Mechanisms affecting seabird-prey associations over submarine canyons in the northwestern Bering Sea

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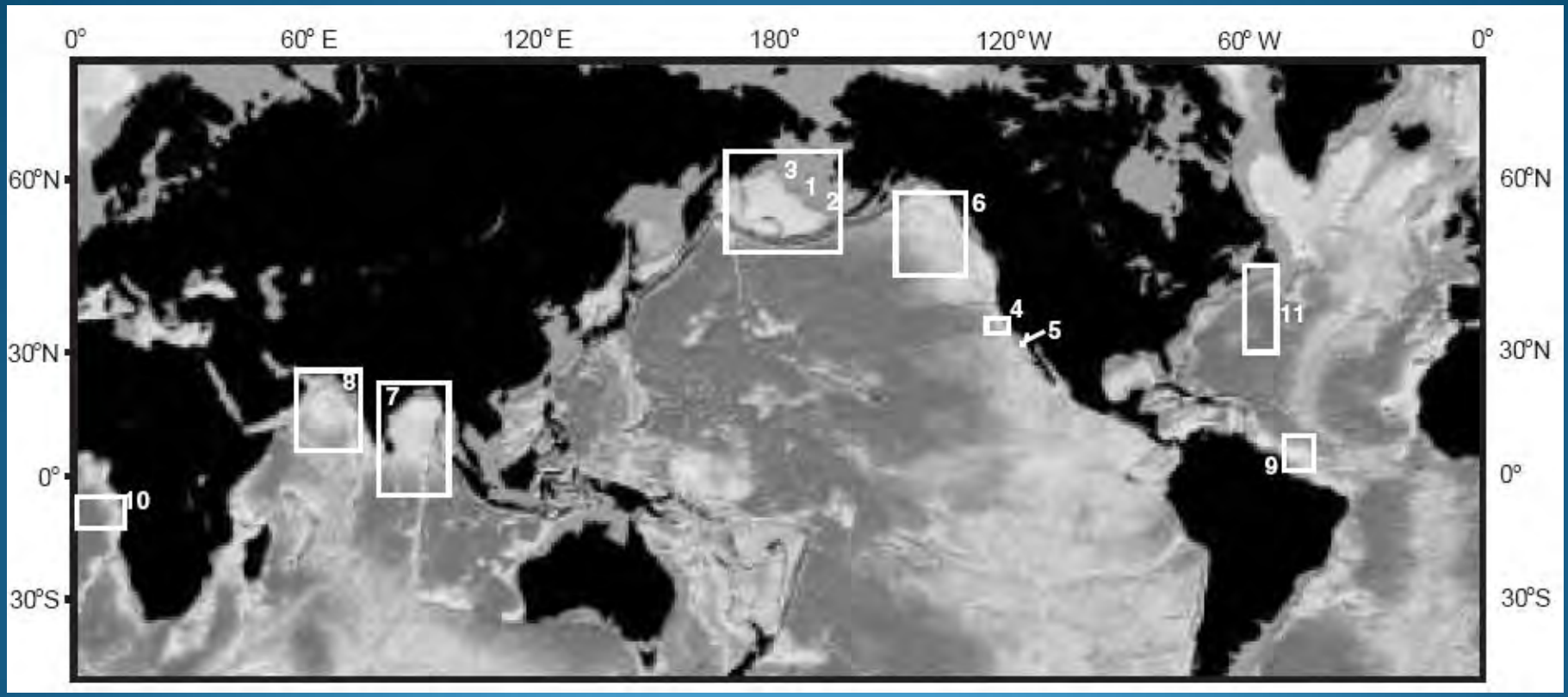
Biological Importance of Submarine Canyons

Continental shelf edges, submarine canyons and seamounts often enhance local primary production through:

- Strong vertical mixing generated by shelf-break fronts, slope and turbidity currents , among other physical processes

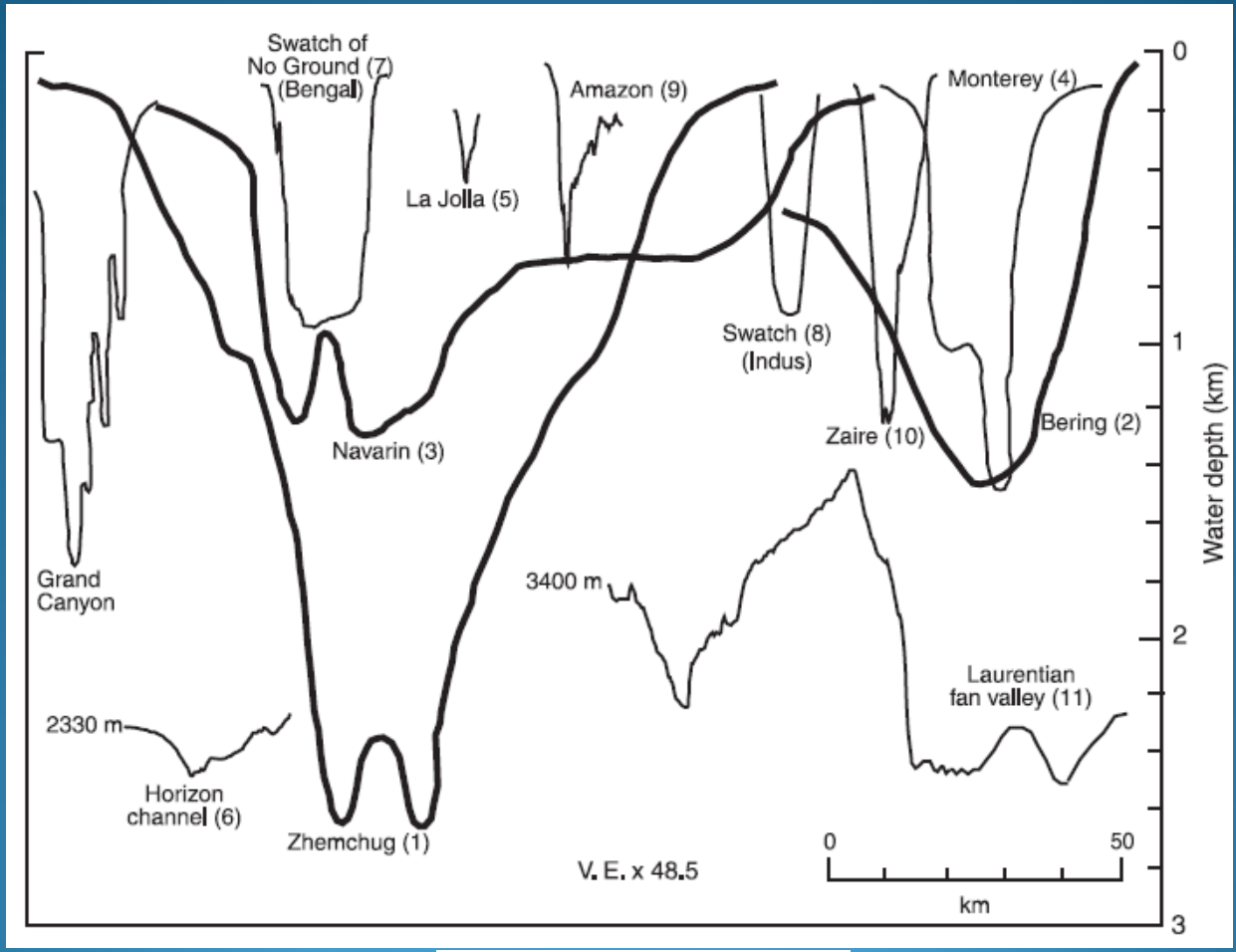
- Aggregation and retention of phytoplankton and prey via flow convergence , or and eddy formation

Largest Submarine Canyons - Globally



Normark and Carlson, 2003, Geo. Soc. Am.

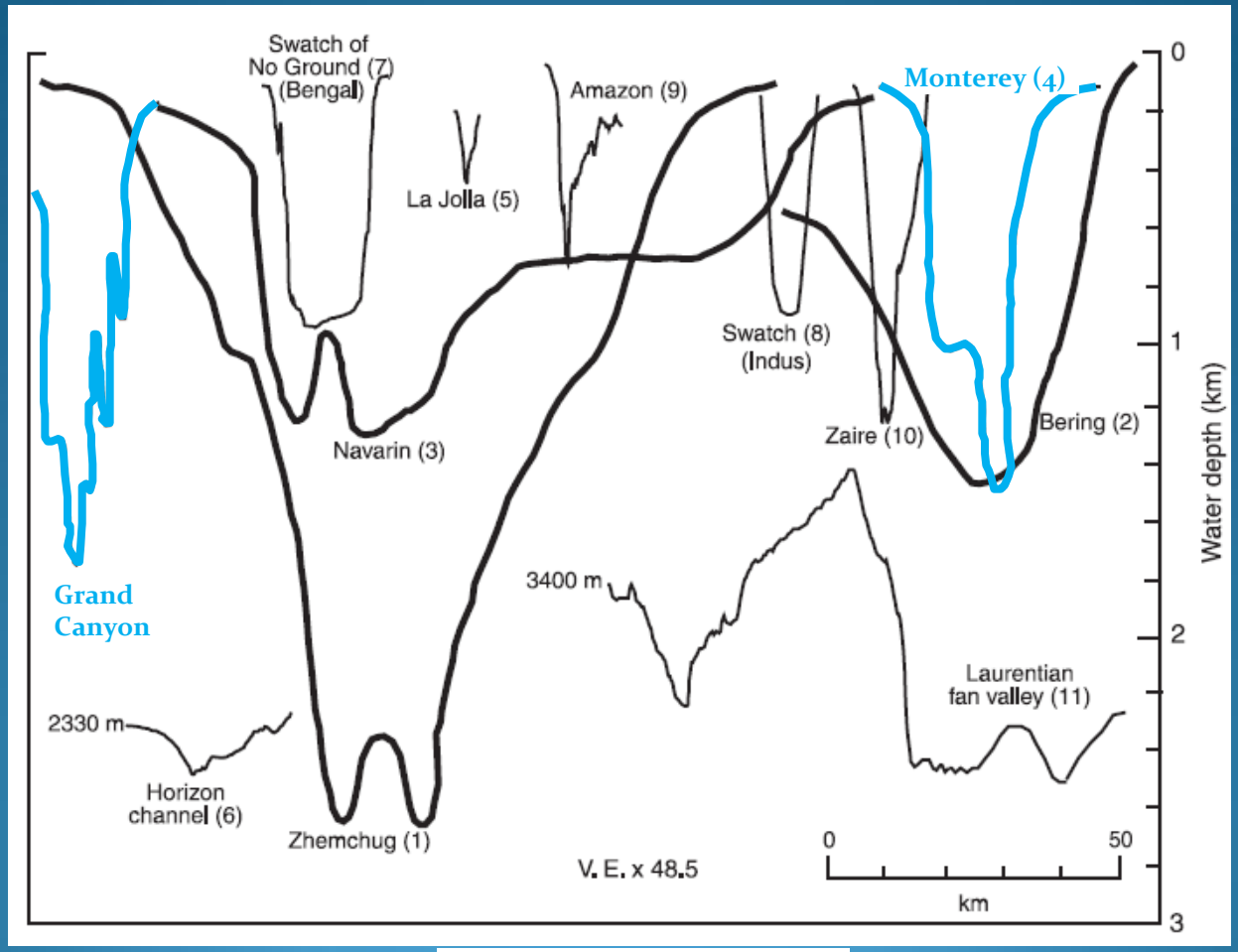
Largest Submarine Canyons



Canyon Cross Section (km)

Normark and Carlson, 2003, Geo. Soc. Am.

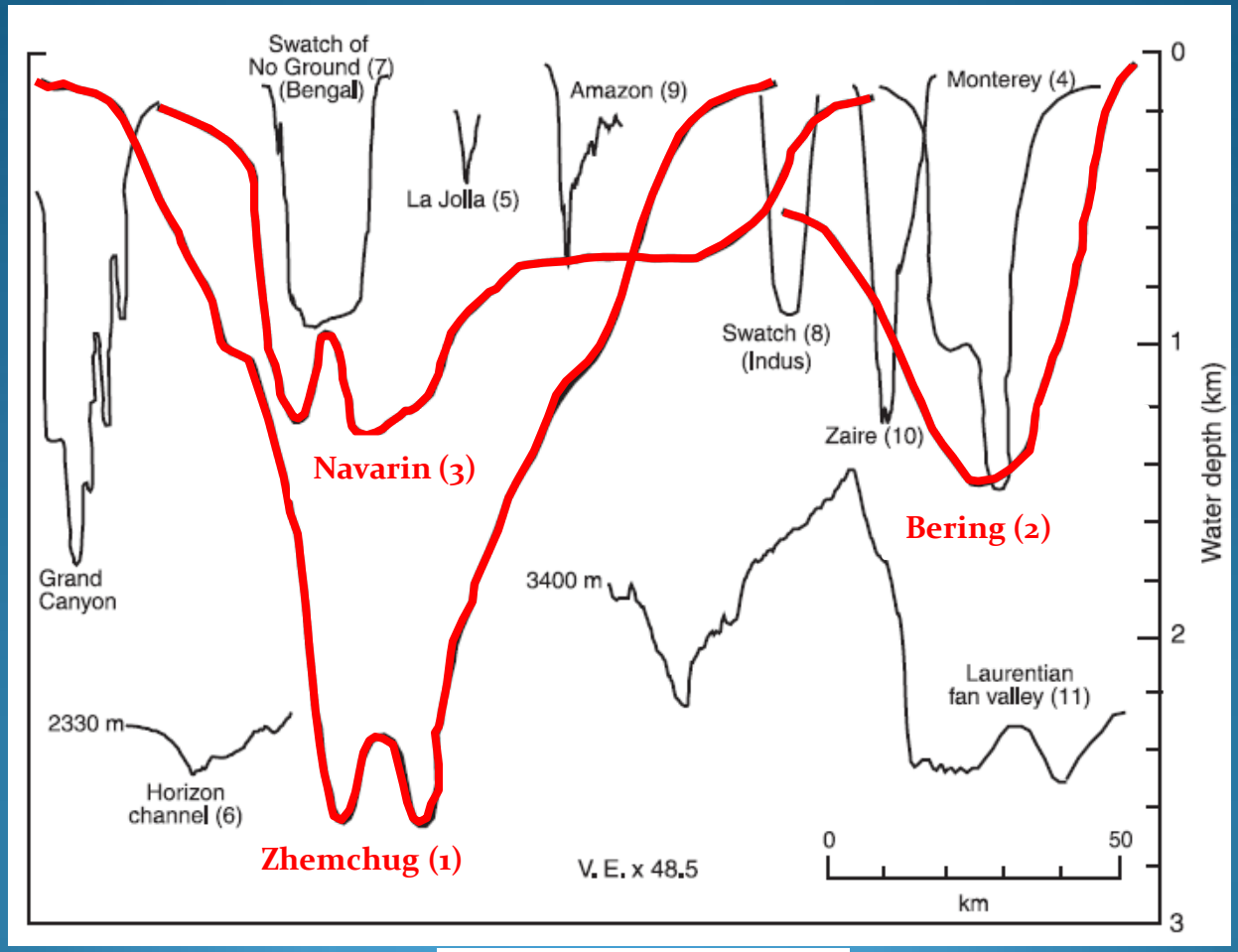
Largest Submarine Canyons



Canyon Cross Section (km)

Normark and Carlson, 2003, Geo. Soc. Am.

