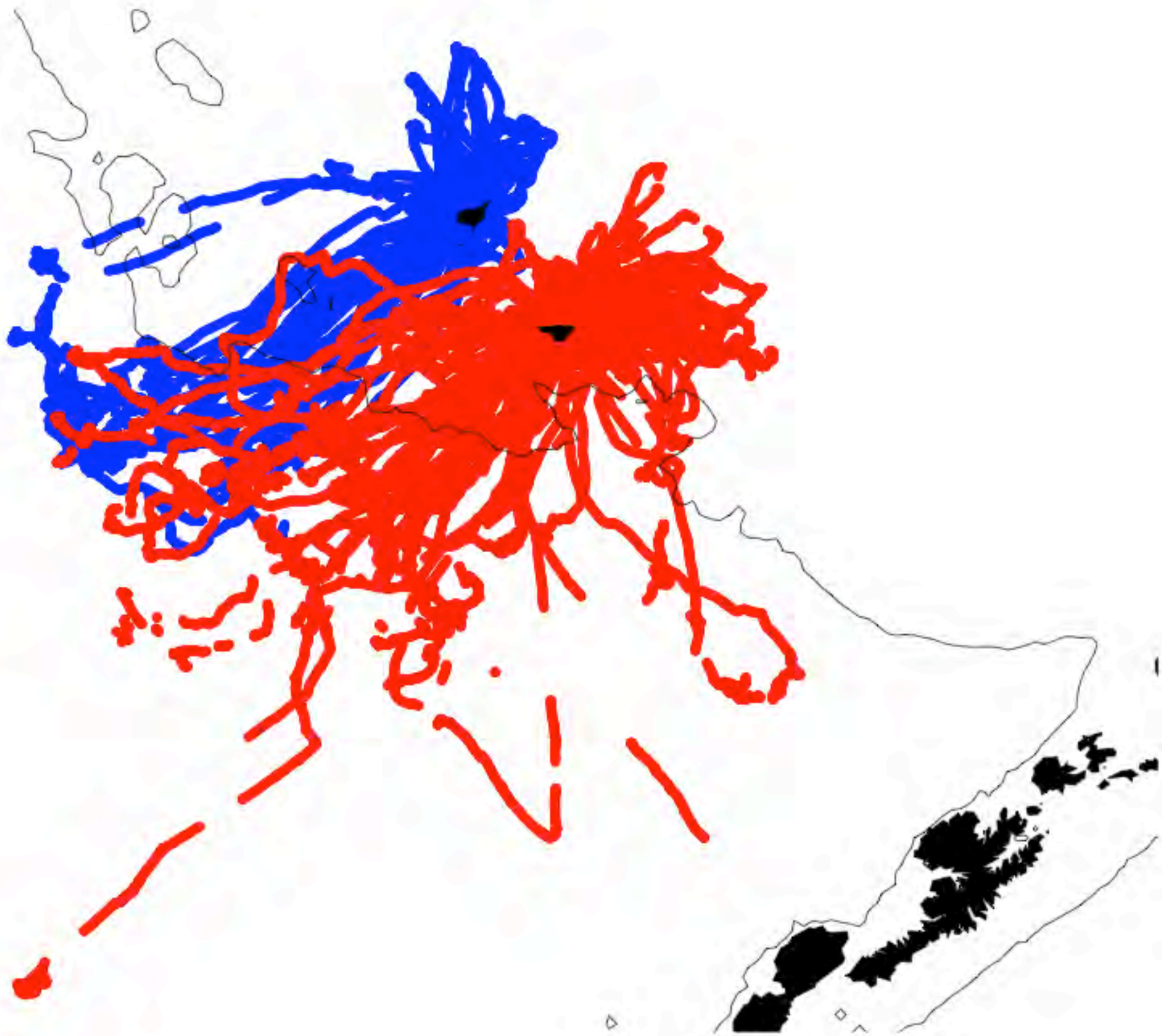
- GPS tracks of Black-legged Kittiwakes from the Pribilof Islands (St. Paul and St. George), courtesy of Rosana Paredes
- 30 years of at-sea surveys in the SE Bering Sea (NPPSD)

