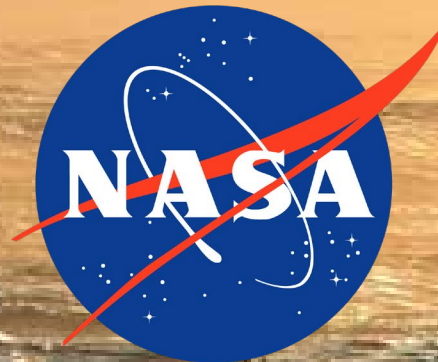
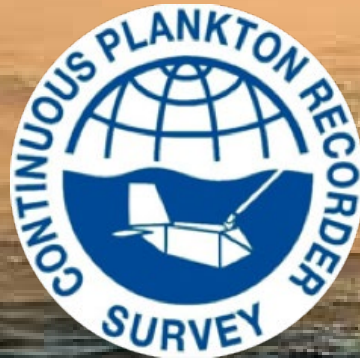


# Spatio-Temporal Persistence in Mesoscale/Regional Zooplankton Communities in the Eastern North Pacific

Brian Hoover<sup>1</sup>, Marisol García-Reyes<sup>1</sup>, Sonia Batten<sup>2</sup>, Chelle Gentemann<sup>3</sup>, Kathleen Dohan<sup>3</sup>, William Sydeman<sup>1</sup>

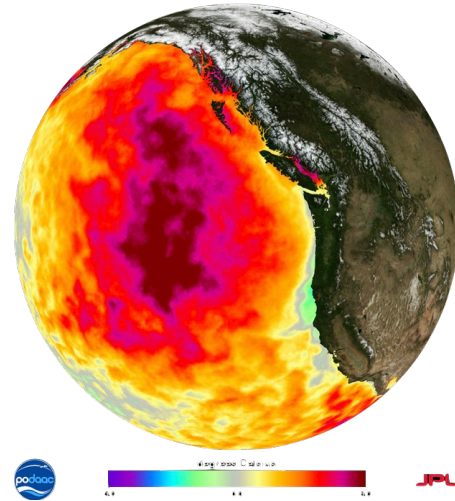


<sup>1</sup> Farallon Institute; <sup>2</sup> Continuous Plankton Recorder Survey; <sup>3</sup> Earth and Space Research

*Photo credit: World Meteorological Association*

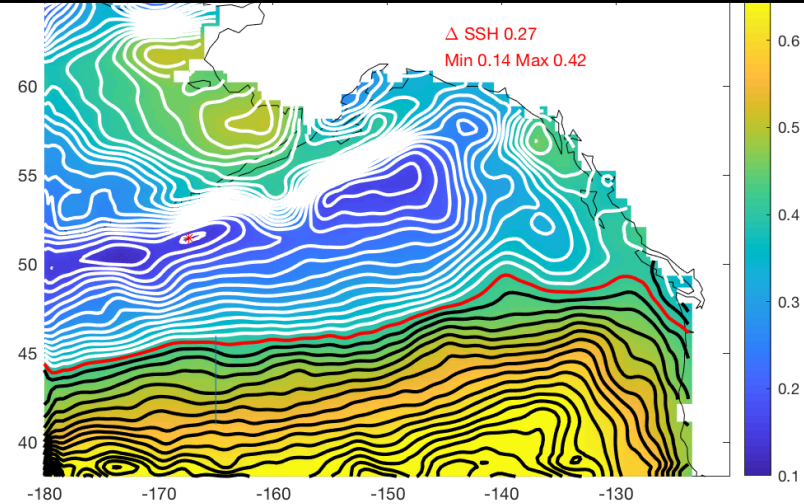
# Northeast Pacific (NEP): A complicated place