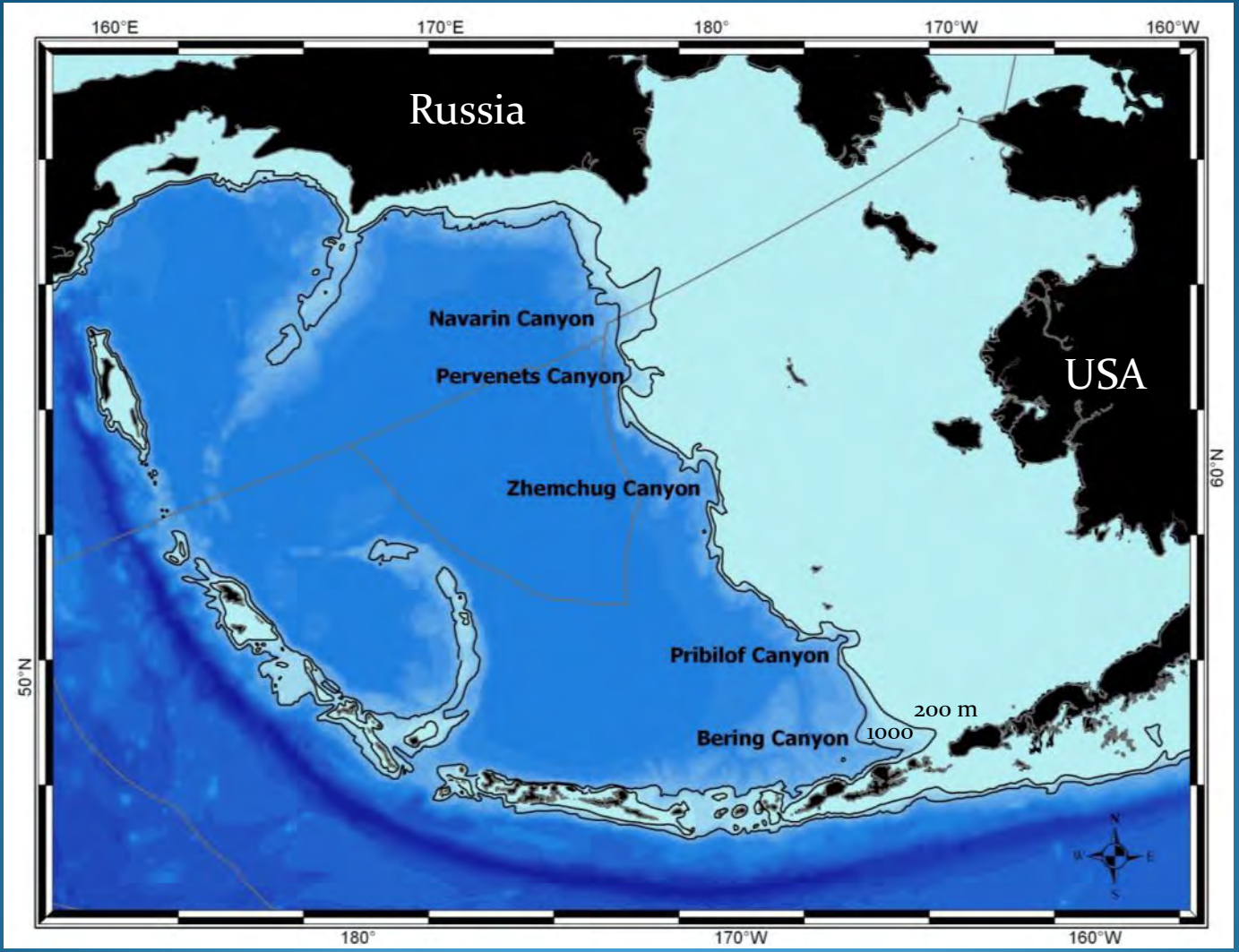
Submarine Canyons in the Bering Sea



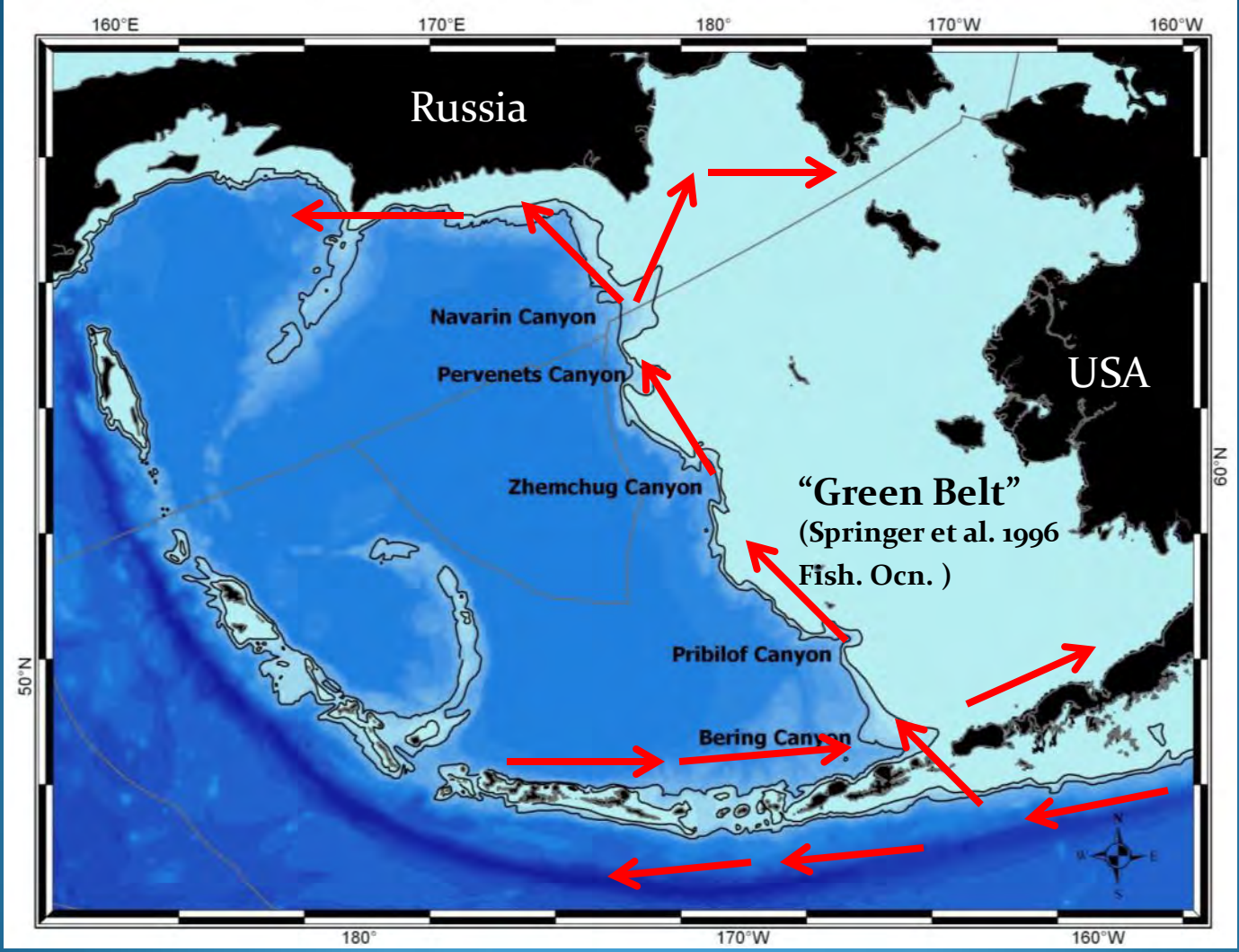
Canyon Cross Section (km)

Normark and Carlson, 2003, Geo. Soc. Am.

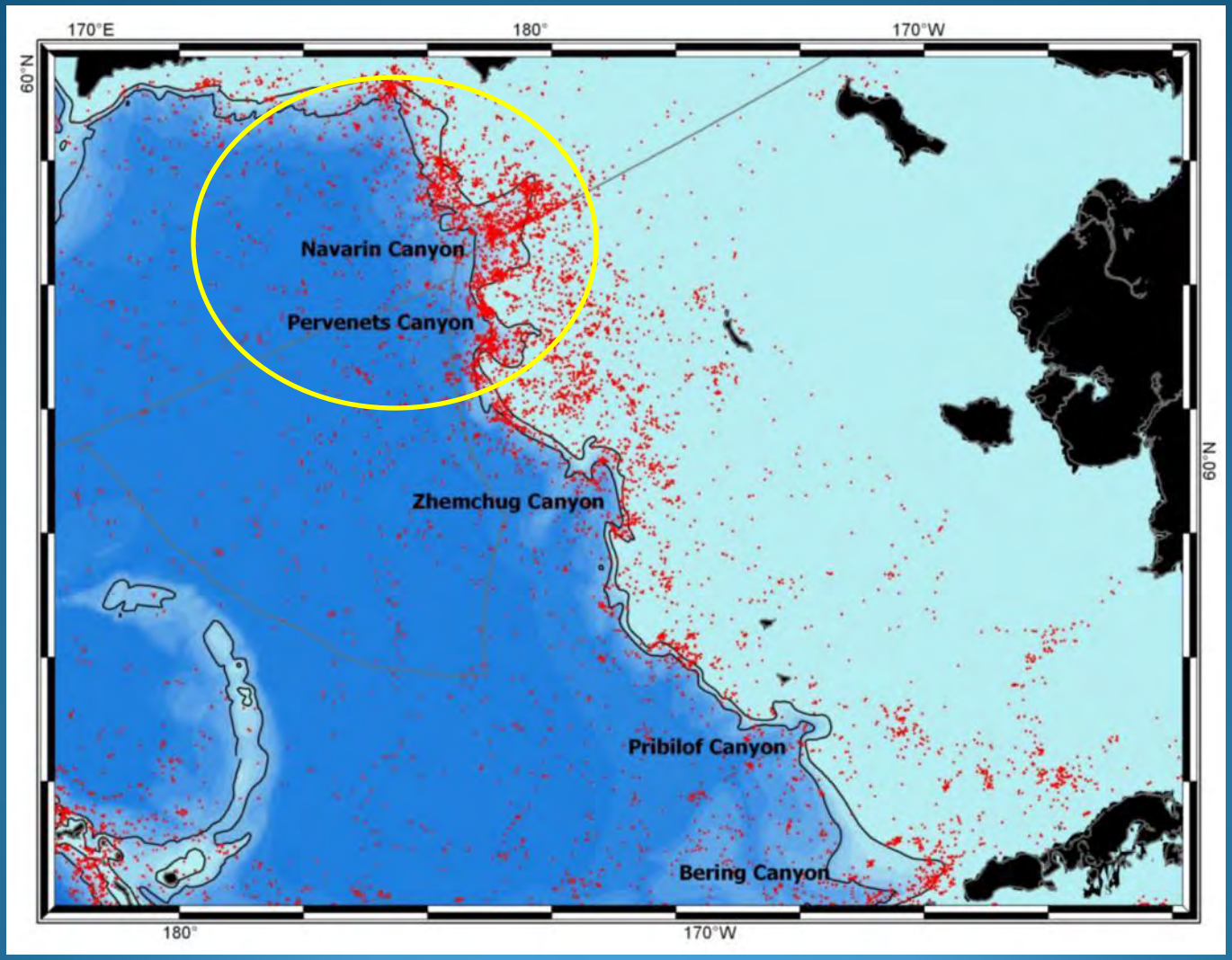
Submarine Canyons - Bering Sea



Bering Slope Current



Short-tailed Albatross Distribution



Objectives

What predators also exhibit non-uniform use of Bering Sea canyon and slope habitat?

Is the spatial distribution of prey consistent with that of predators?

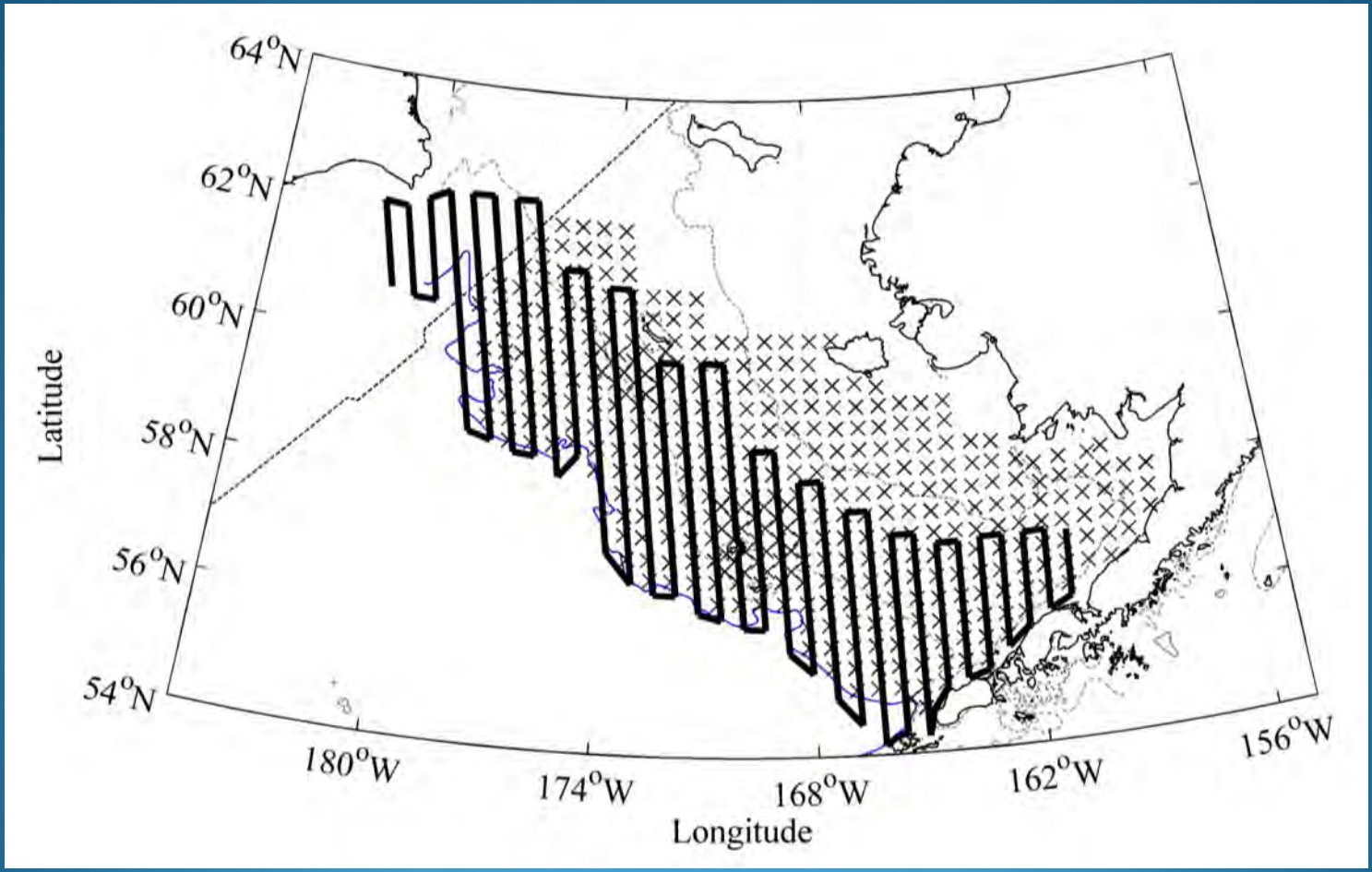
How might regional oceanography affect the productivity of Navarin Canyon?