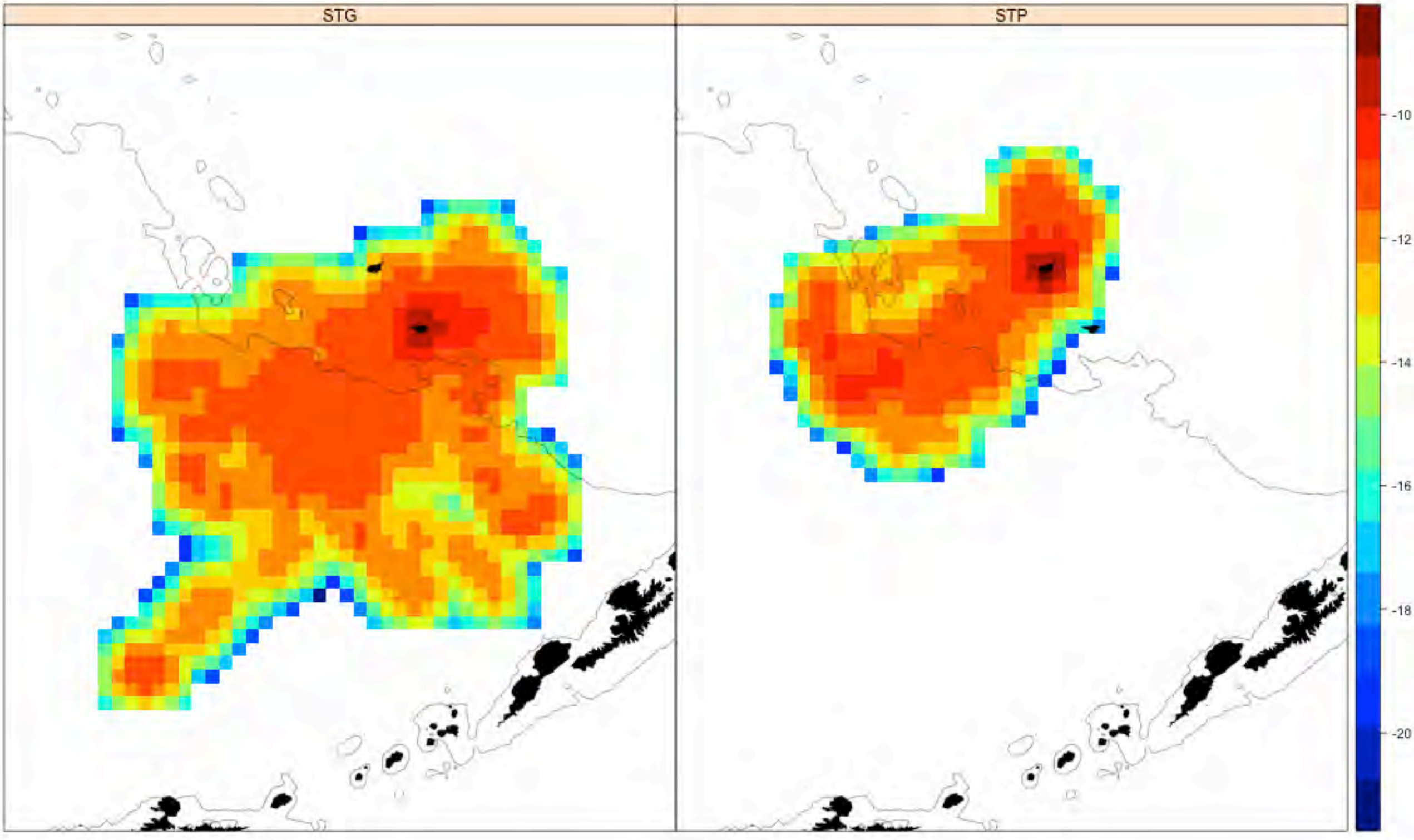
NPPSD



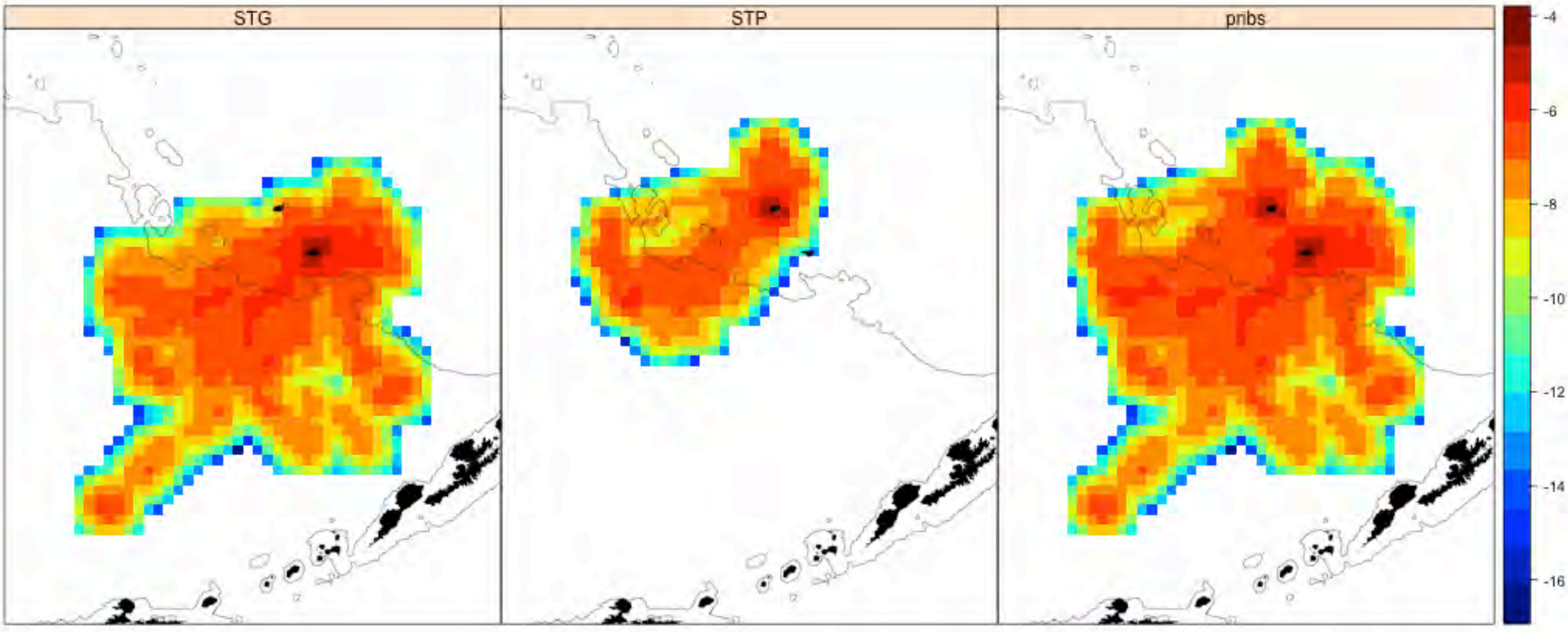
73 ind. BLKI, St. Paul
200,342 GPS locations