SST Anomaly: May2015

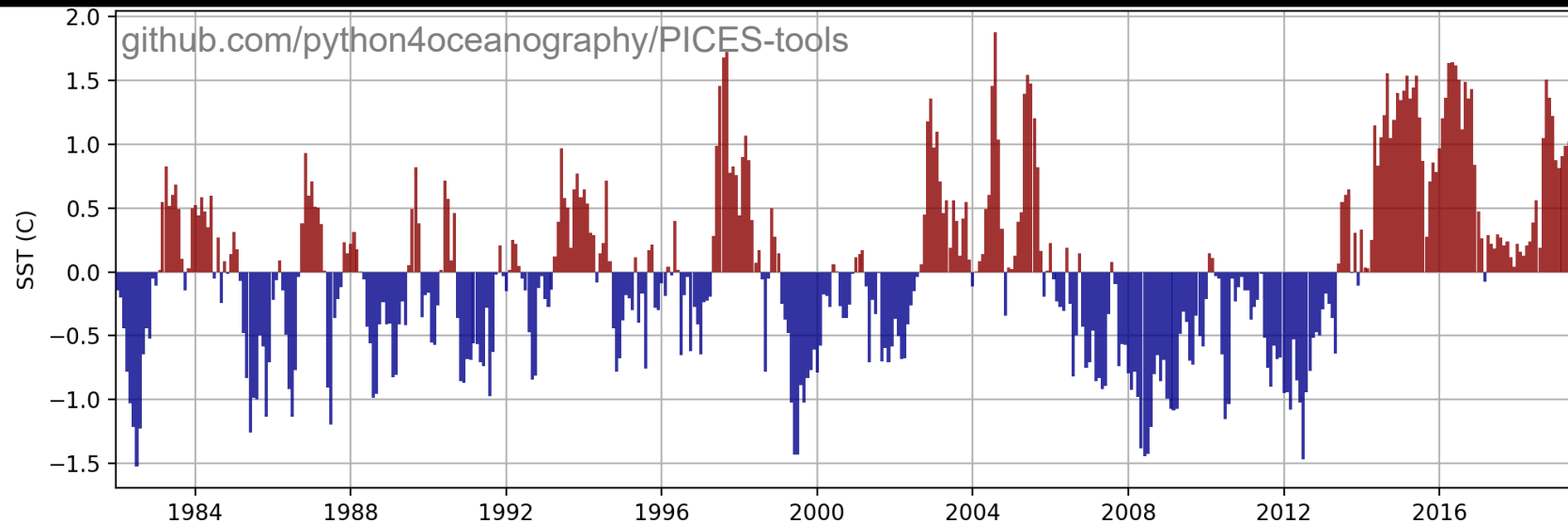


*Chelle Gentemann and  
JPL PO.DAAC:  
Charles Thompson  
and Jeffery Hall.*

Sea Surface height: MayJuneJuly 2008



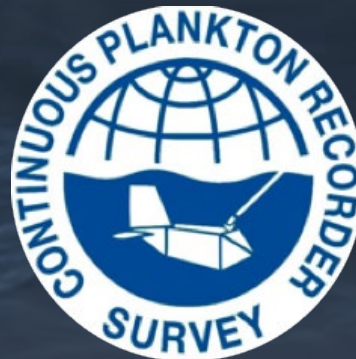
Gulf of Alaska SST Anomaly Time Series



# Hypothesis & Methods...

**HYPOTHESIS:** Zooplankton communities in Northeast Pacific (NEP) are spatially persistent across years of varying condition