Might on-shelf productivity be enhanced adjacent to canyons

Satellite Tracking Short-tailed Albatrosses

photo credit Alvaro Jaramillo

Surveys of juvenile pollock and euphausiids in the eastern Bering Sea



Vessel-Based Seabird Surveys

At-sea surveys:

Single observer on bridge

Strip transects (300m)

GPS-integrated data recording

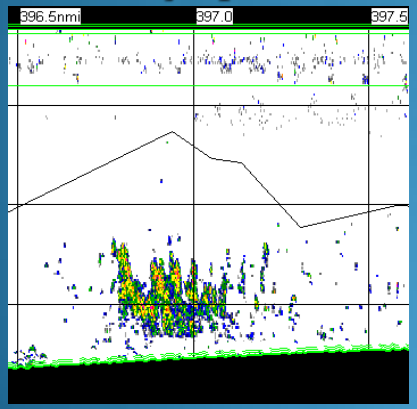
2006-2010: > 90,000 km surveyed

Analysis:

Calc. densities (birds/km^2) in 3-km bins

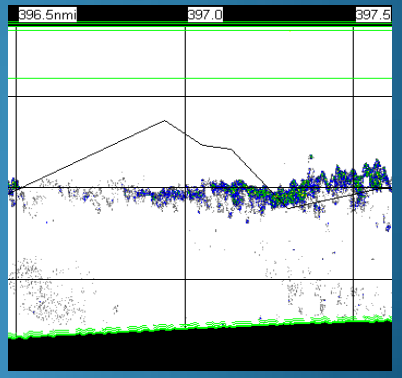
Multi-frequency acoustic data and trawl catches to survey age 1 pollock and euphausiids ('krill')