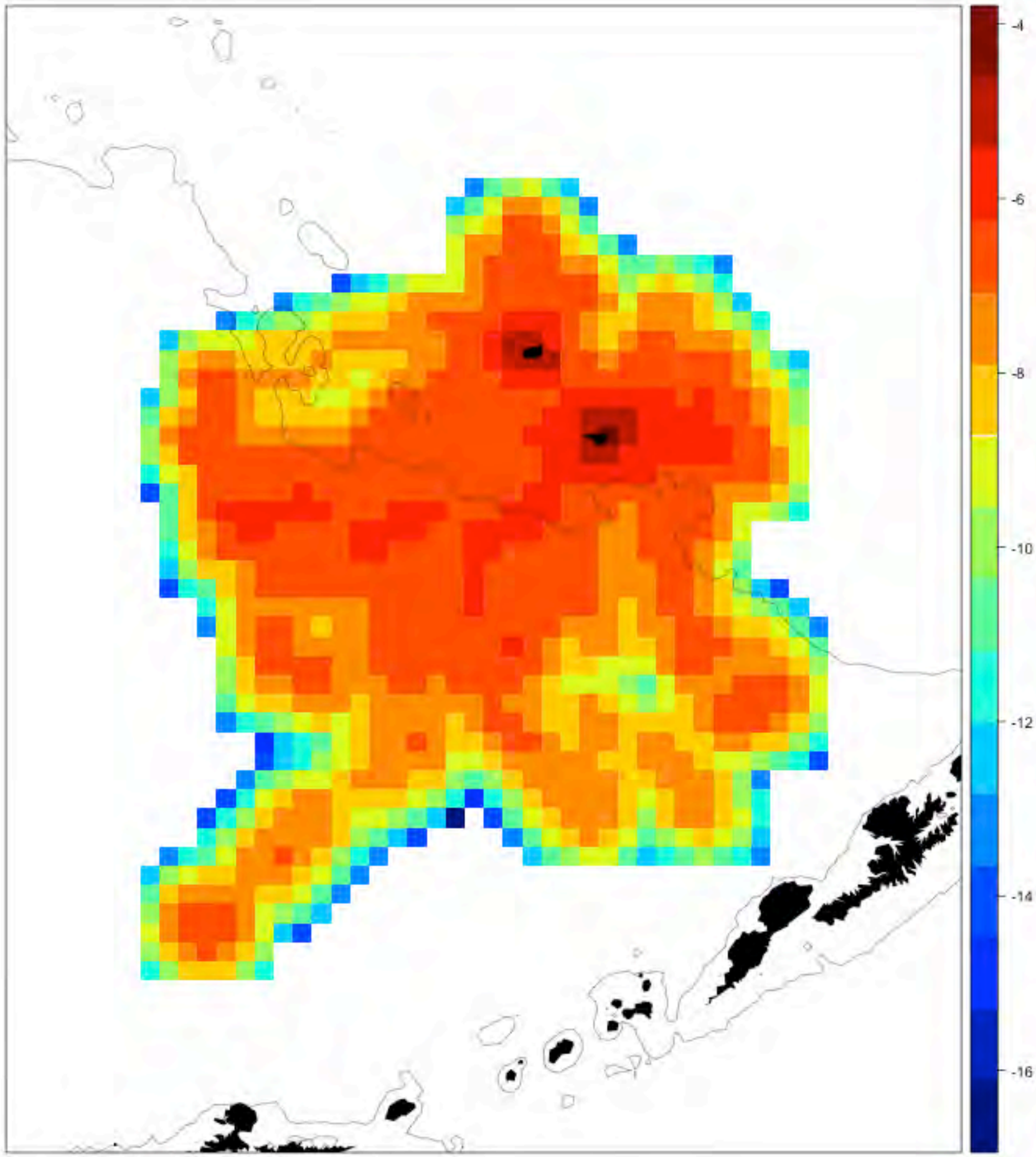

-10
-12
-14
-16
-18
-20



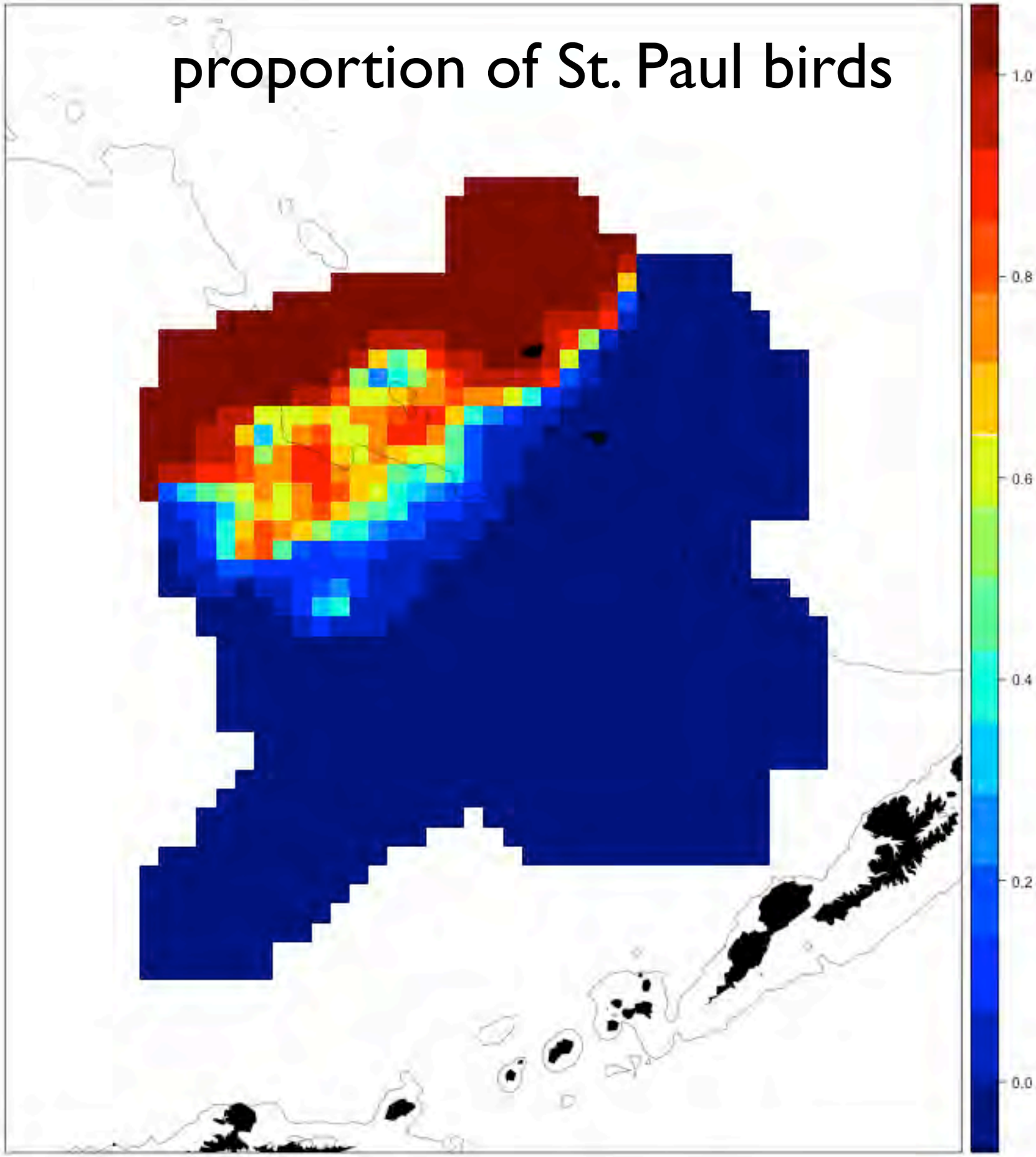

STG
STP
-10
-12