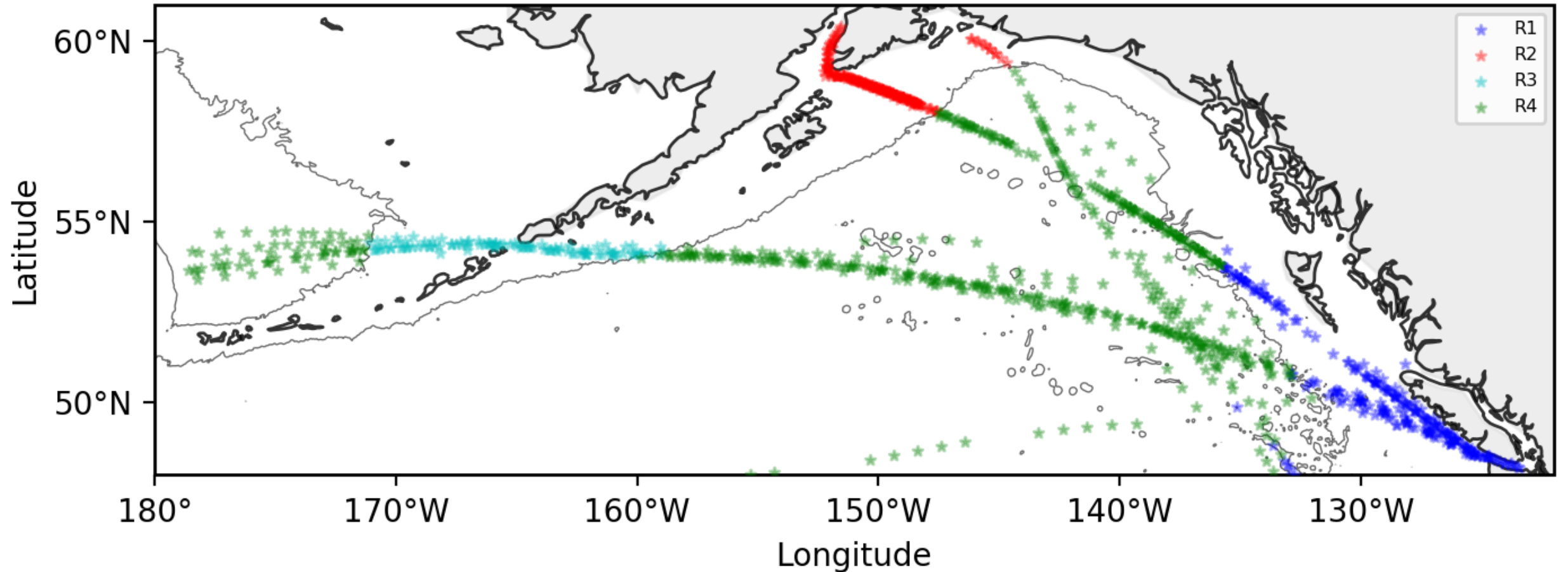
**APPROACH:** Analysis of 17 years' (2000 - 2016) of zooplankton assemblage data in the NEP (May 16 – August 15), provided by Continuous Plankton Recorder Survey (CPR).