Walleye pollock



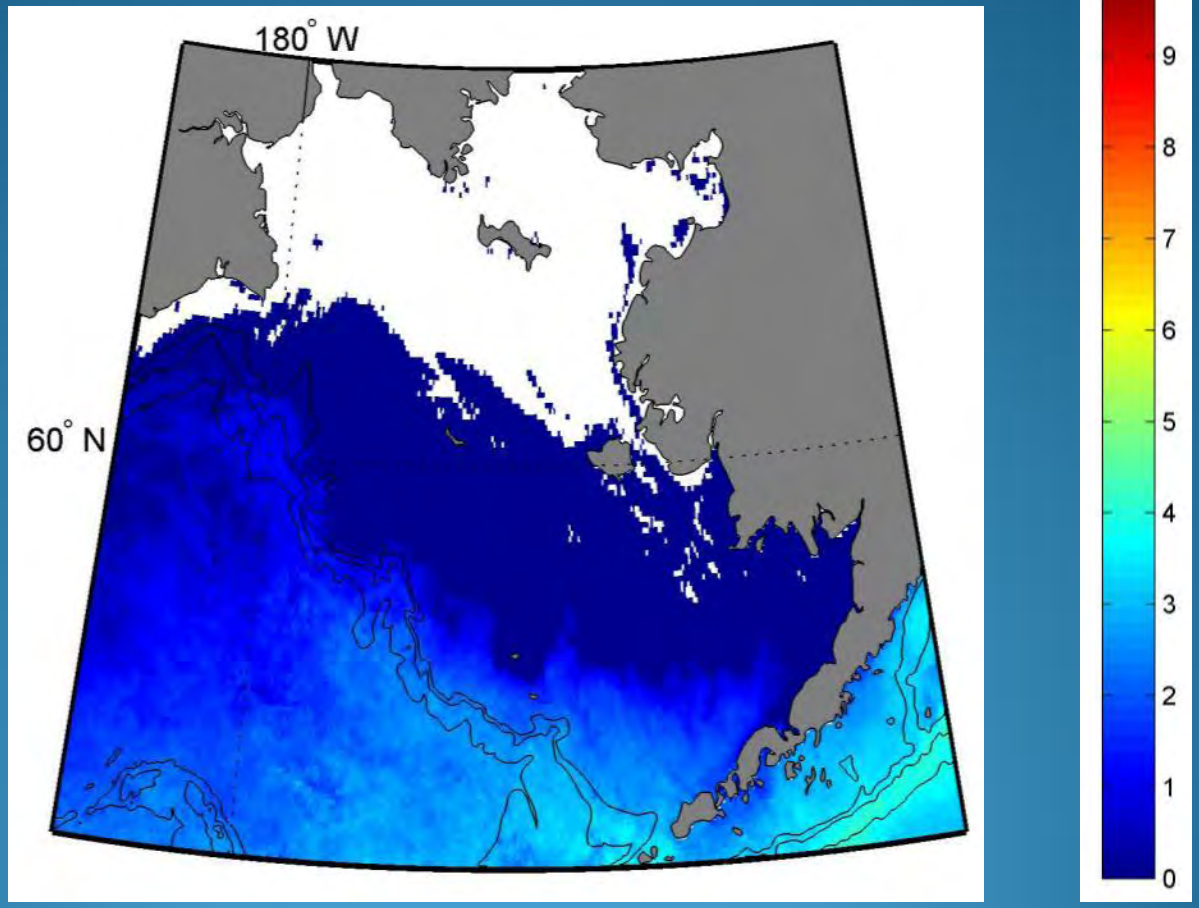
18, 38, 120, 200 kHz

Euphausiids



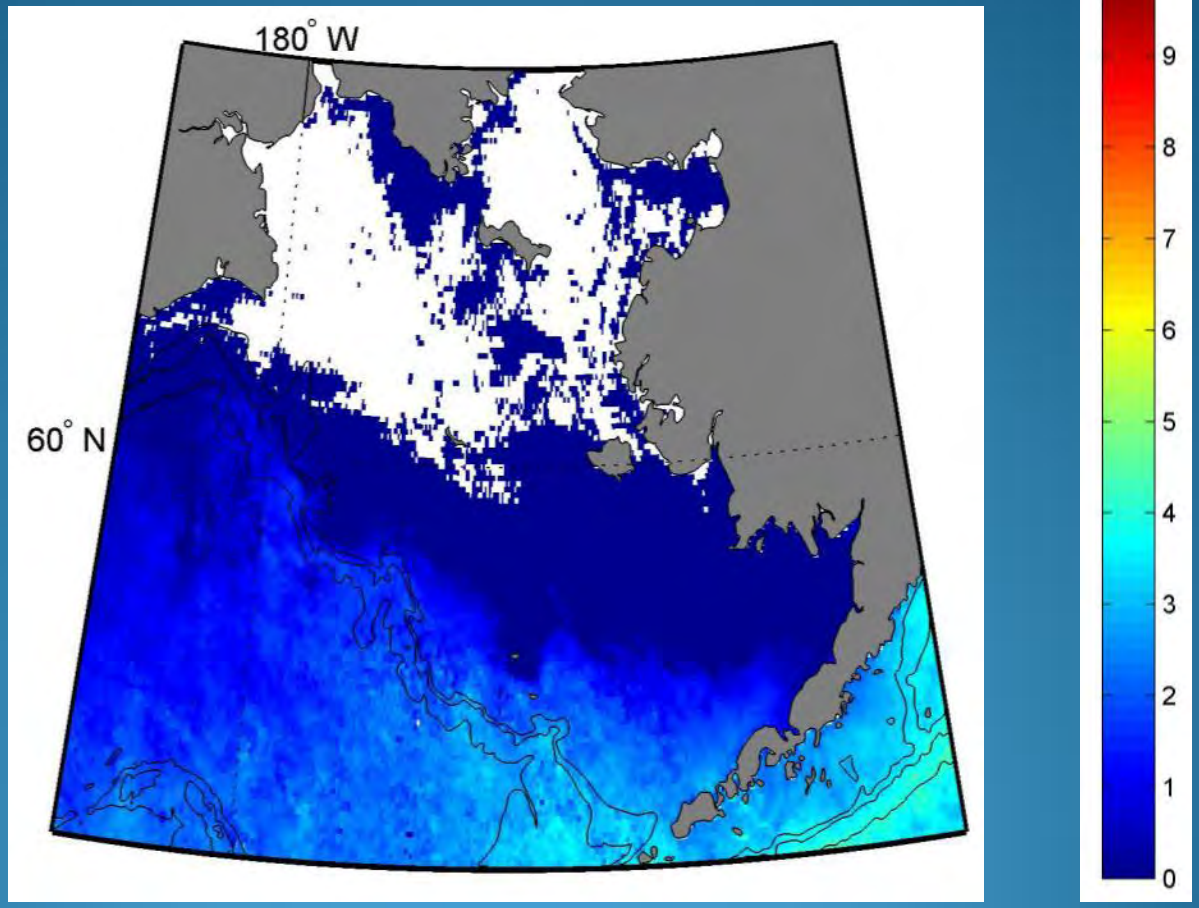
SST – *seasonal trends*

March



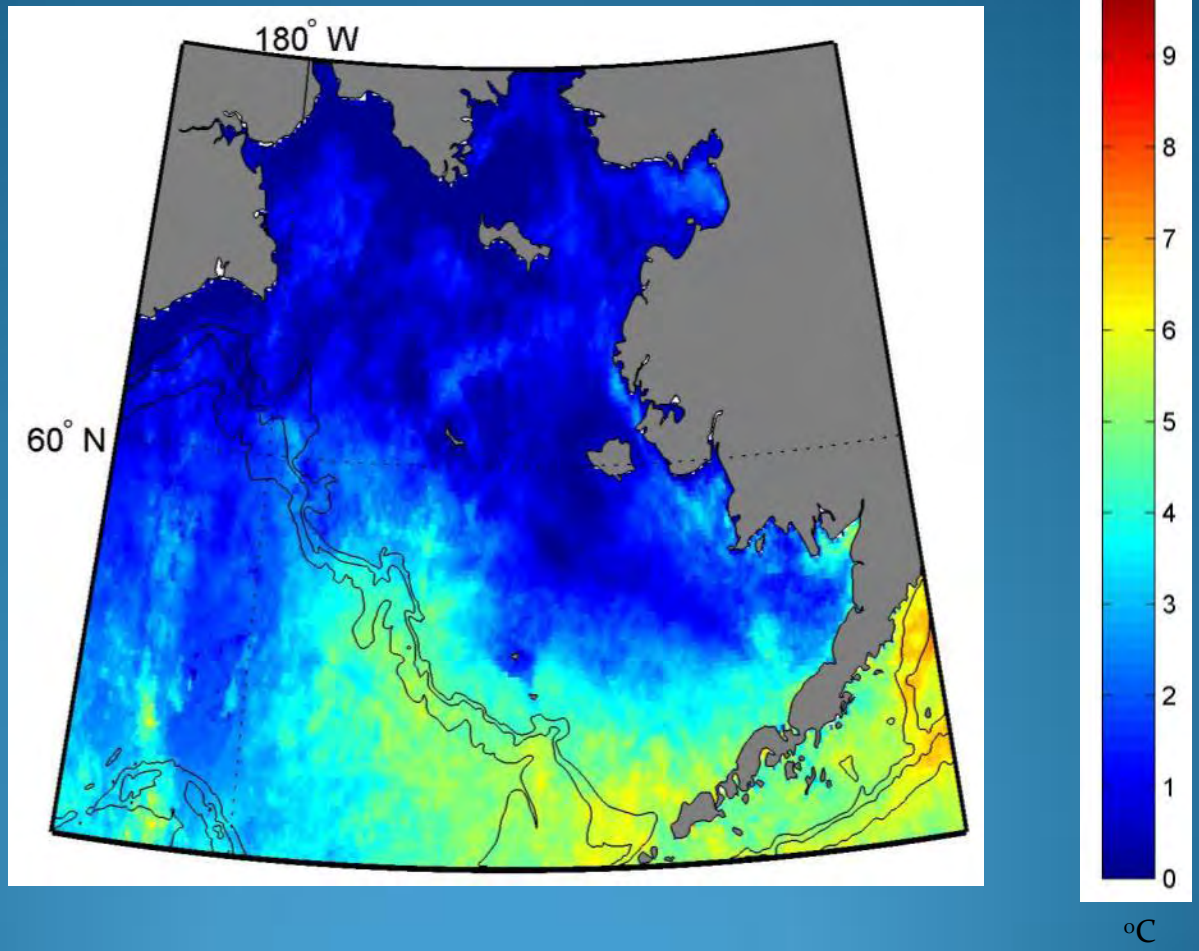
SST – *seasonal trends*

April



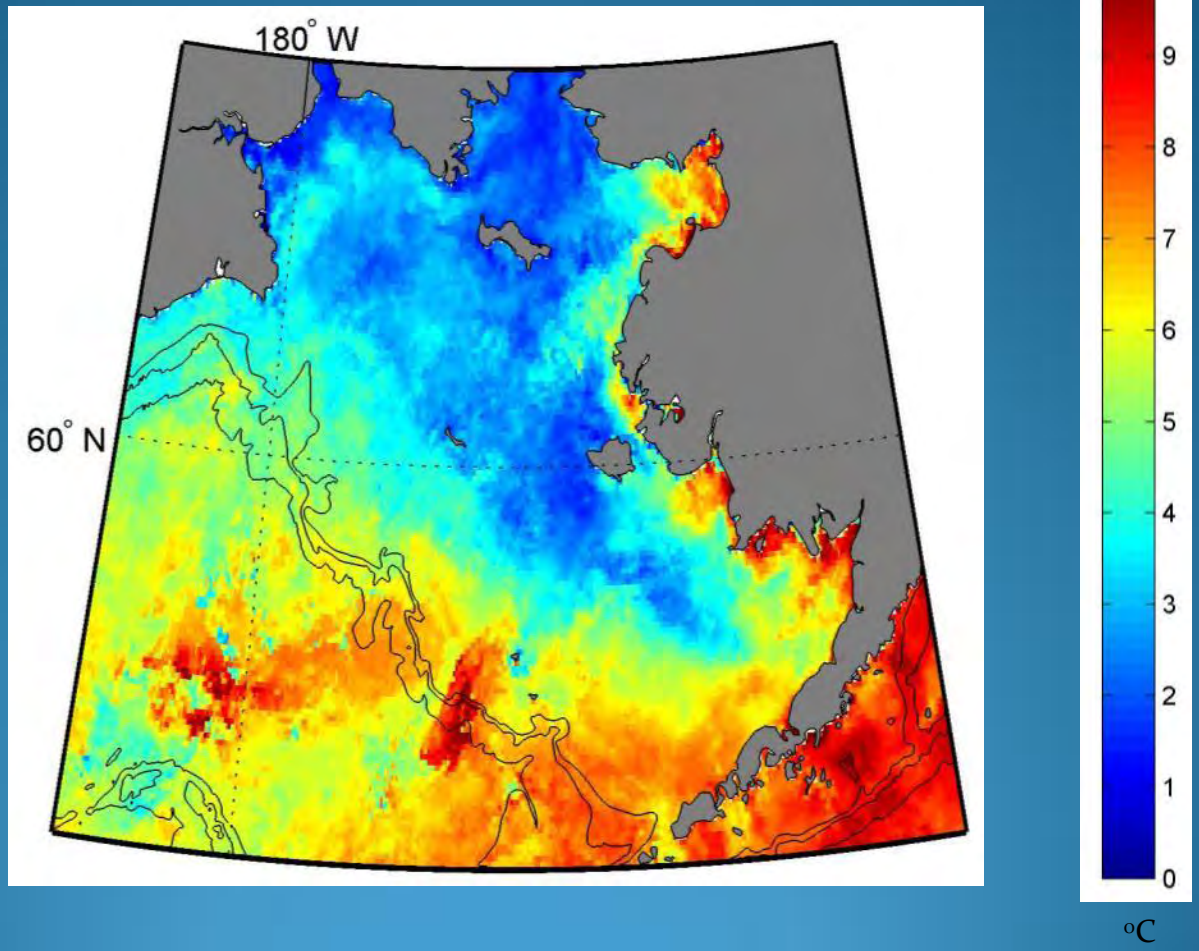
SST – *seasonal trends*

May



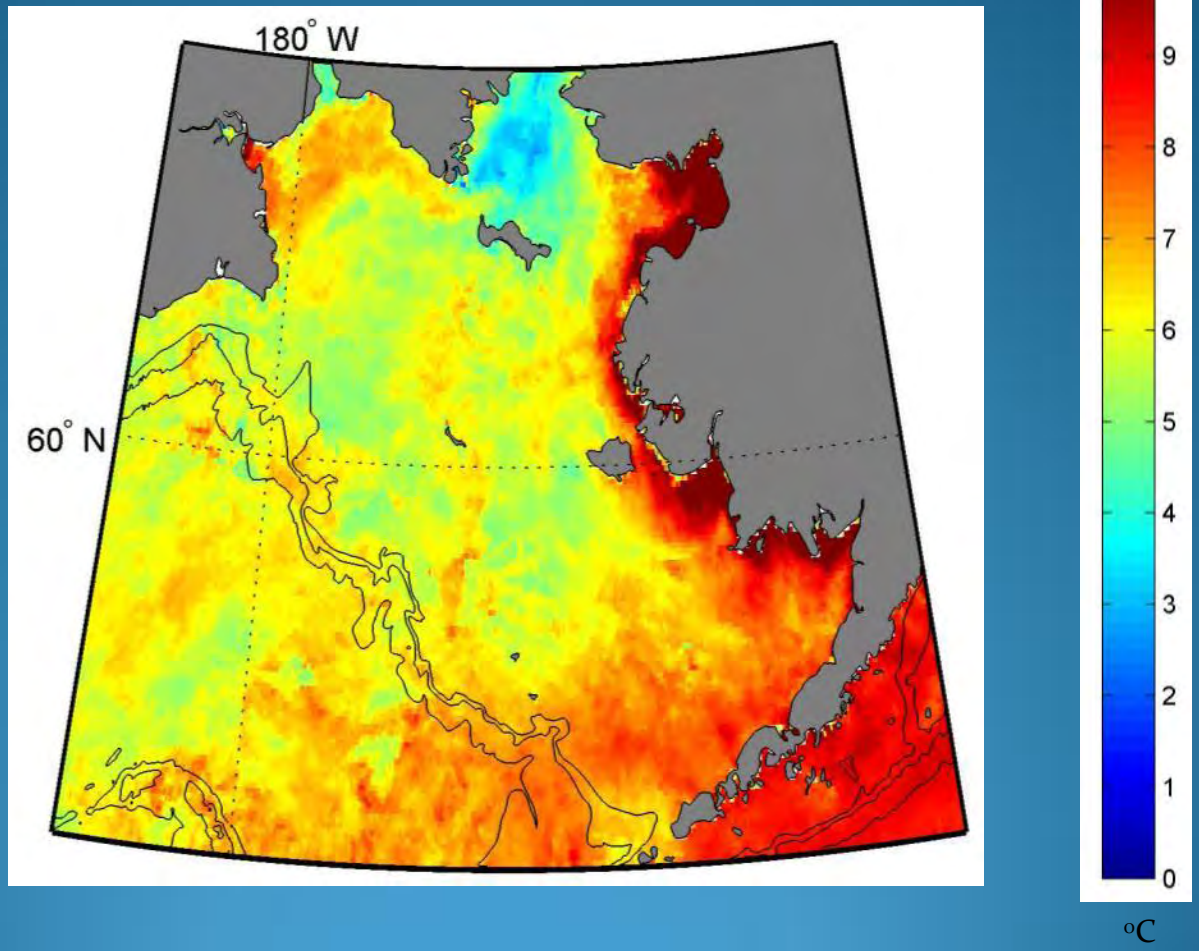
SST – *seasonal trends*

June



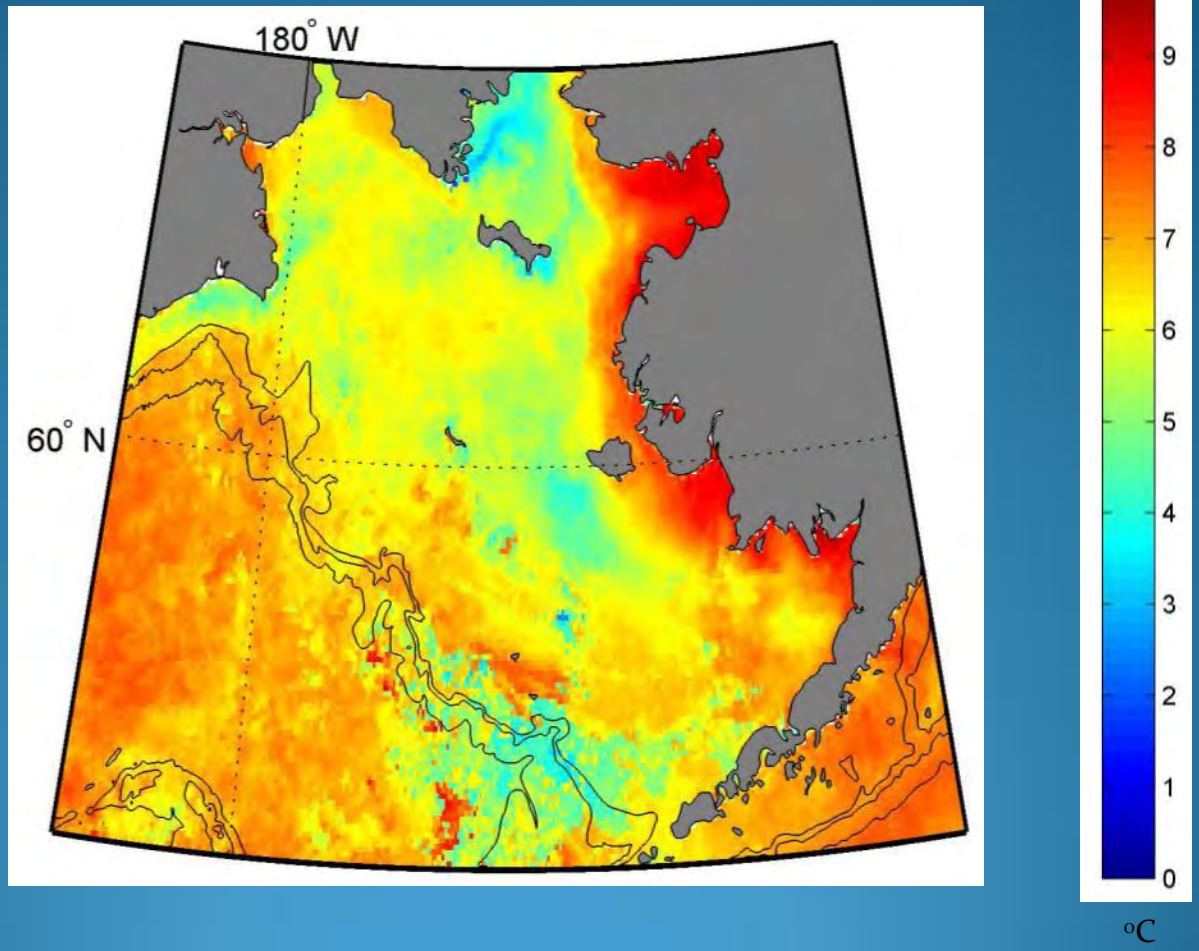