-14
-16
-18
-20

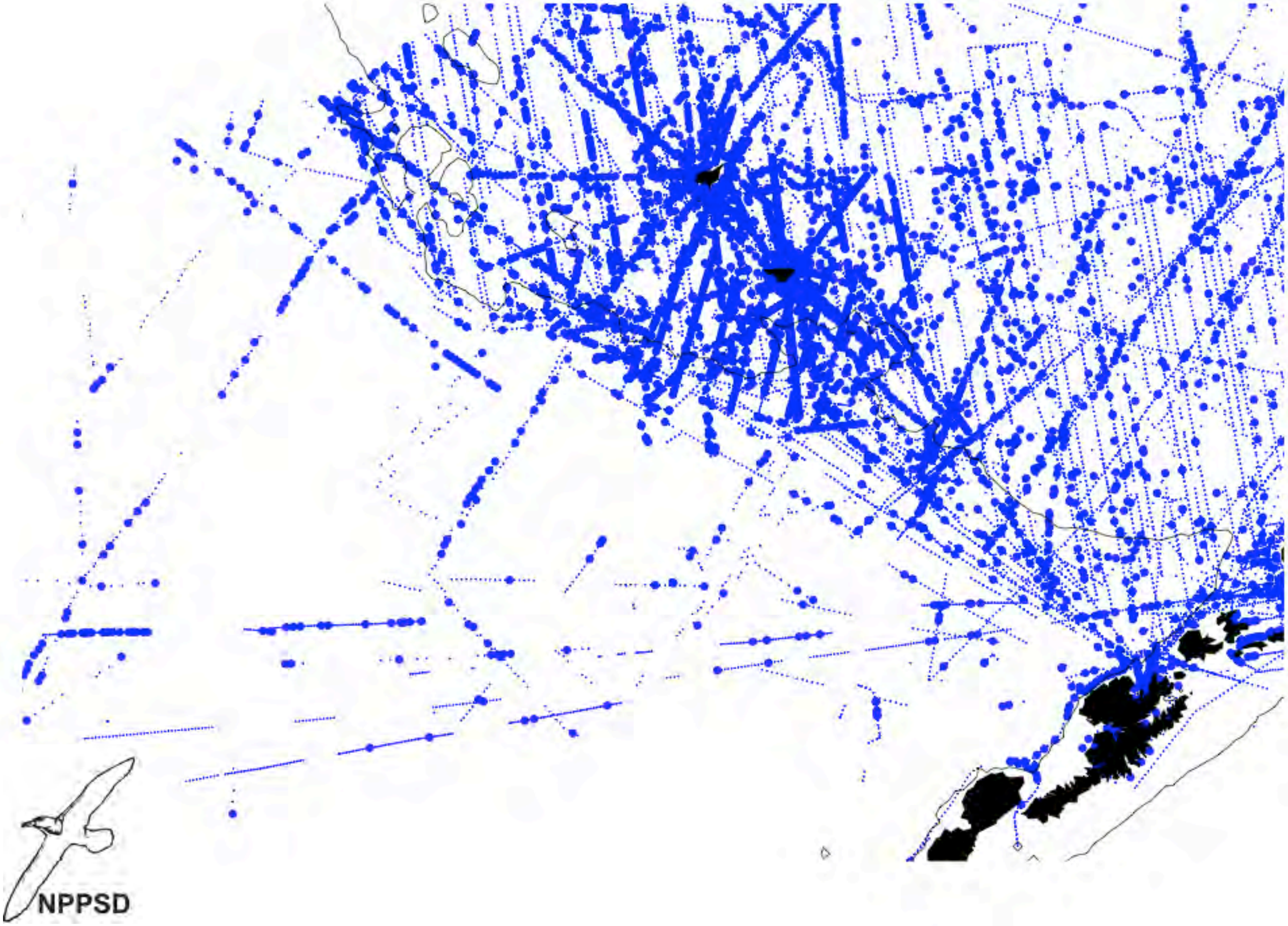
scale each island by the total number of breeders
add all islands