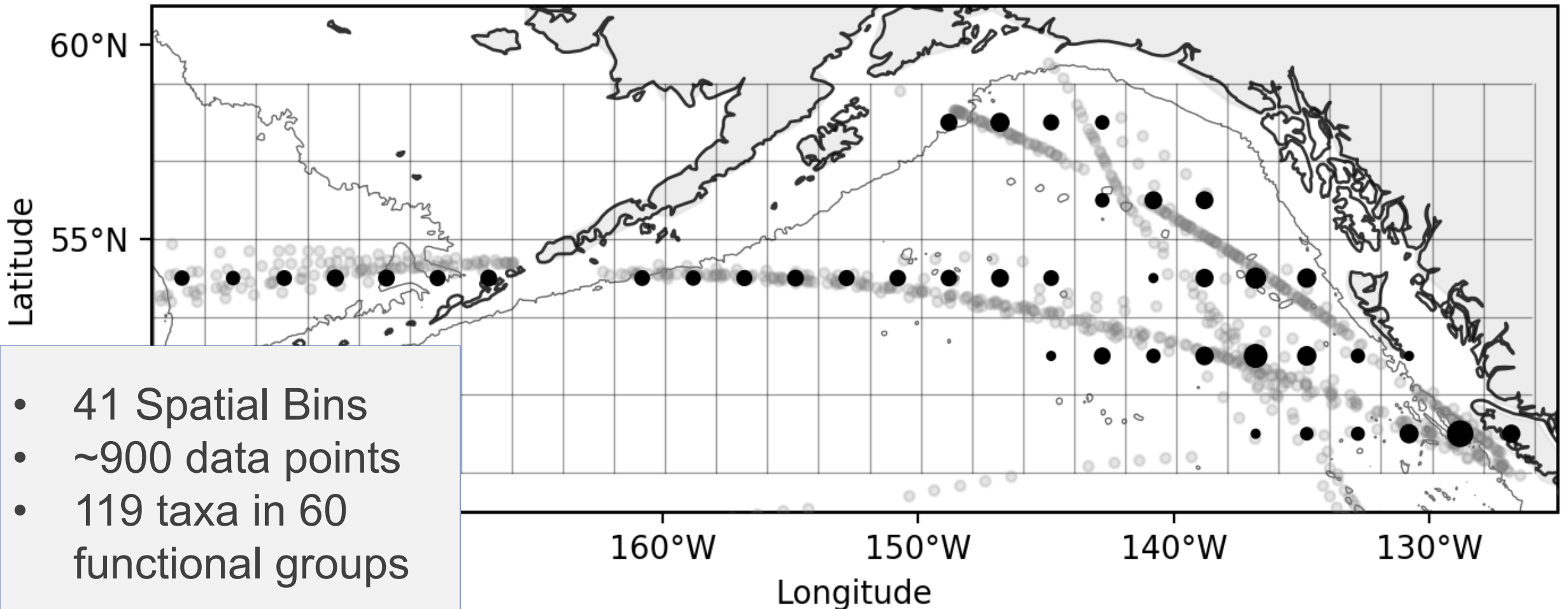
# Continuous Plankton Recorder

- South-North & East-West transects
- Summer: May 15 – Aug. 16



# CPR transects: 2000 - 2016

Zooplankton data summarized within 40 two \* two degree grid cells