SST – *seasonal trends*

July



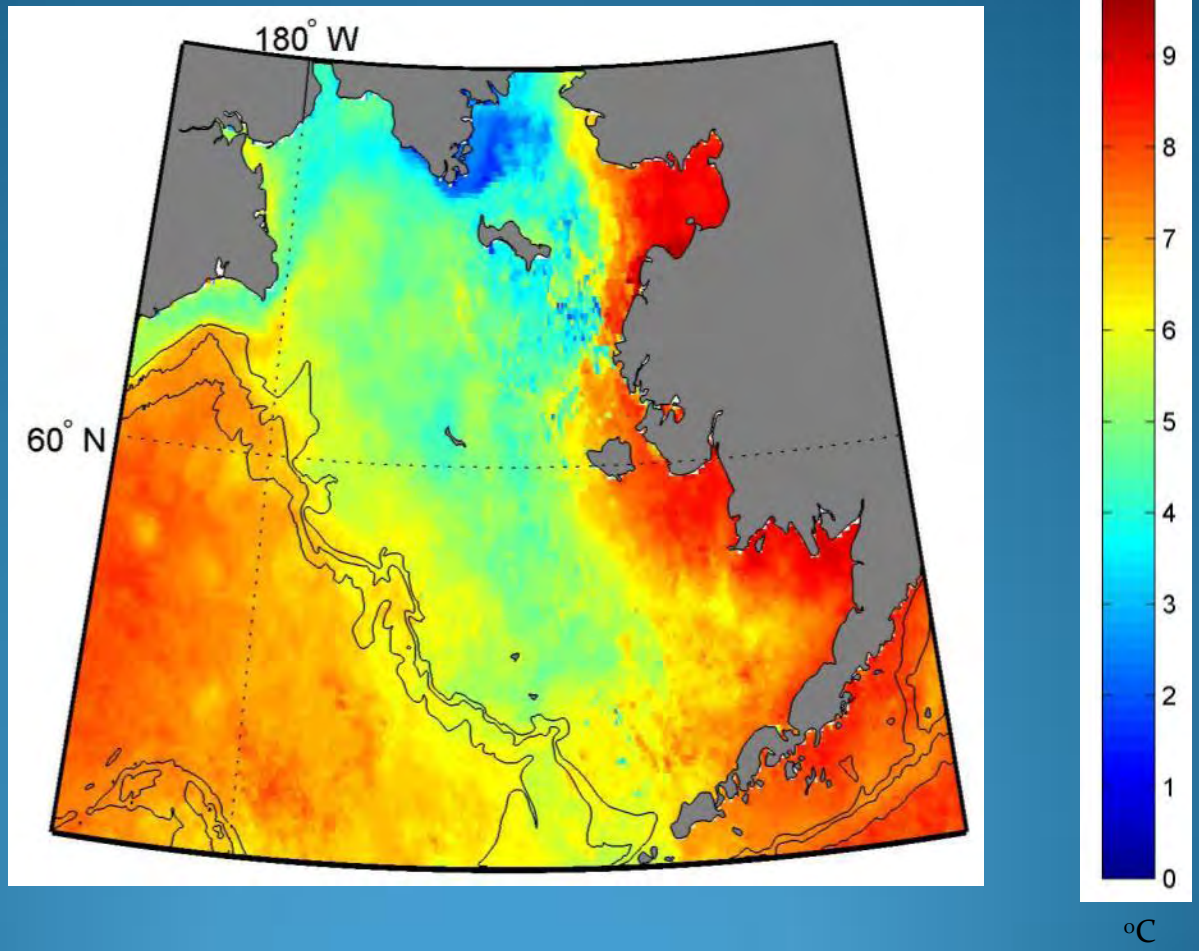
SST – *seasonal trends*

August



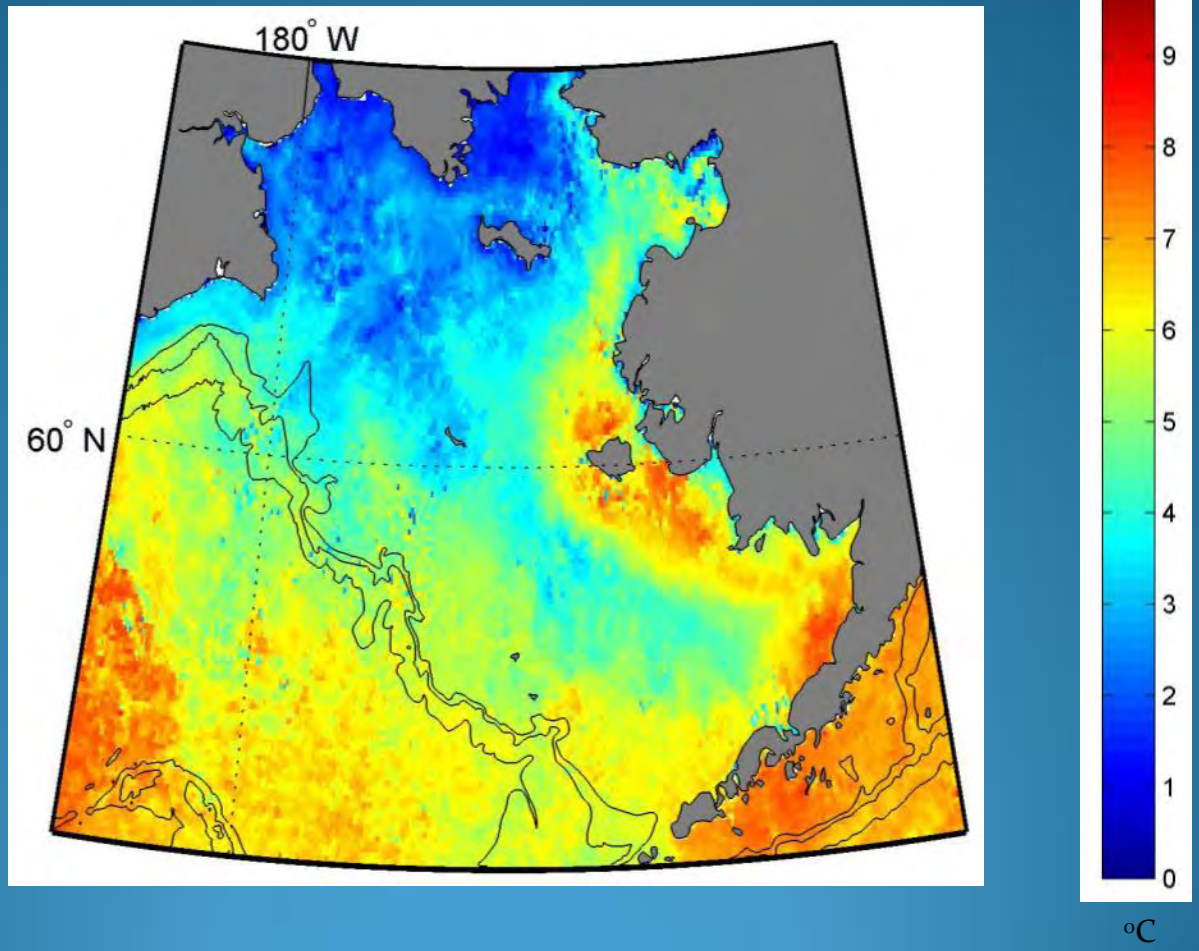
SST – *seasonal trends*

September



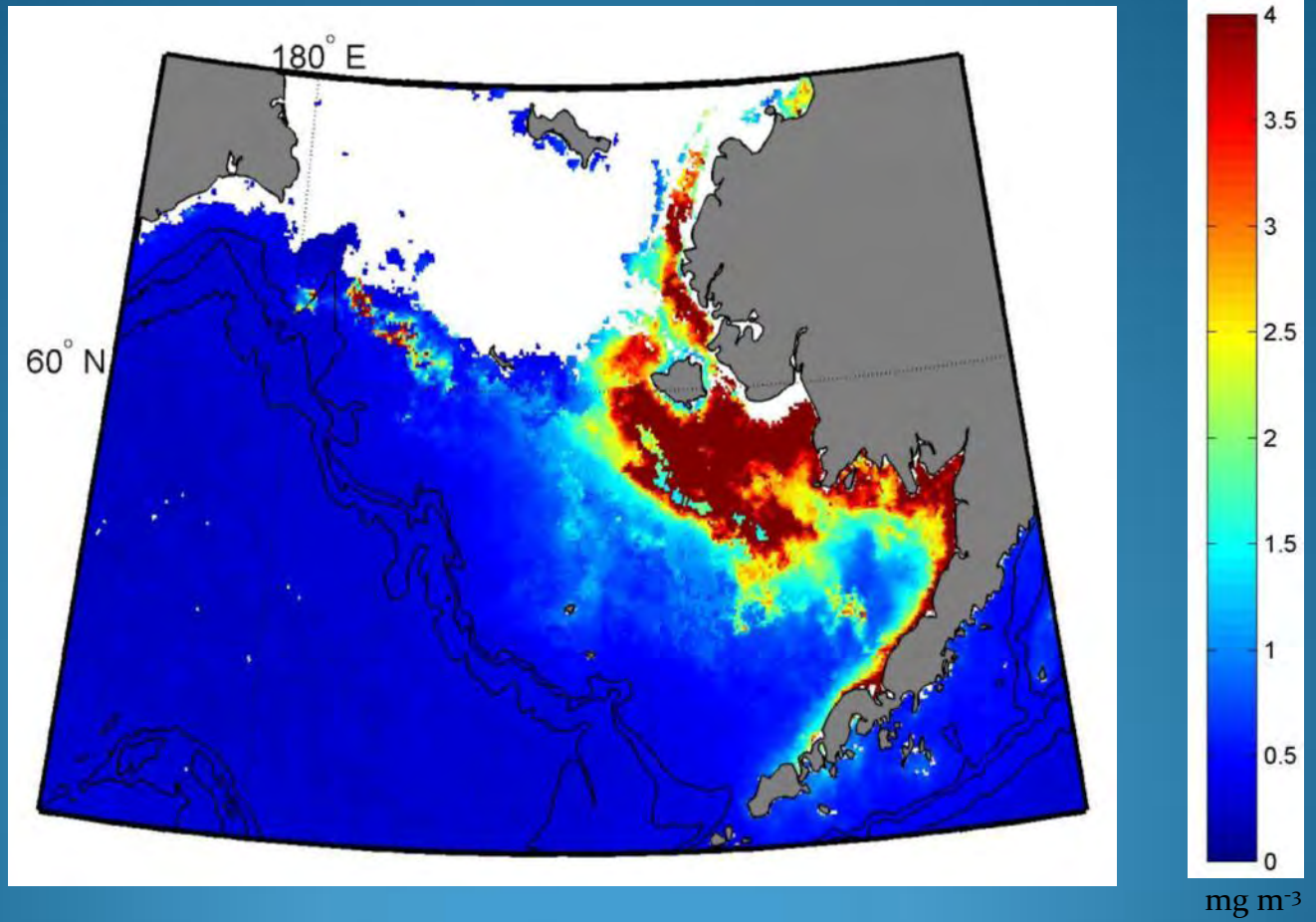
SST – *seasonal trends*

October



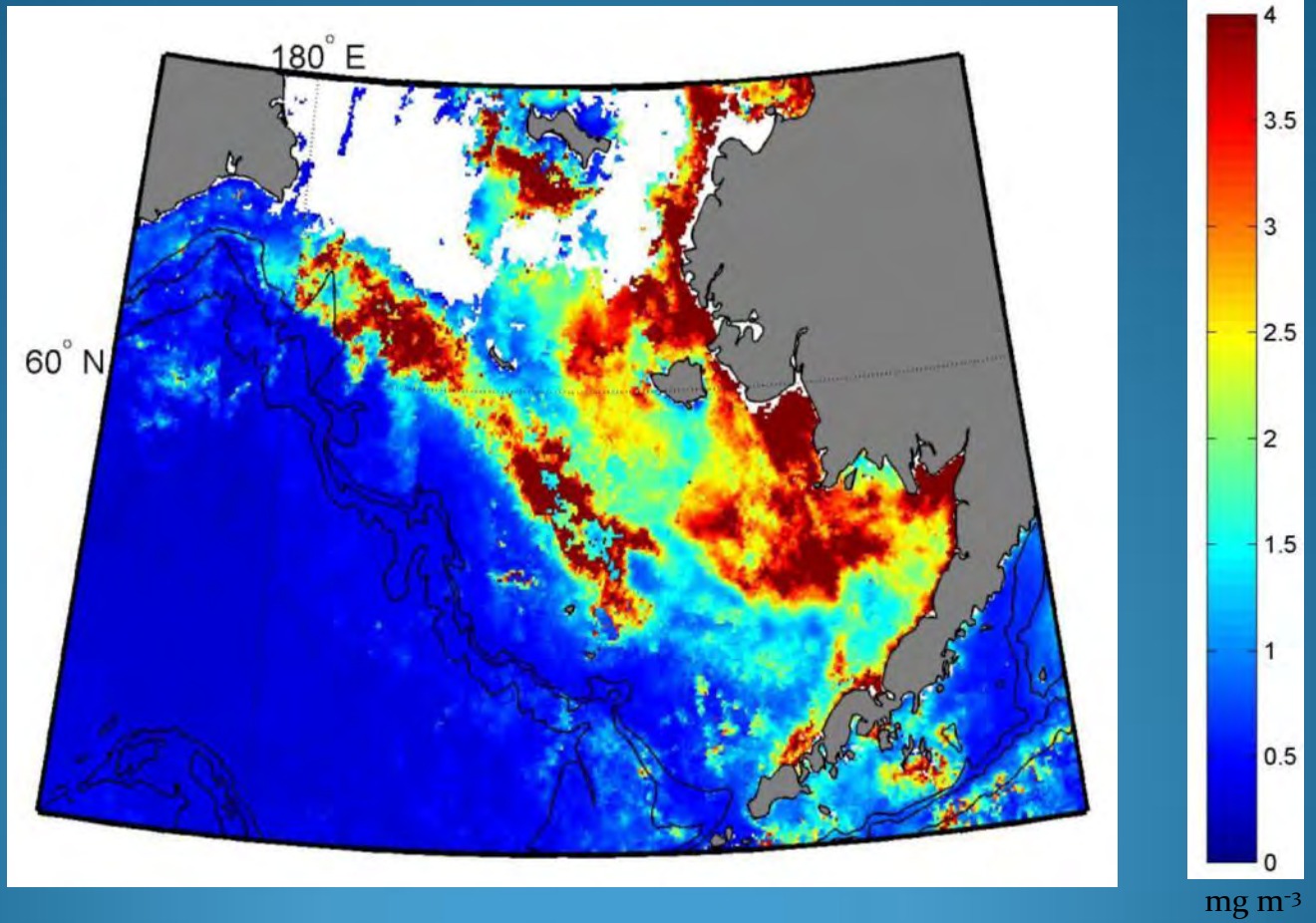
Chlorophyll *a* – *seasonal trends*

March



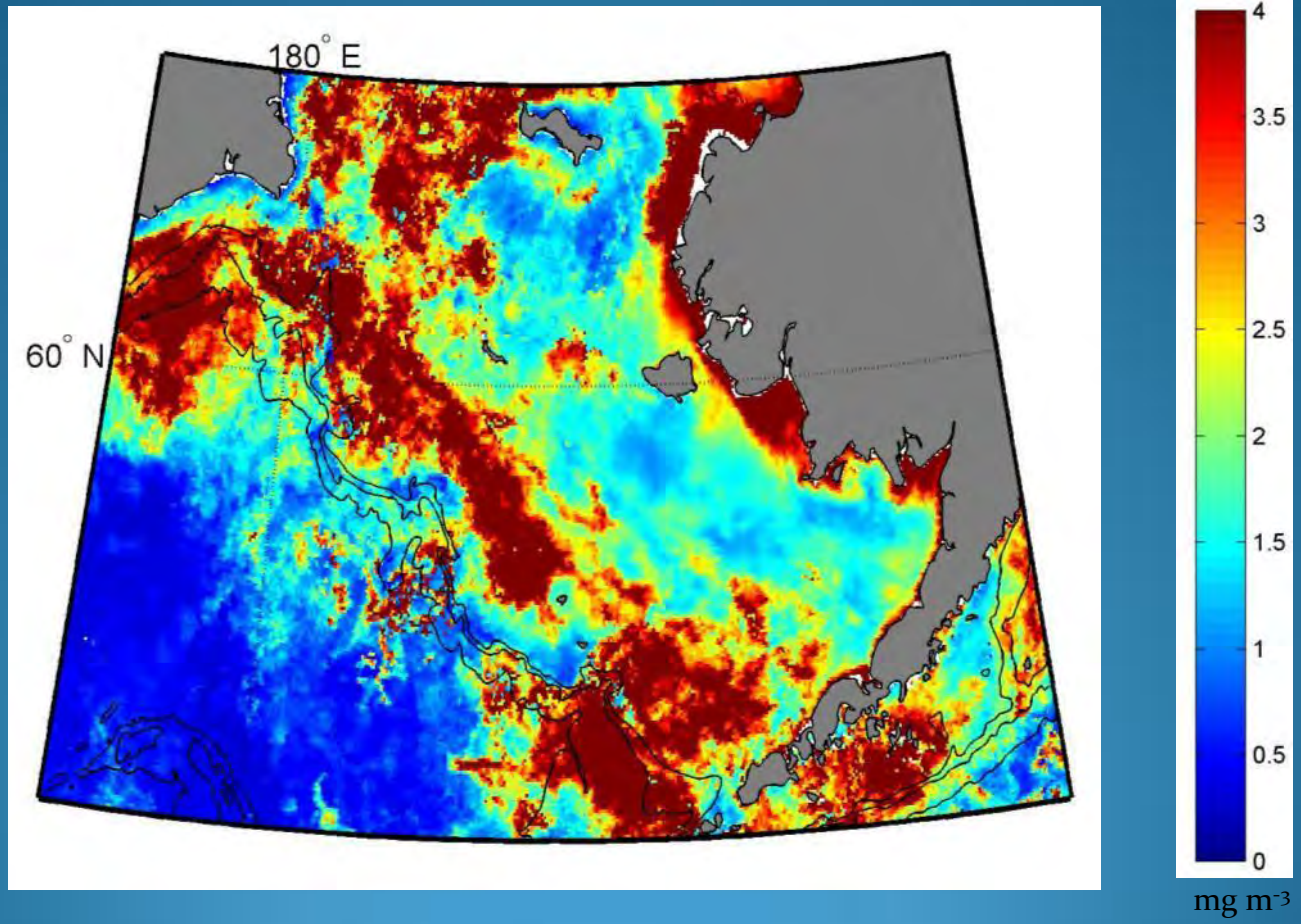
Chlorophyll *a* – *seasonal trends*