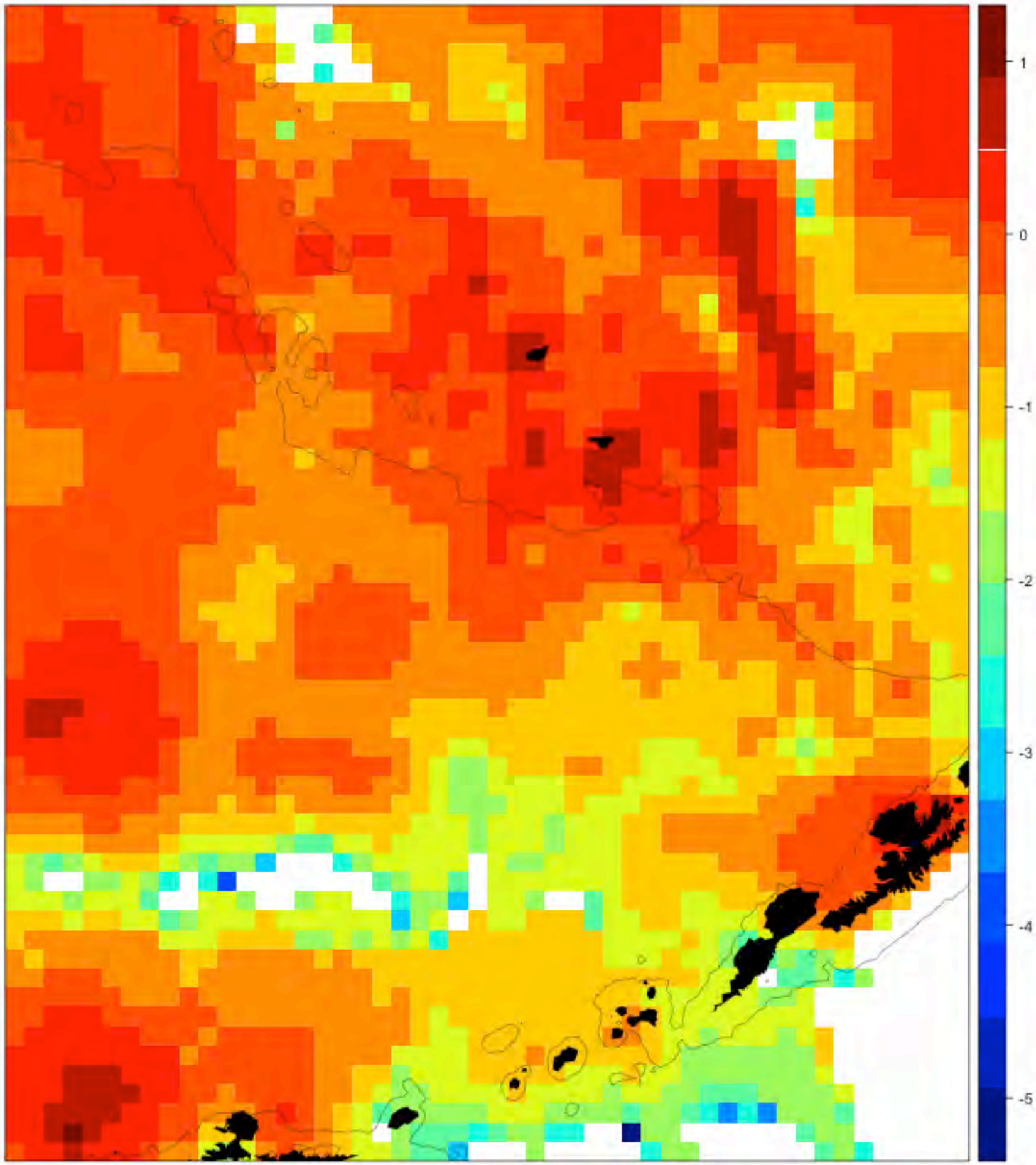



-4
-6
-8
-10
-12
-14
-16

proportion of St. Paul birds




NPPSD

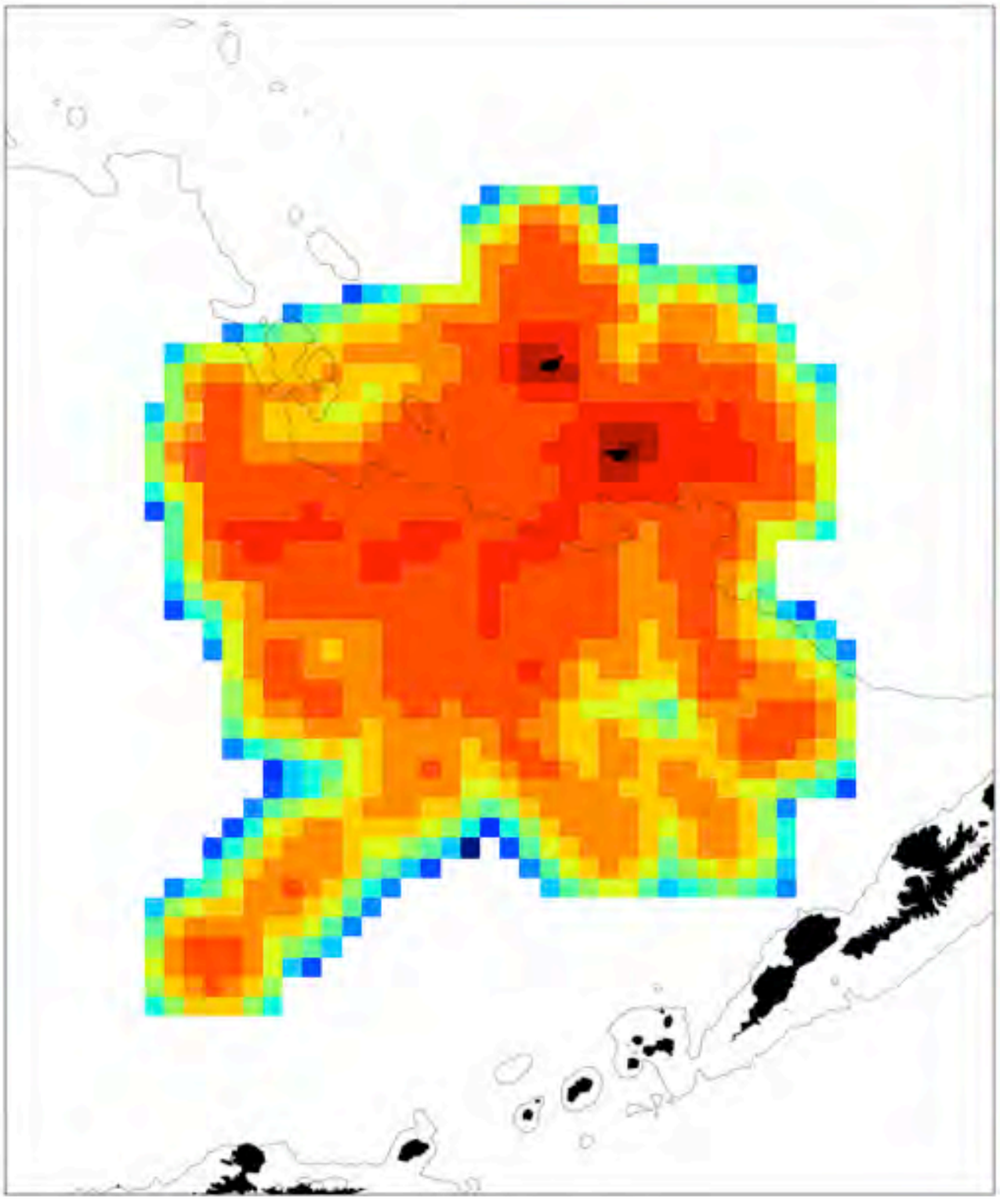


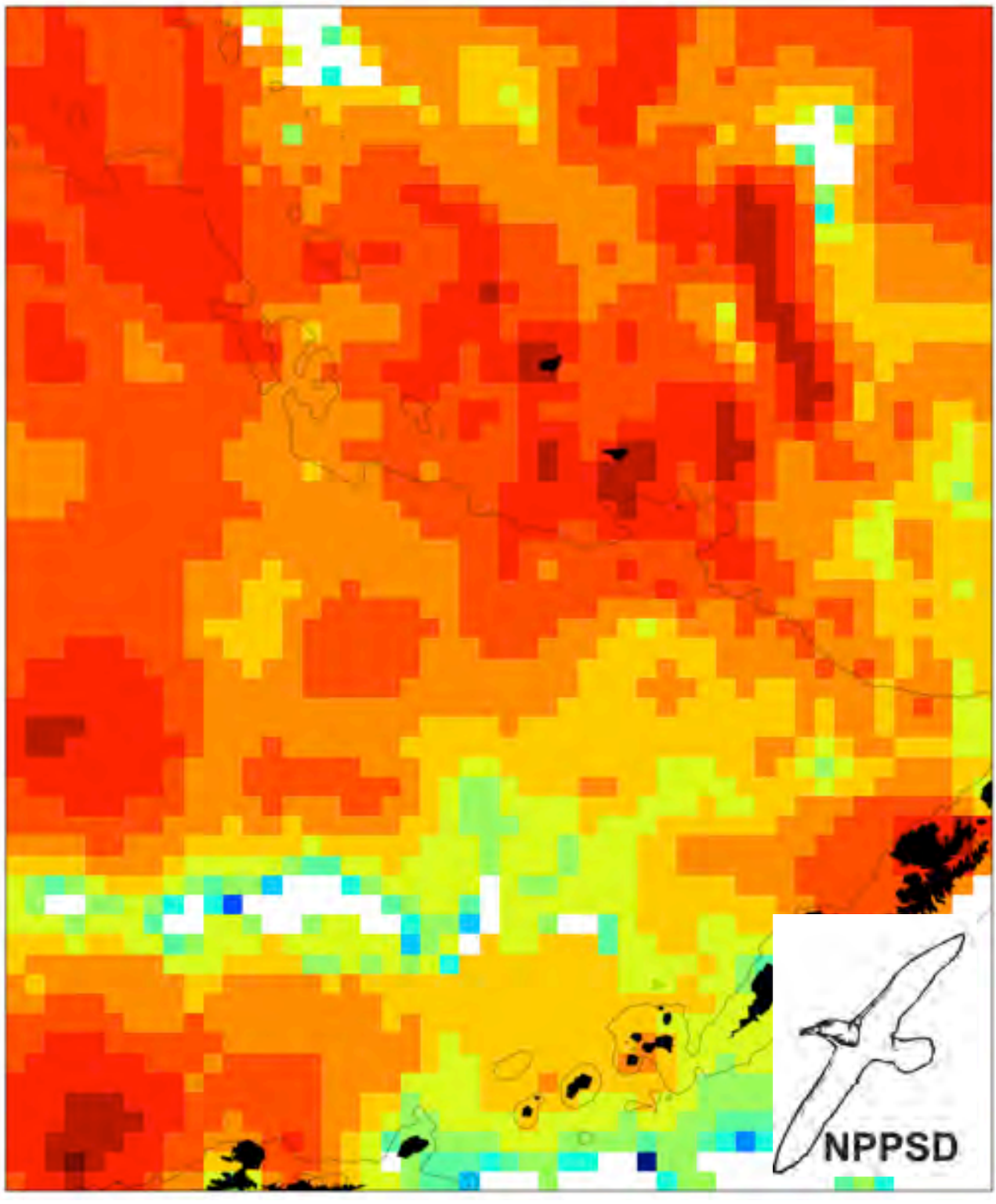
kriged BLKI, June-July

NPPSD

GPS

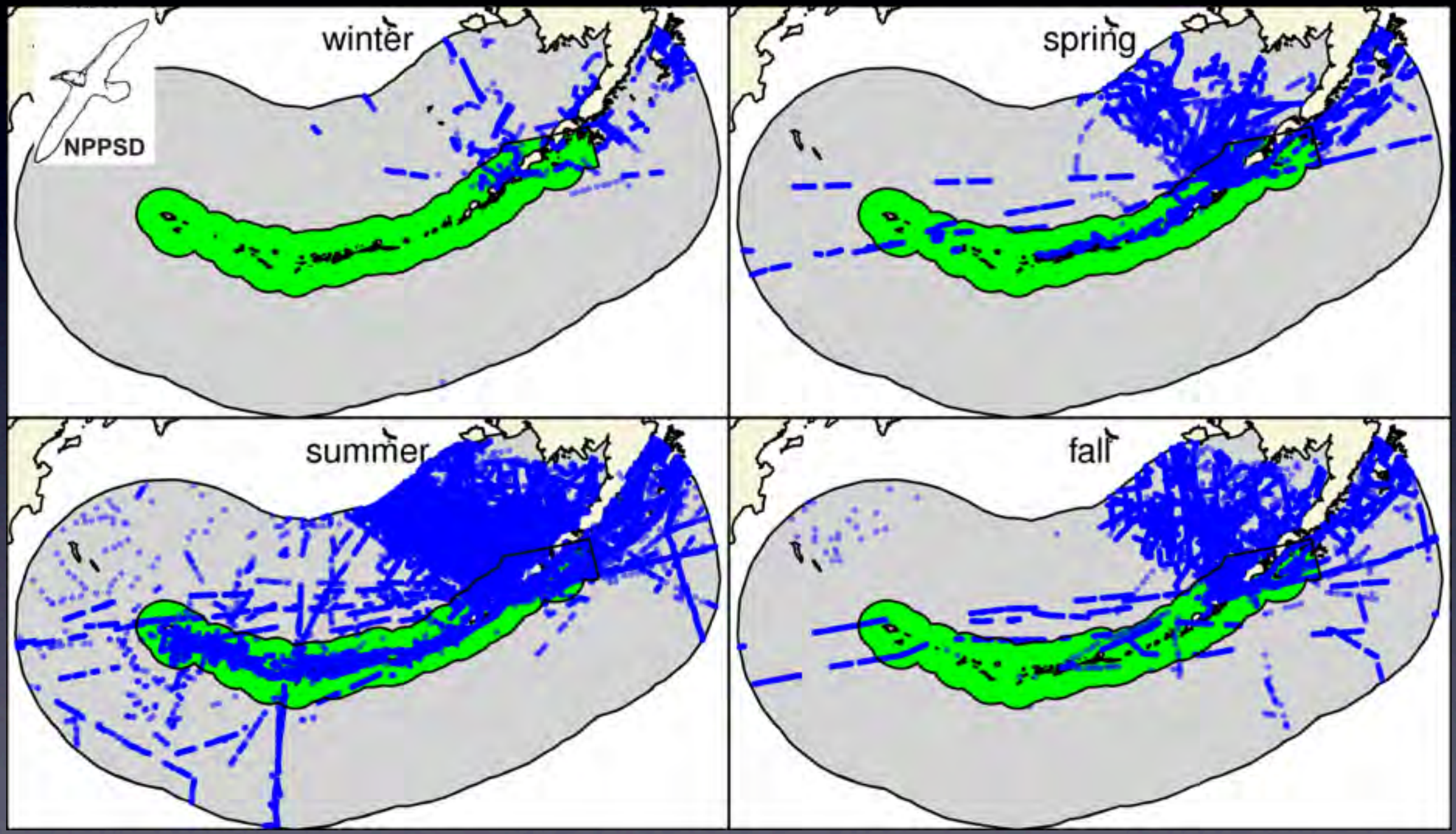
survey





	strength	weakness
survey	direct measure of density 4 decades of historic data all species	coverage (winter, offshore) ship attraction, detection
track	full spatial coverage (temporal coverage)	representative sample? population size known?