# Processing Data

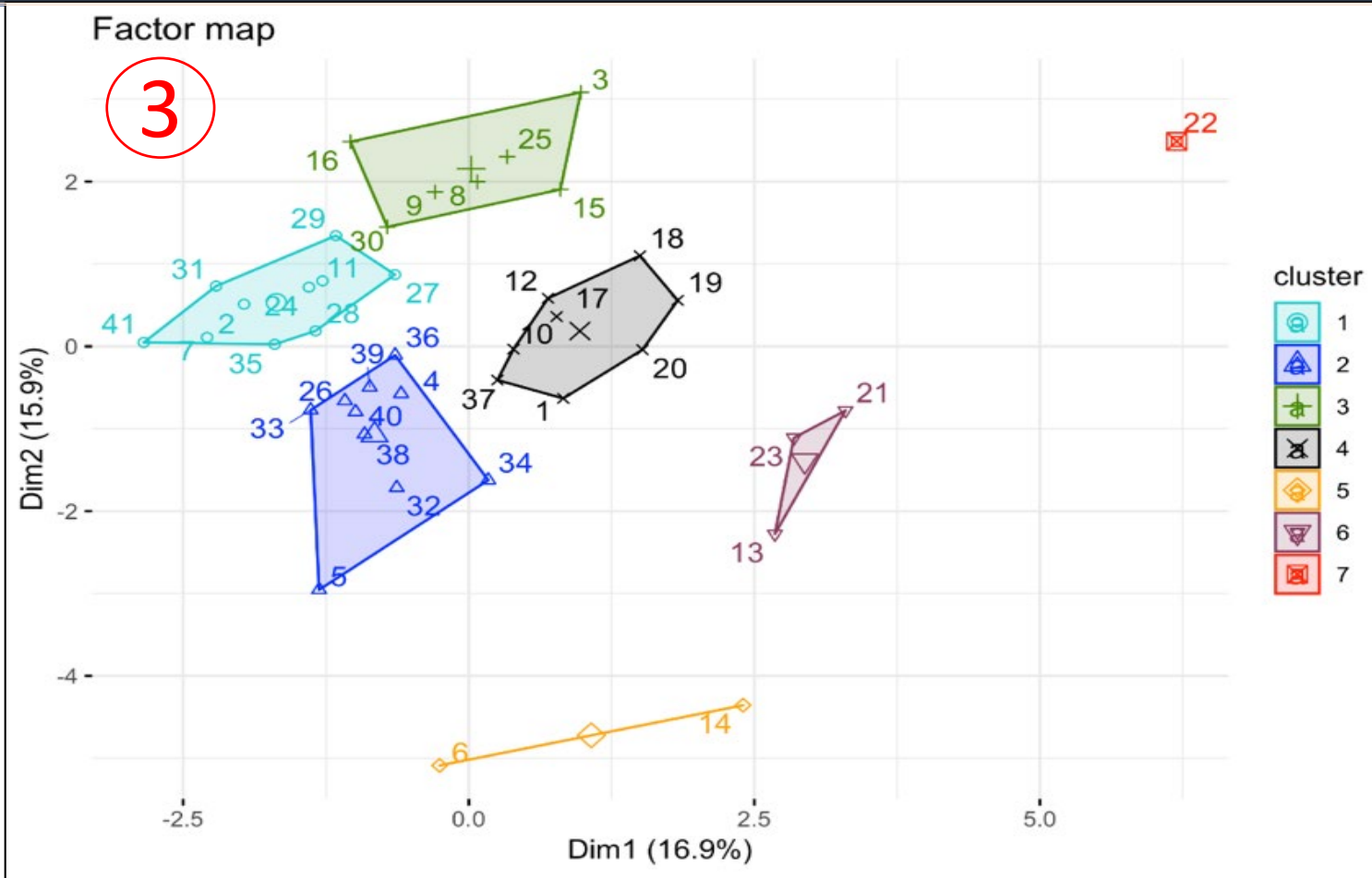
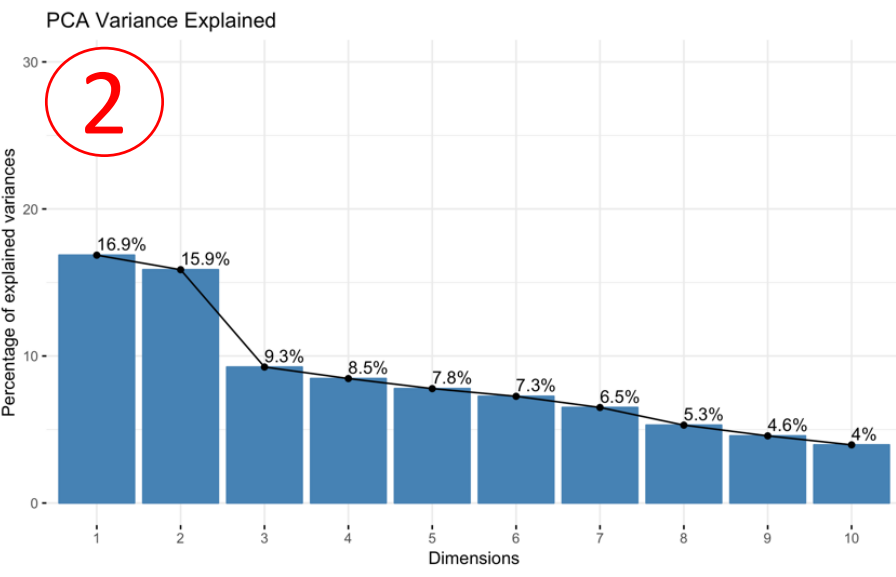
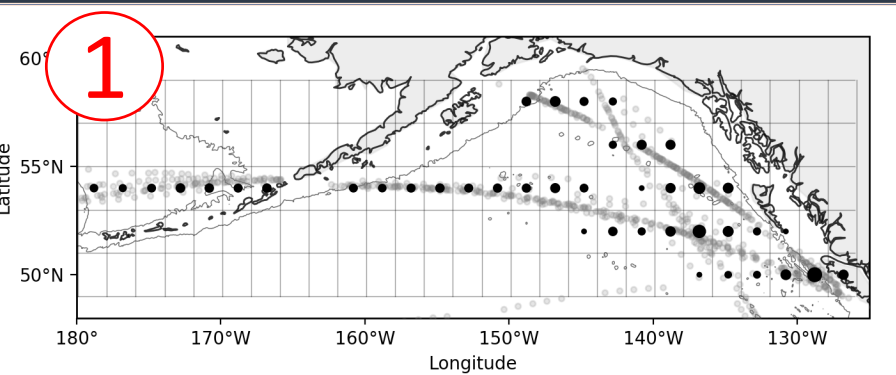
18 dominant zooplankton taxa retained from 100+ identified taxa