April



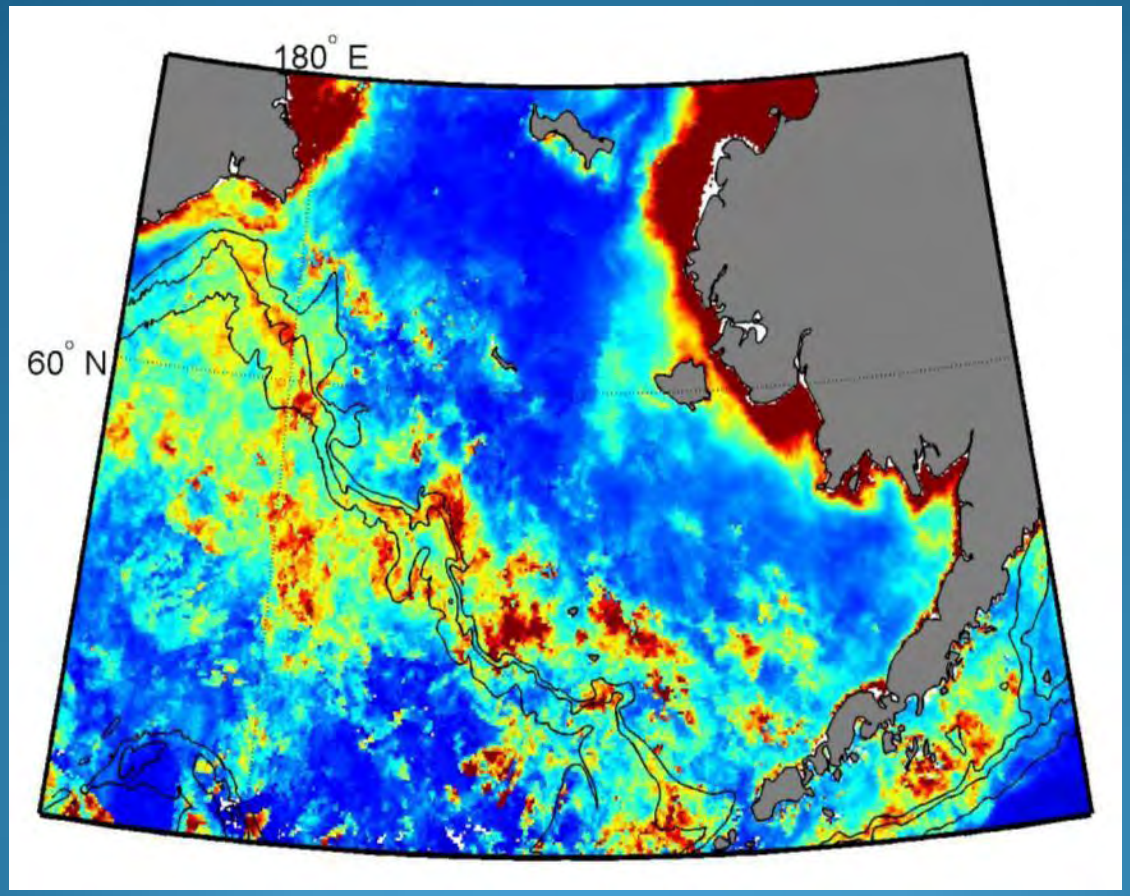
Chlorophyll *a* – *seasonal trends*

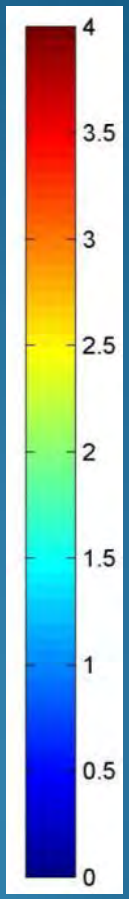
May



Chlorophyll *a* – *seasonal trends*

June

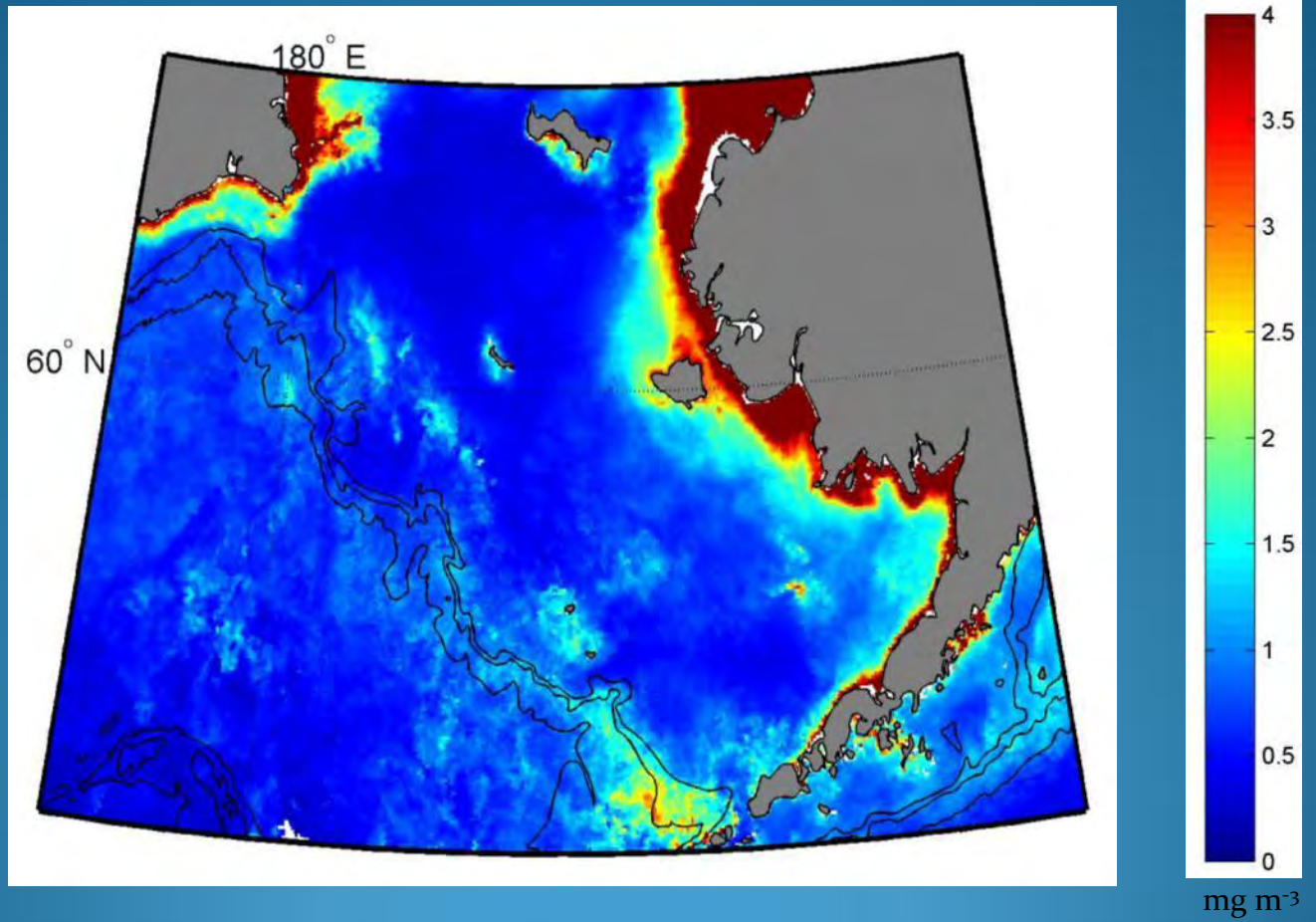




mg m^{-3}

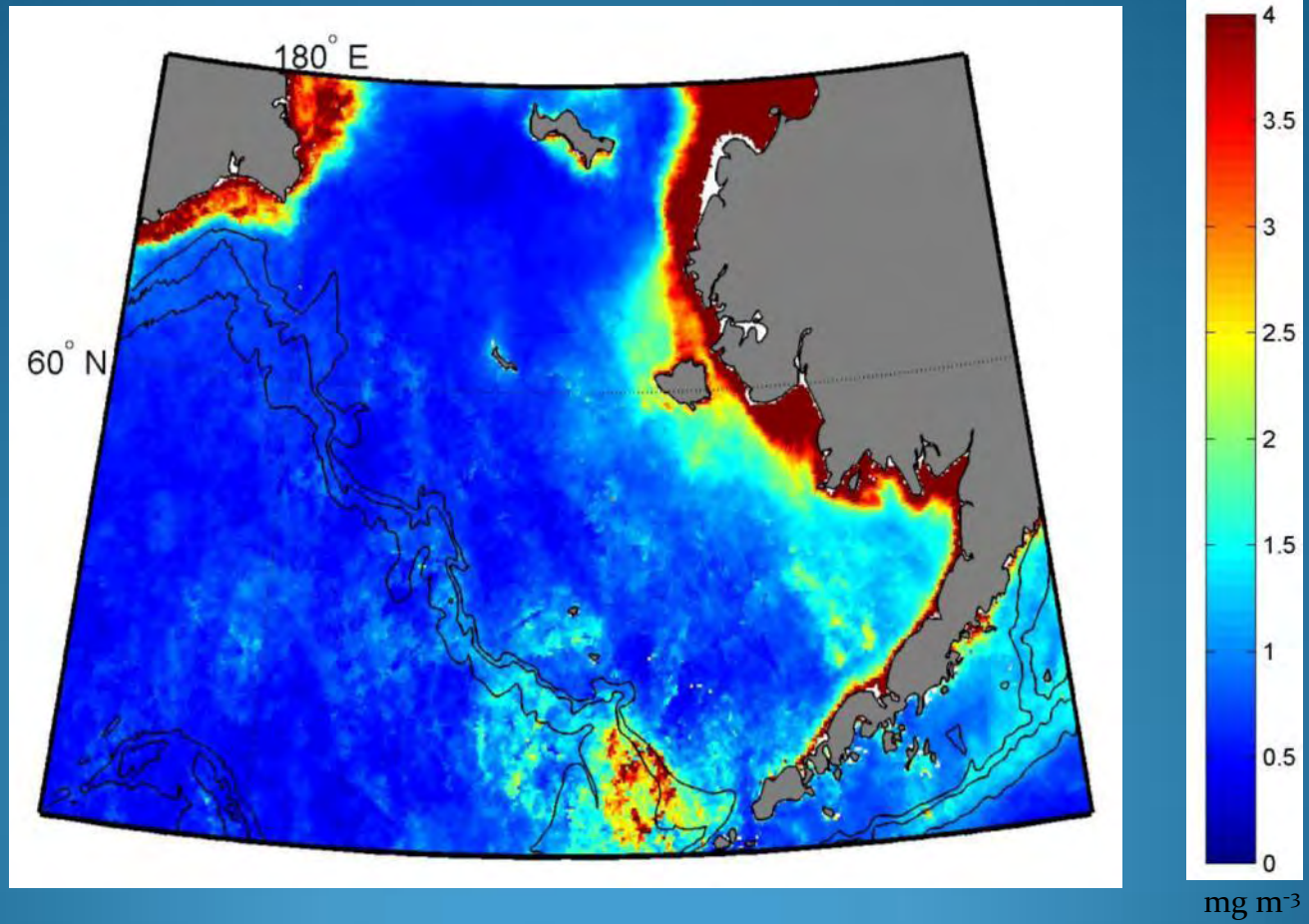
Chlorophyll *a* – *seasonal trends*

July



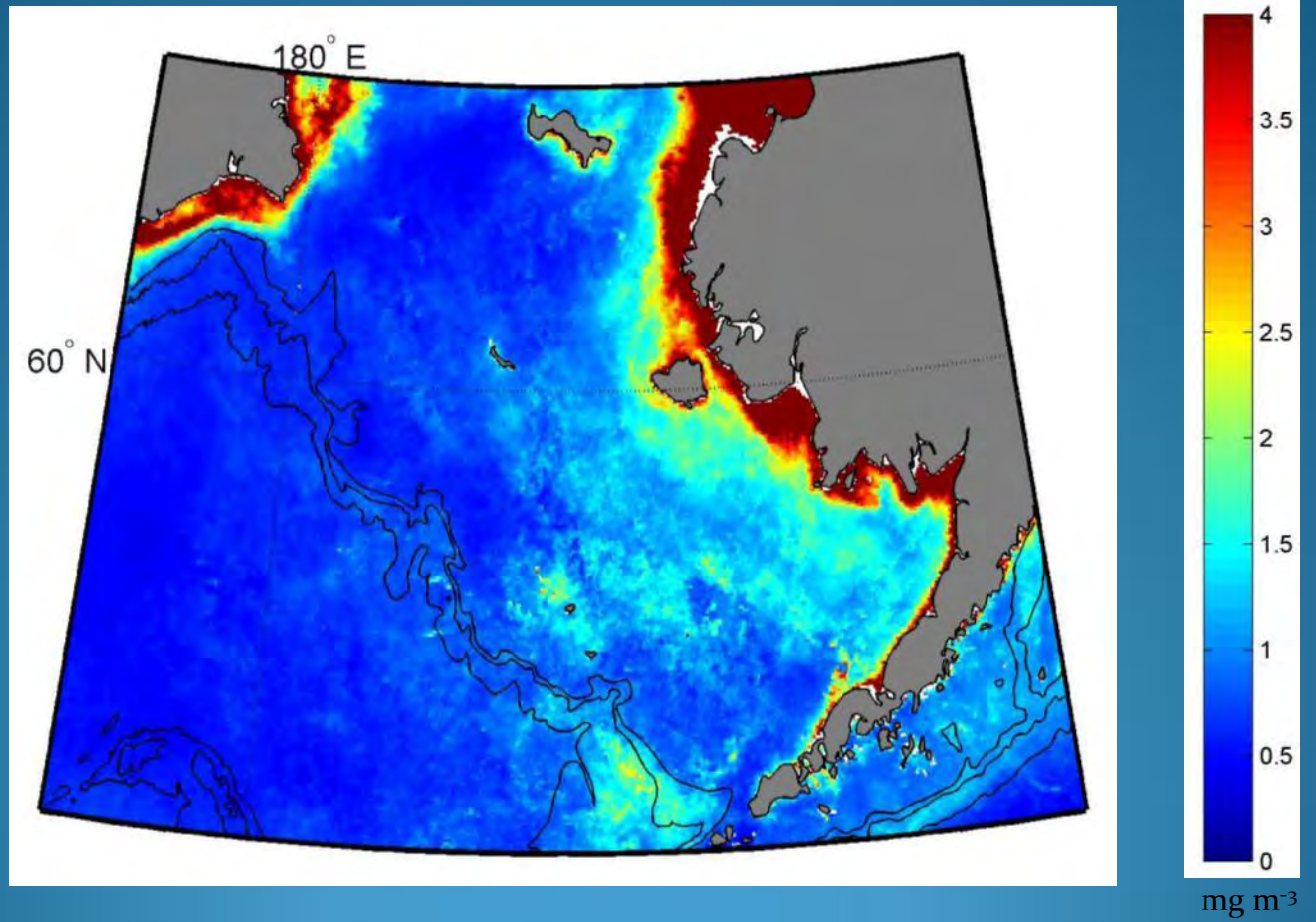
Chlorophyll *a* – *seasonal trends*

August



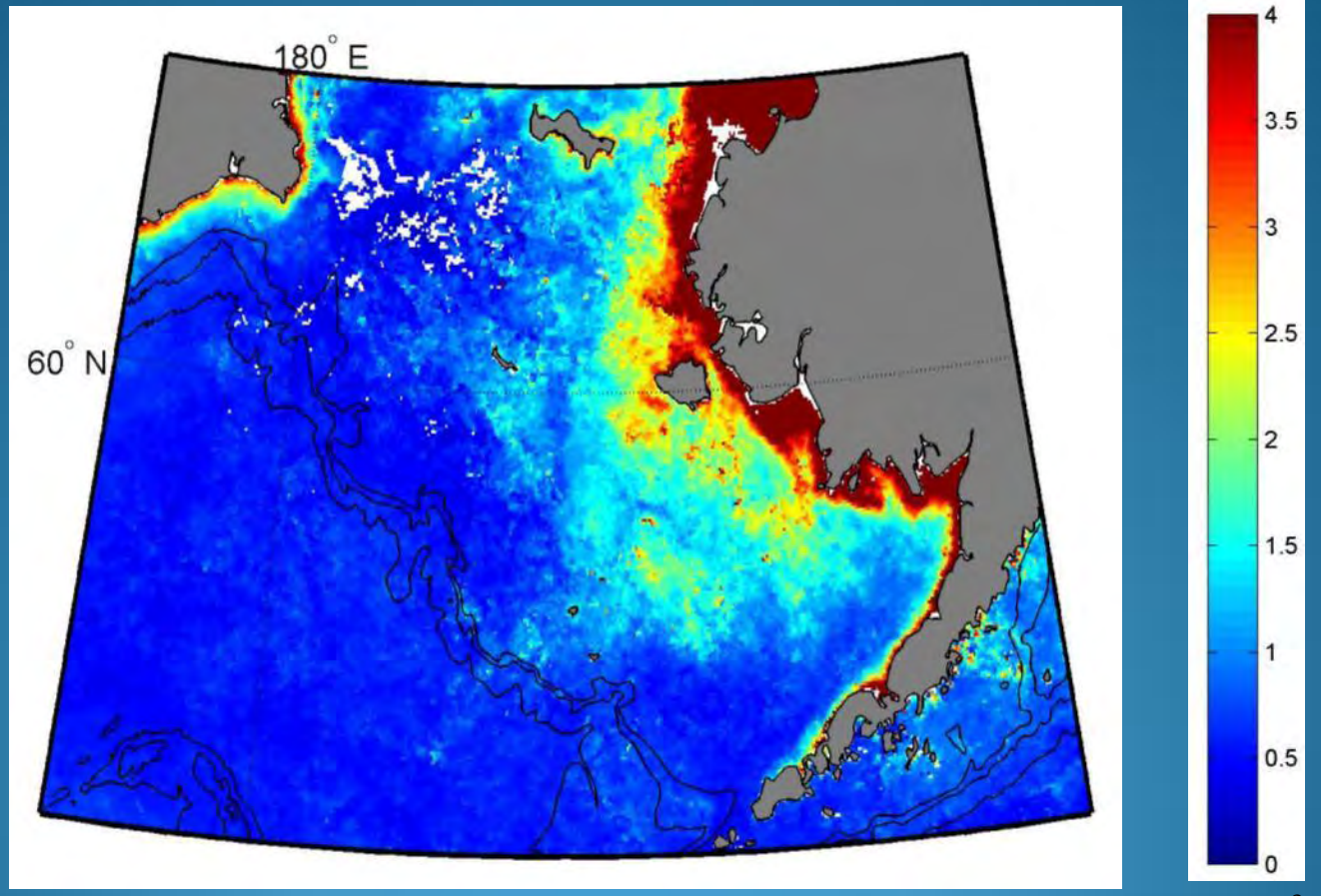