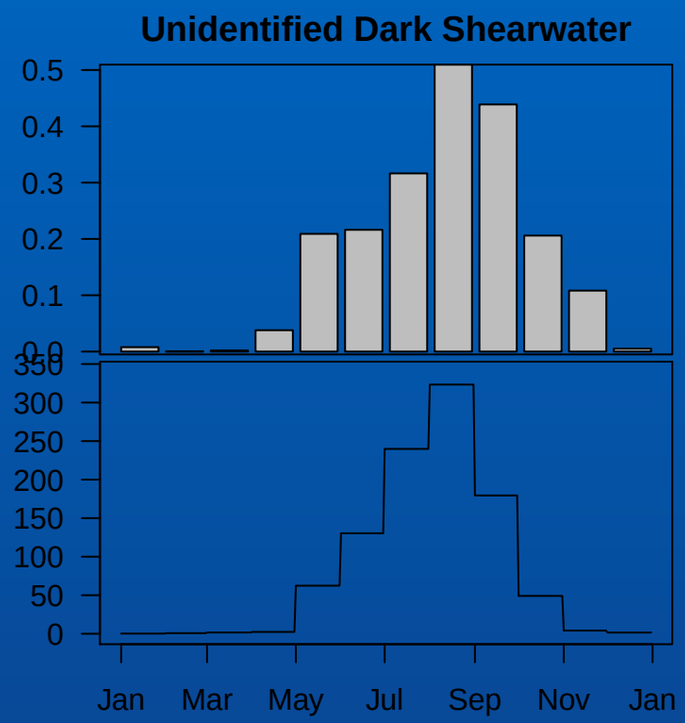
> 100,000 records

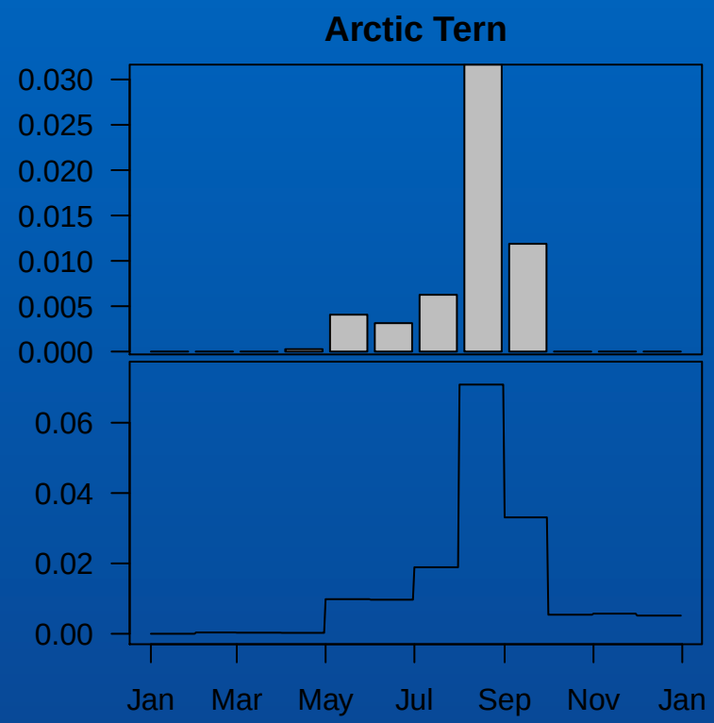


Modeling Problems

% occurance

RF density





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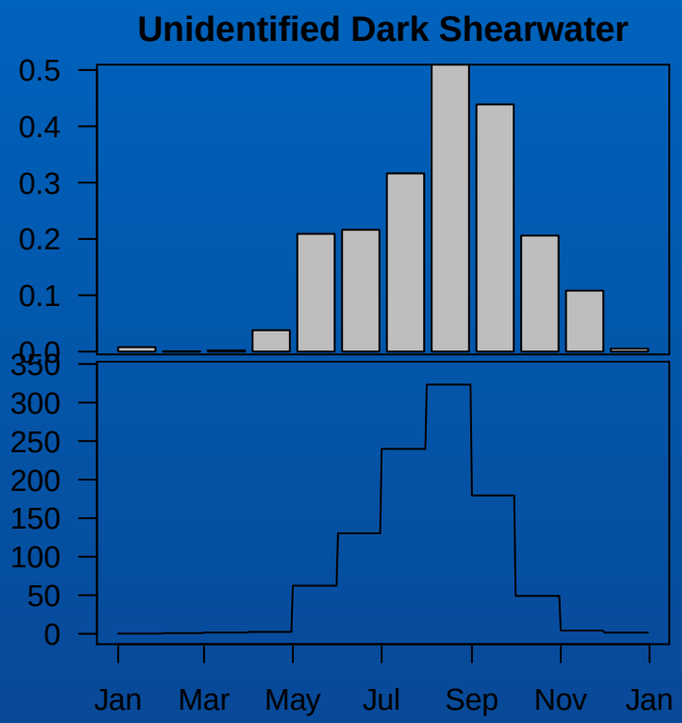

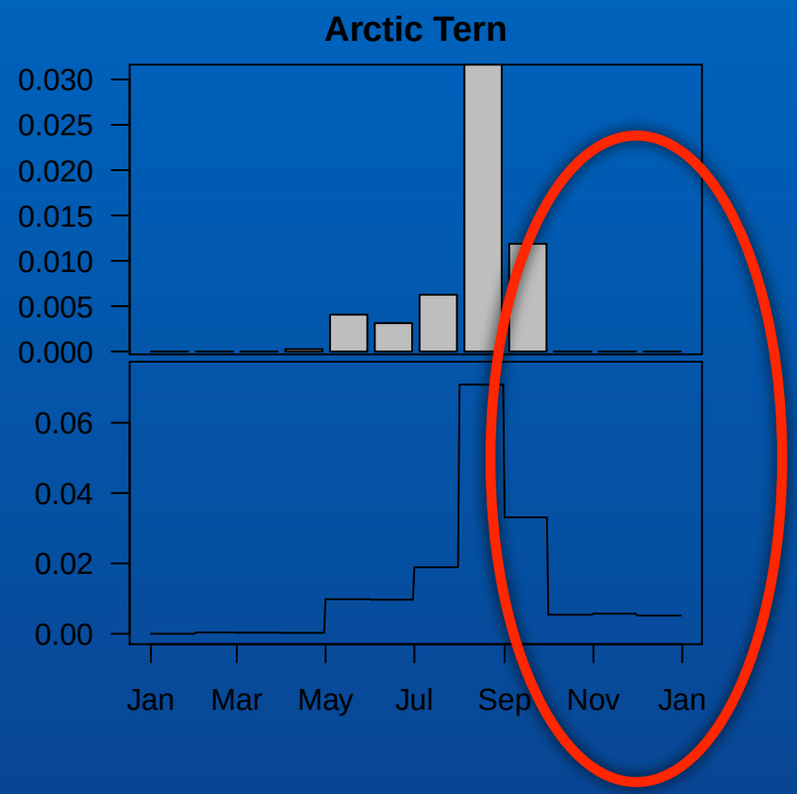

How after all?

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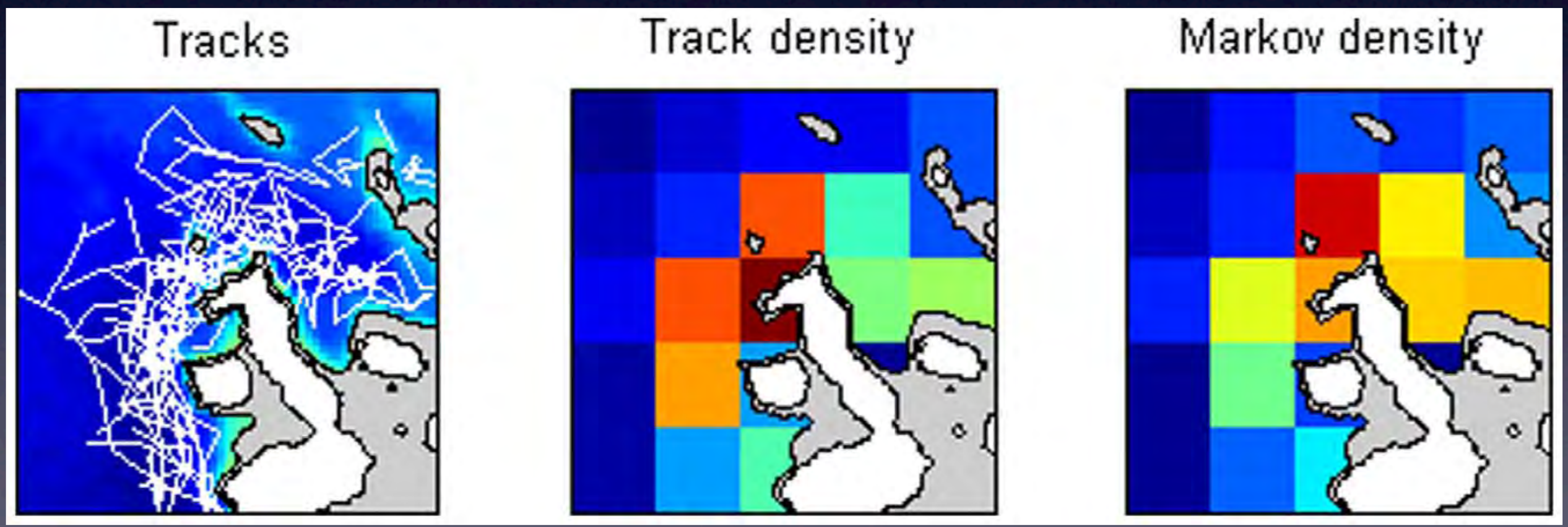
- Whitehead & Jonsen 2013
(STAL, cetaceans)