Chlorophyll *a* – *seasonal trends*

September

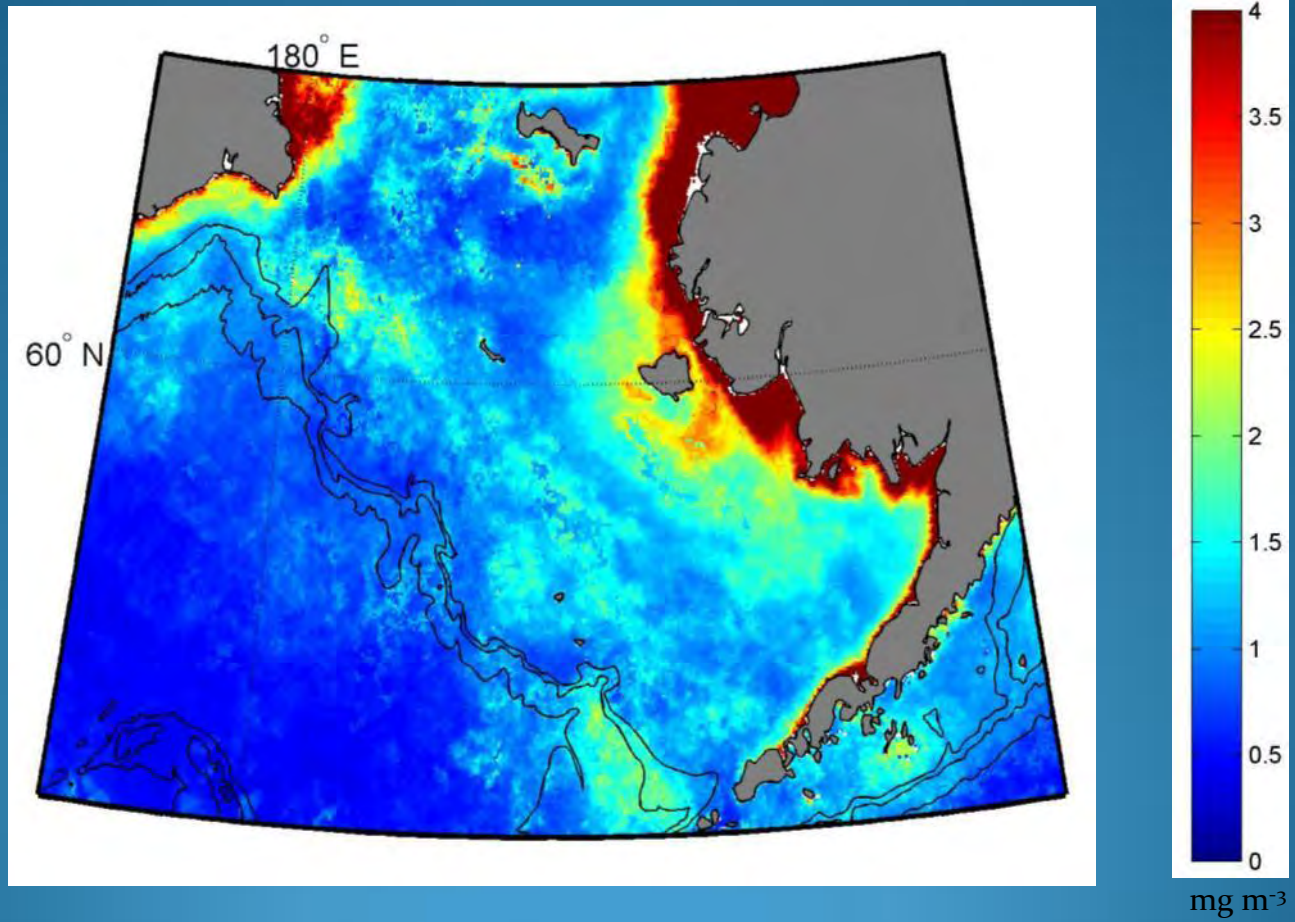


Chlorophyll *a* – *seasonal trends*

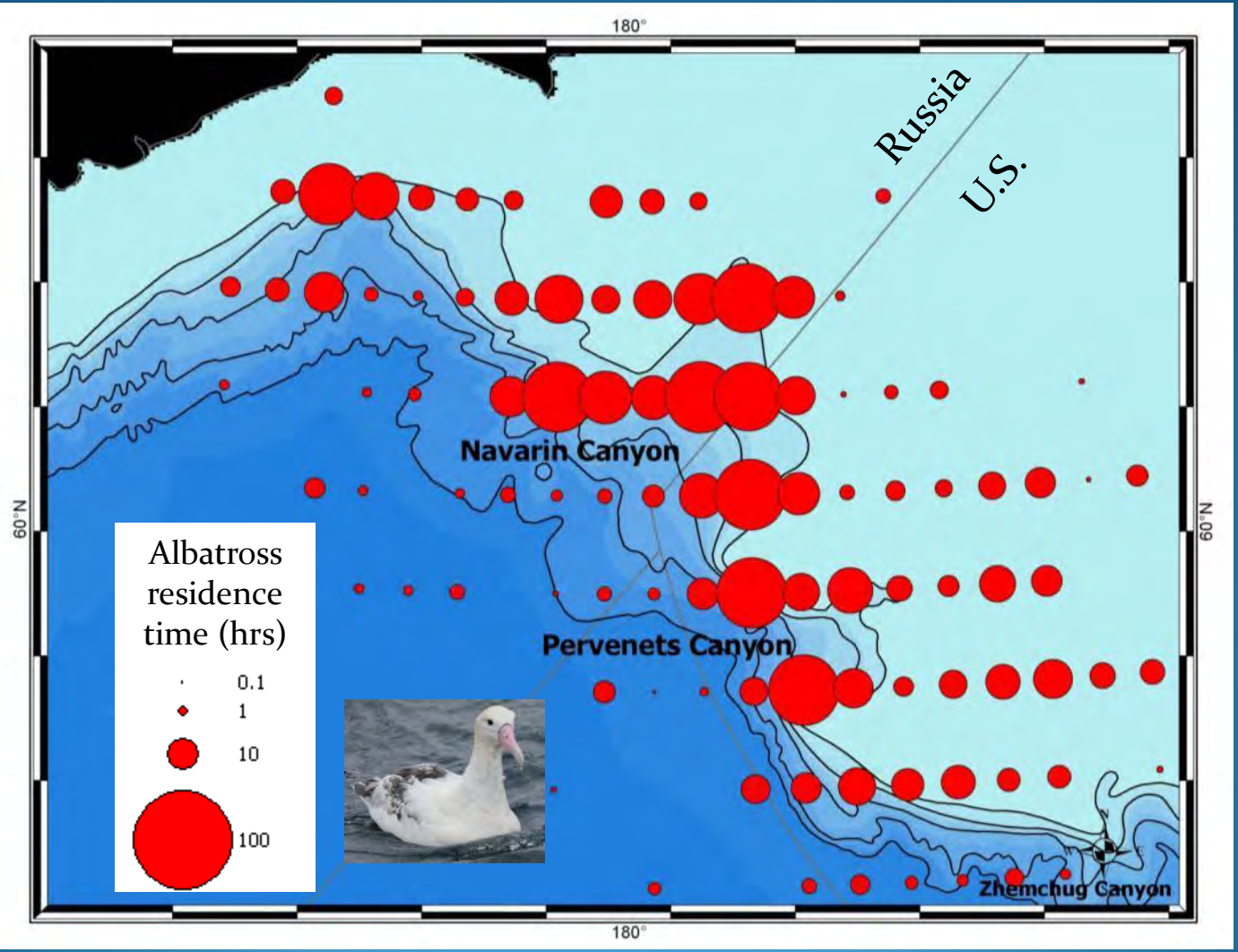
October



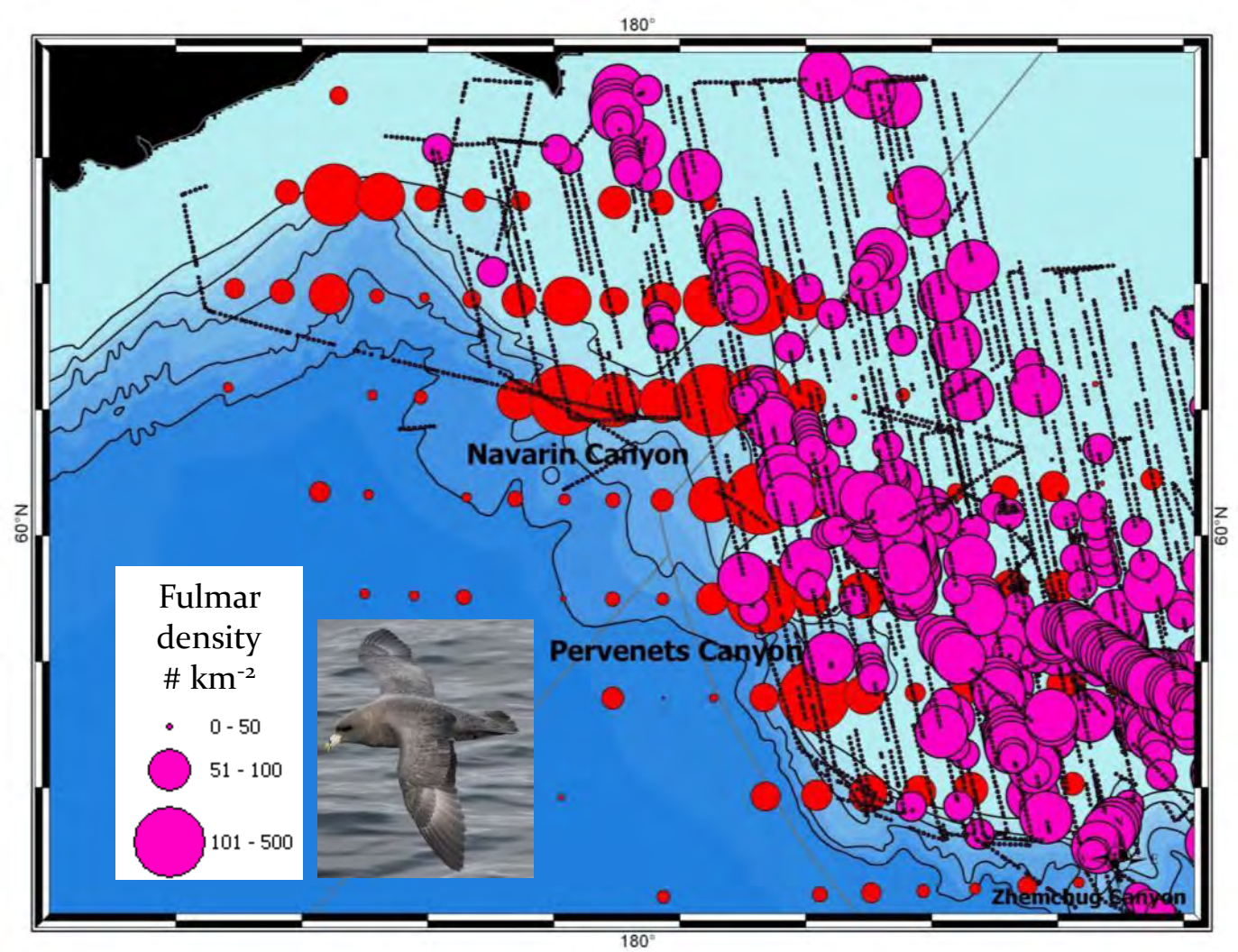
Chlorophyll *a Composite – 2003-2009*



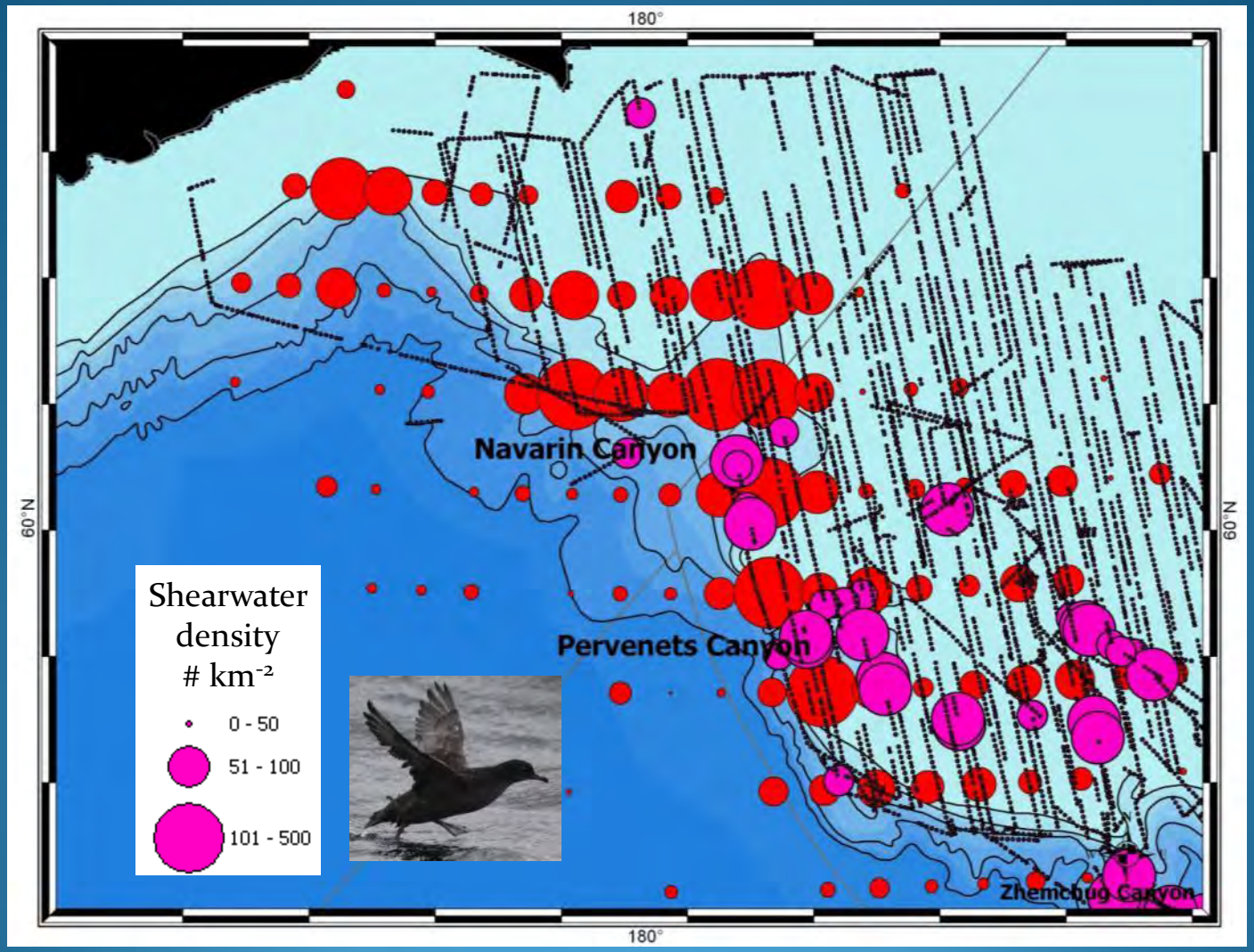
Albatross Distribution



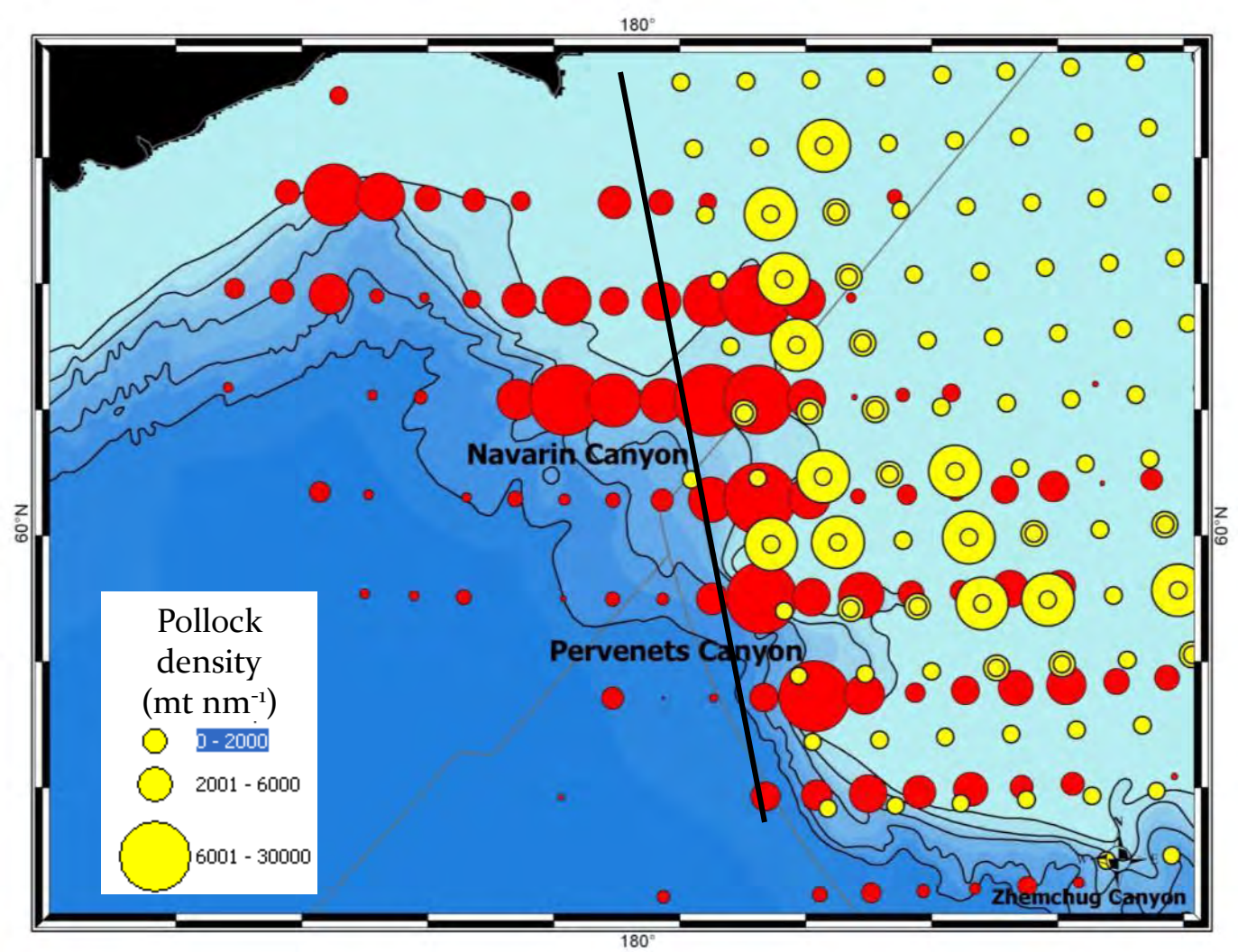
Albatross and Northern Fulmar Distribution



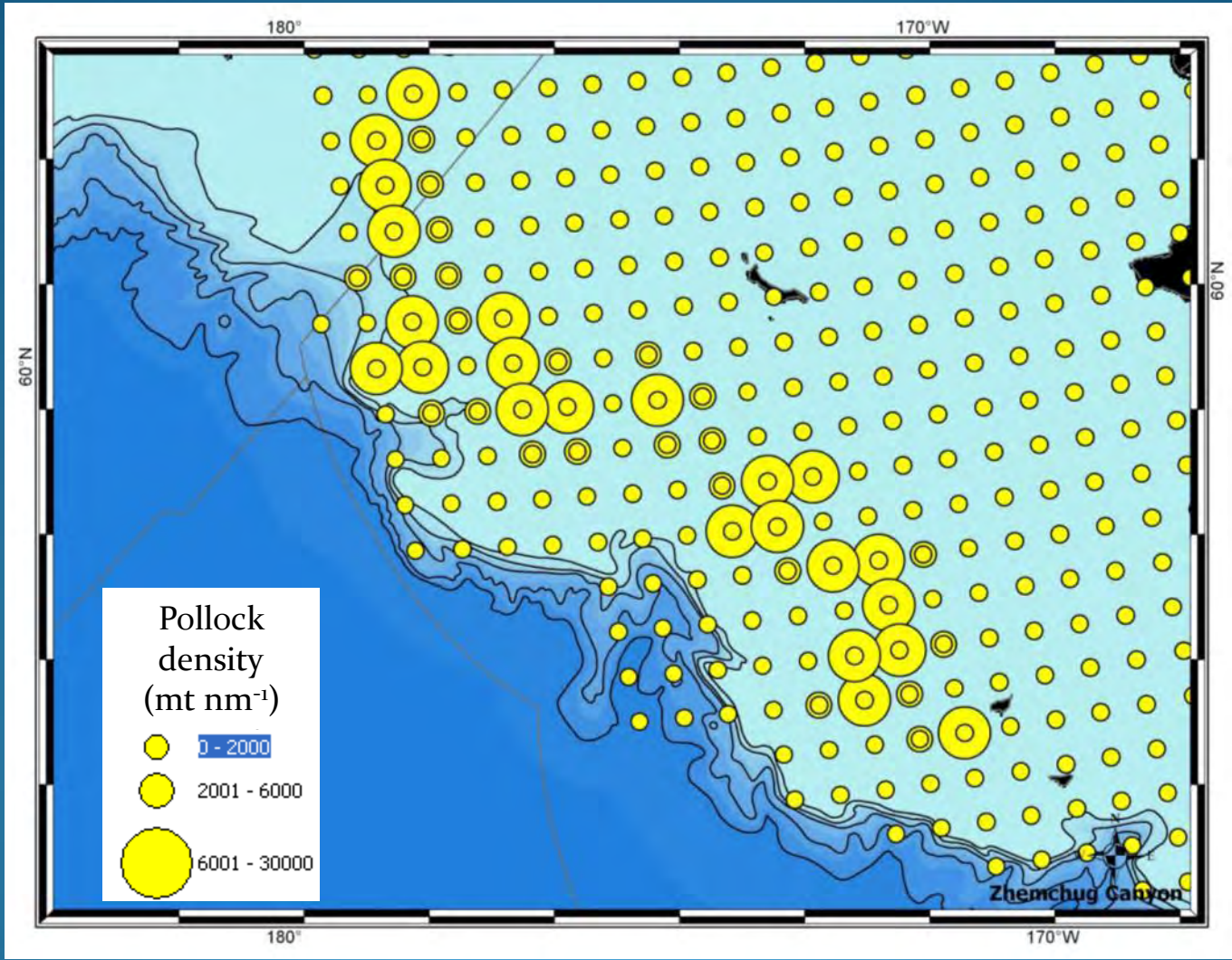
Albatross and Shearwater Distribution



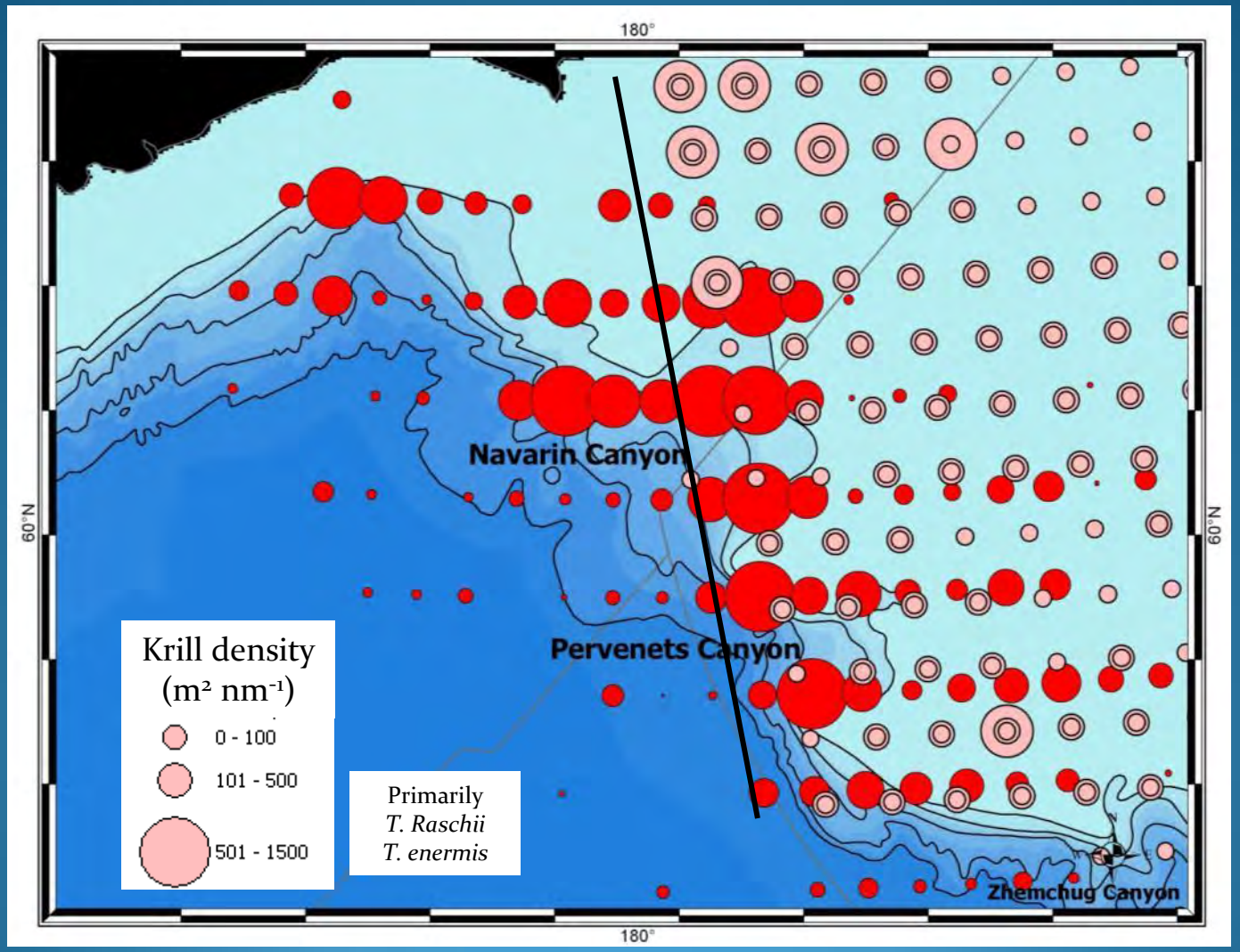
Albatross & Age 1 Pollock Distribution



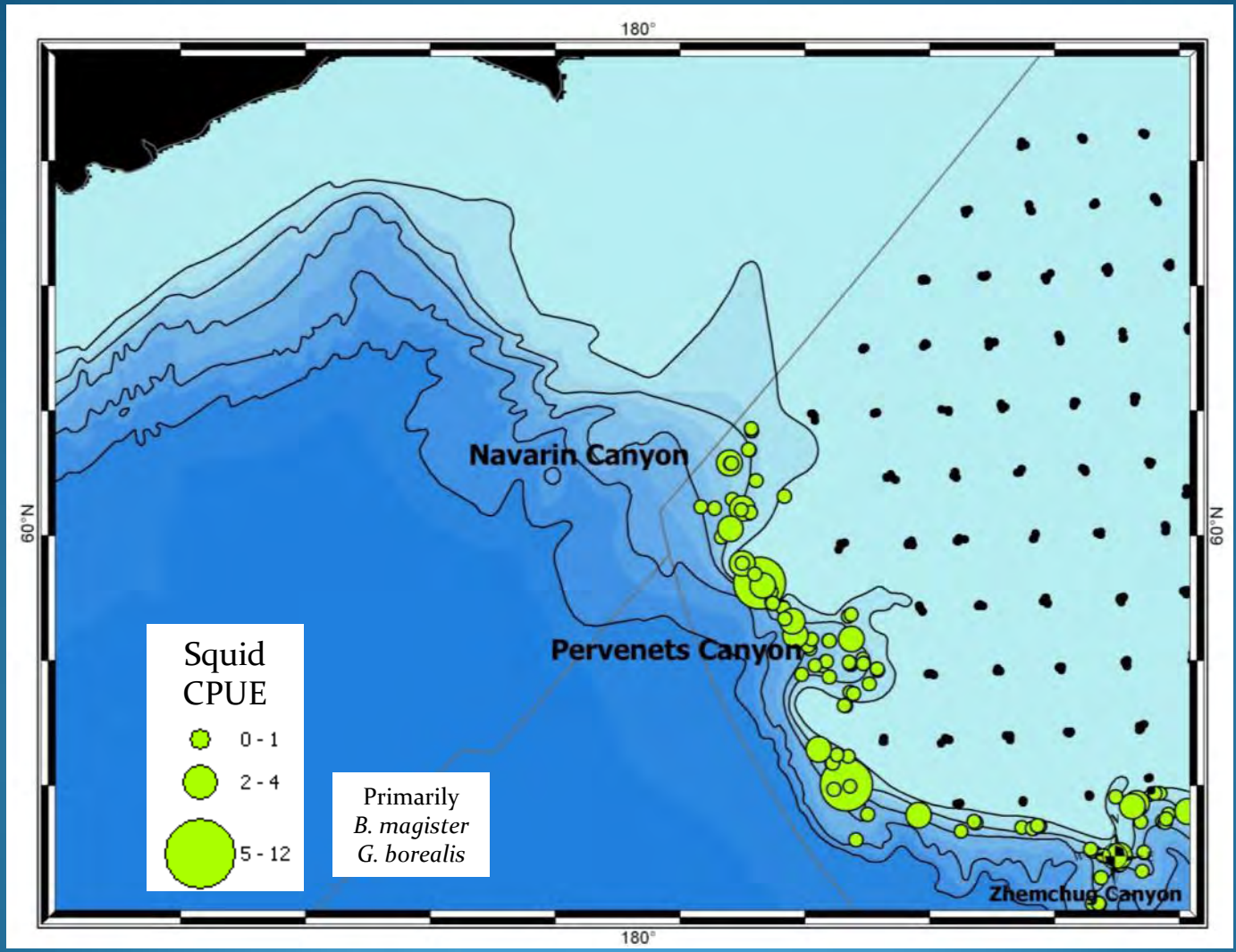
Age 1 Pollock Distribution



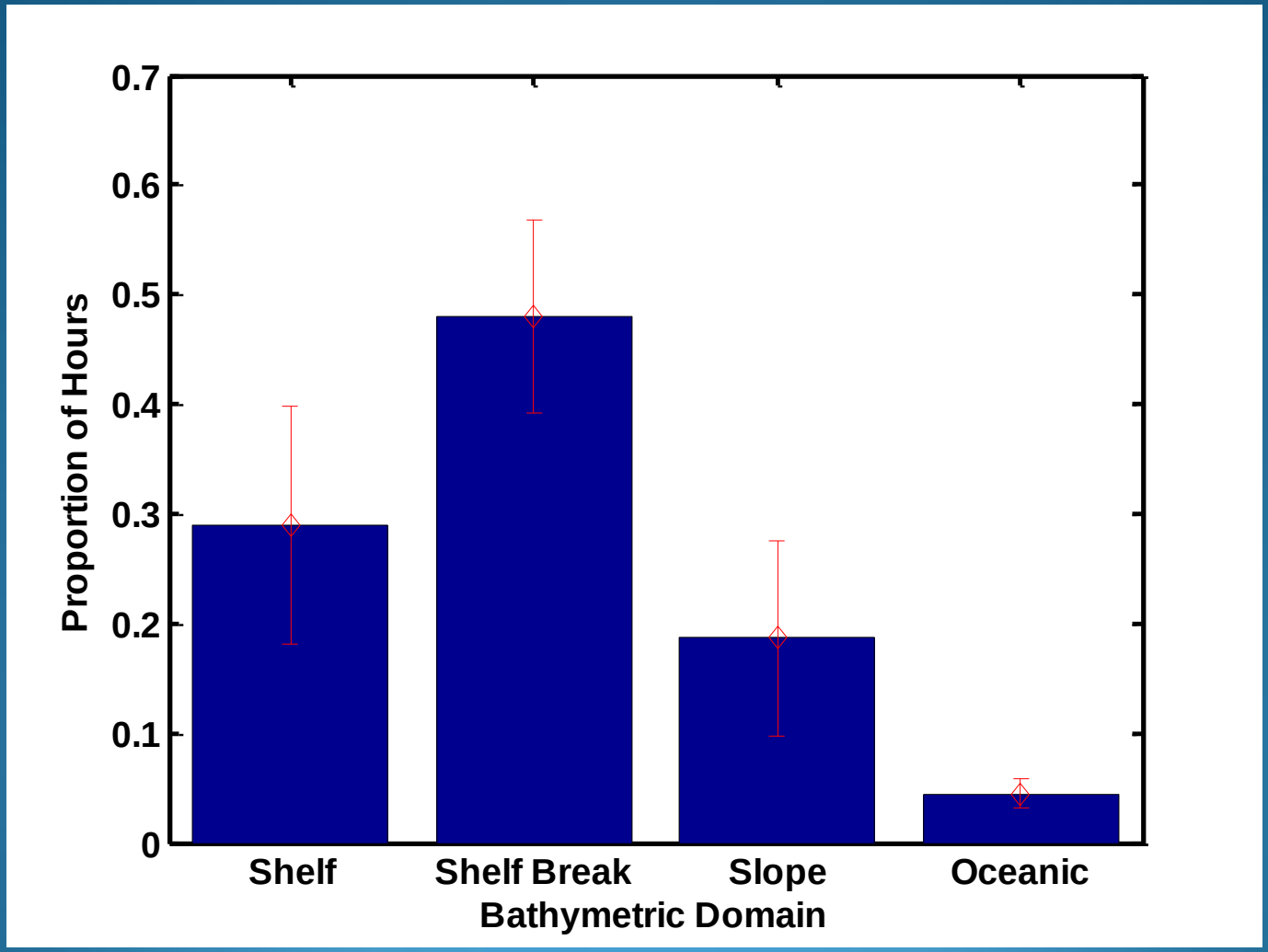
Albatross & Krill Distribution



Squid Distribution



Albatross Distribution with Depth



Conclusions

- Navarin is one of two Bering Sea canyons that appears to have higher overall mean primary productivity

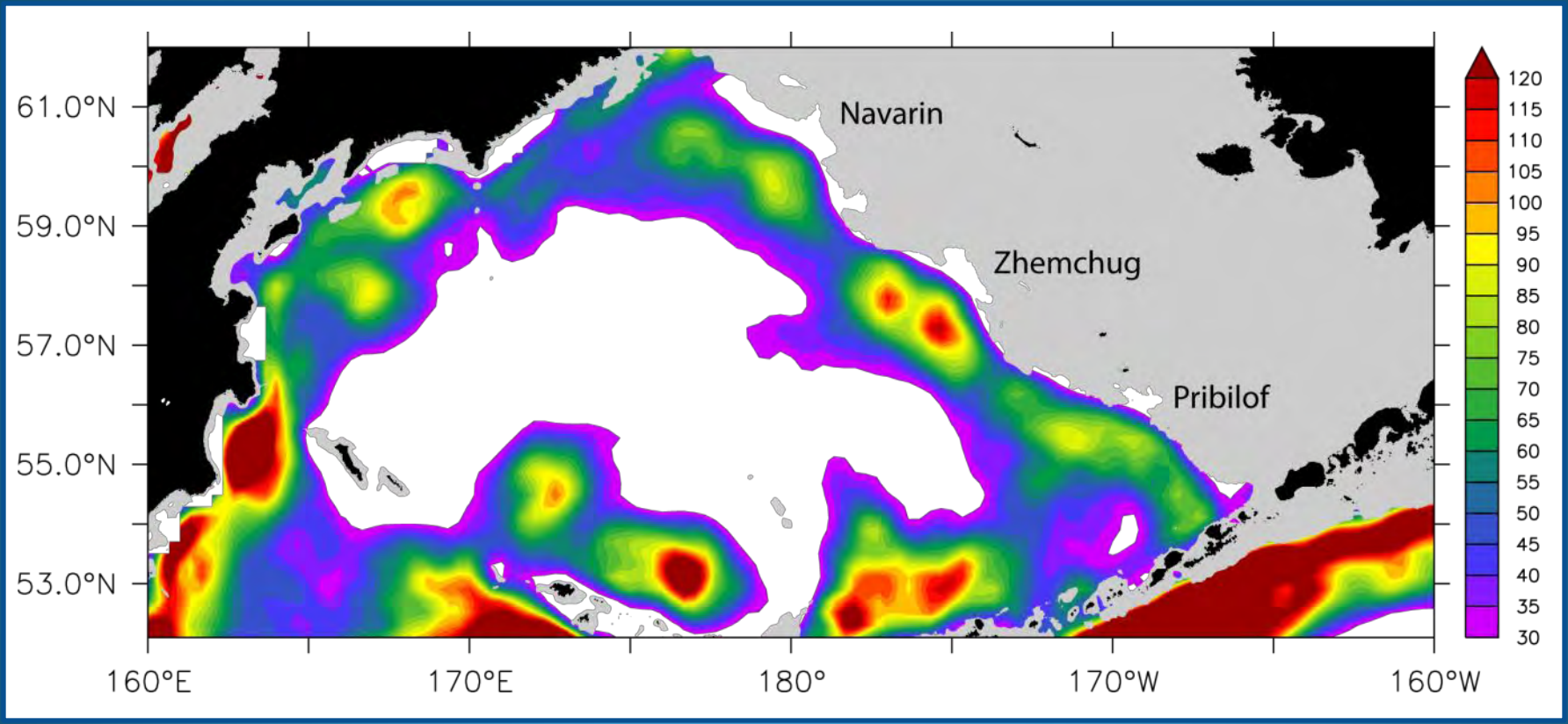
- Navarin canyon hosts higher densities of some predator and prey species

- Geomorphology and hydrography of Navarin and Zhemchug canyons appear to enhance productivity of adjacent continental shelf

- Albatrosses' particularly strong association with canyon shelf break-slopes appears to be, in part, a result of prey preference.

Deep Water Eddies

Additional Mechanisms of Transport?



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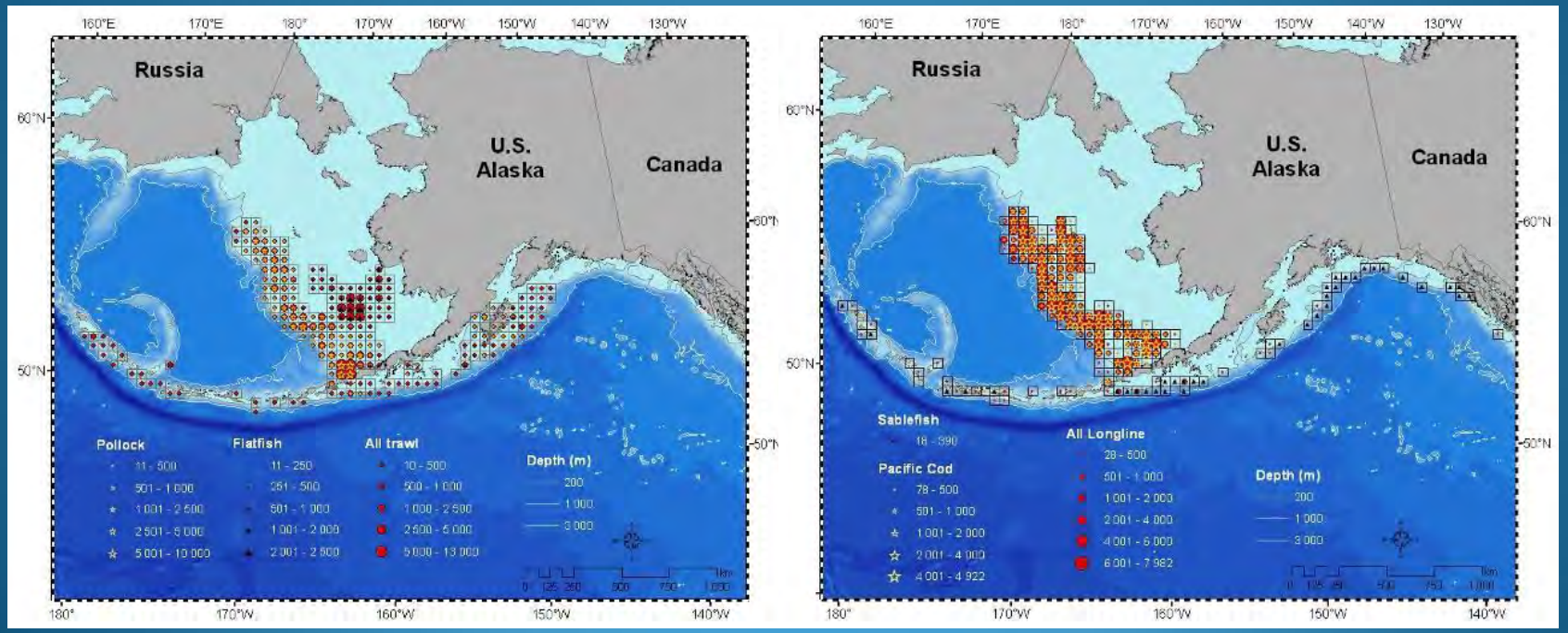
Fisheries


photo by Mark Rauzon


Russia
U.S.
Alaska
Canada
Pollock
Flatfish
All trawl
Depth (m)
Russia
U.S.
Alaska
Canada
Sablefish
All Longline
Pacific Cod
Depth (m)

Acknowledgements

NOAA – Alaska Fisheries Science Center
North Pacific Research Board
National Science Foundation
U.S. Fish and Wildlife Service
Yamashina Institute for Ornithology

PICES