Whitehead & Jonsen 2013 Sperm Whale



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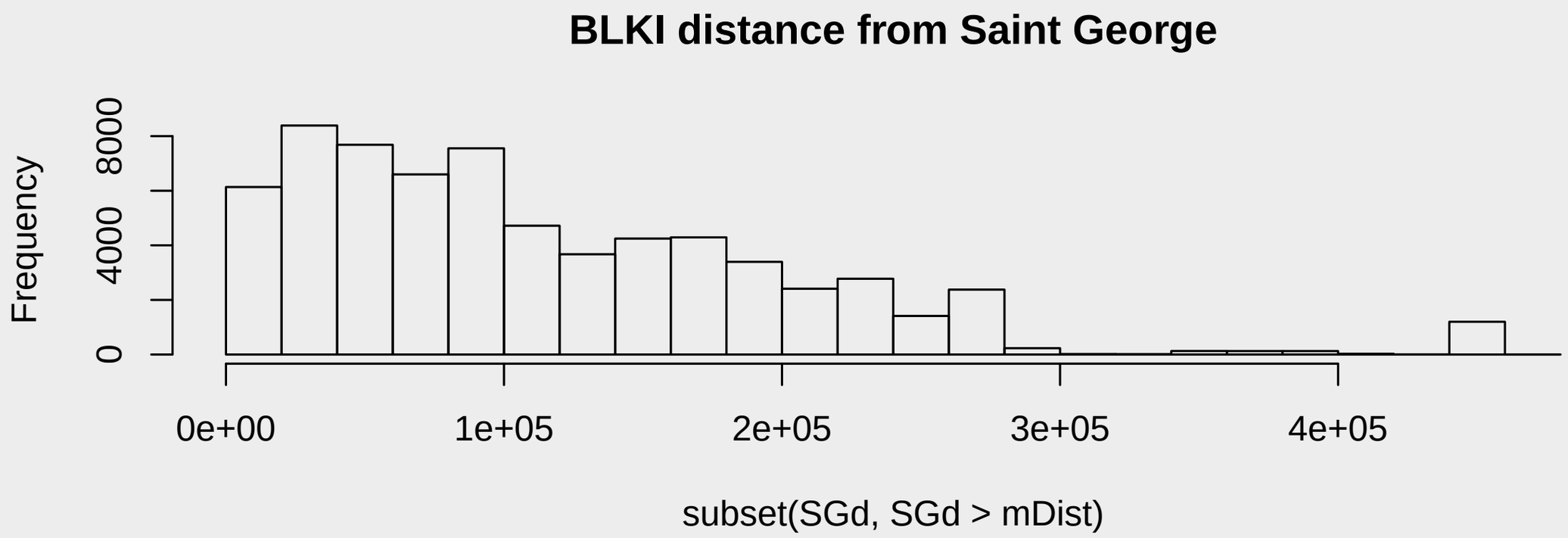
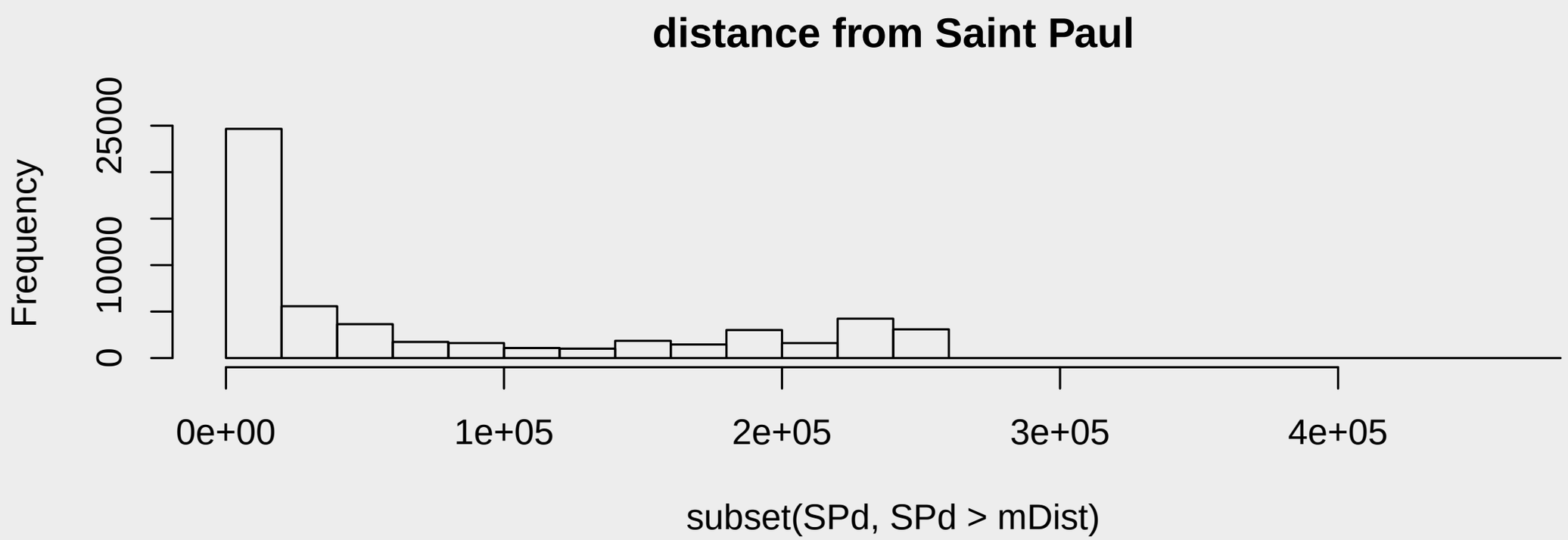

BLKI distance from Saint George
Frequency
0
4000
8000
0e+00
1e+05
2e+05
3e+05
4e+05
subset(SGd, SGd > mDist)


distance from Saint Paul
Frequency
0
10000
25000
0e+00
1e+05
2e+05
3e+05
4e+05
subset(SPd, SPd > mDist)

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- improve “colony effect”
- regression survey~track
- use hard cut-offs

Hard cut-offs?

- use all locations to define presence/absence
- Build spatial-temporal, not environmentally driven model
- phenology of long-distance migrants
- winter areas, if adequate sampling available (likely from satellite/geolocators, not summer GPS)

How after all?

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- isolated areas (Pribs)
- use hard cut-offs
- calibrate survey (vessel attraction)
- bayesian model

Proceed with caution

Promising

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- well mixed species:

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  - cetaceans (within stocks)

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Promising

- well mixed species:
  - cetaceans (within stocks)
  - short-tailed albatross
  - stack all colonies (LAAL, BFAL)
  - non-breeding seabirds?
- complement select locations (boundaries = ?)

Where it doesn't work

- most seabird and seal species during breeding season?
- not representatively sampled
  - many colonies, sampled on land
  - Aleutian seabirds, gulls, WHAU

Summary

- Survey and tracking data complement each other
- Merging them is not straightforward and may only happen in special cases

Future

Future

NSA

CIA

Future

NSA

- snoop on every individual

CIA

- fly drones

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CIA

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What is sound investment?