Taxa	Functional group
<i>N. plumchrus flemingeri</i>	Large, cold-water grazing copepods
<i>E. bungii</i>	
<i>N. cristatus</i>	
<i>M. pacifica</i>	
<i>C. marshallae</i>	
<i>A. longiremis</i>	Small neritic copepods
<i>C. abdominalis</i>	
<i>C. pacificus</i>	Medium widespread copepods
<i>Pseudocalanus</i> spp.	Small widespread copepods
<i>Oithona</i> spp.	
<i>Clione</i> spp.	
<i>L. helicina</i>	Pteropods
Salpidae	Gelatinous filter-feeders
Appendicularia	
Siphonophores	
Euphausiacea	Large diel migrators
Hyperiidæ	Amphipods
Chaetognaths	Arrow worms, predators of small copepods

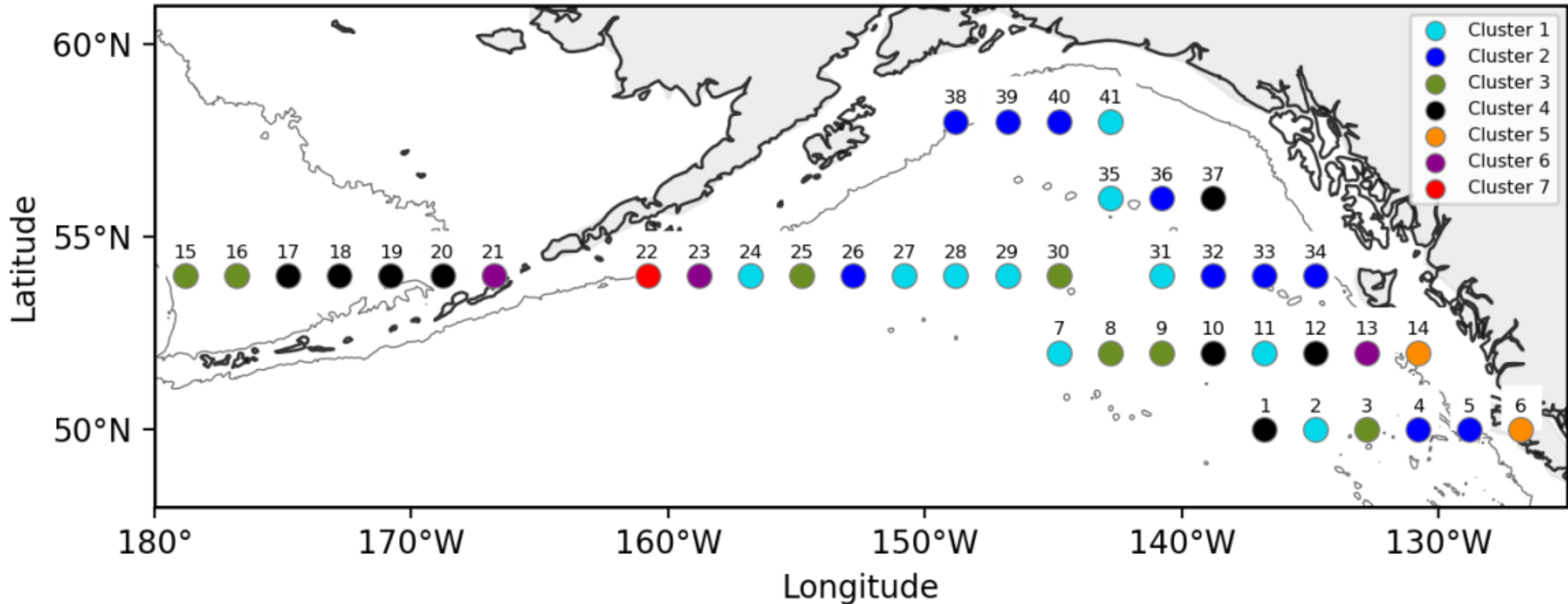


# Methods to Determine Community Spatial Patterns

- 1) Binning the data in spatial grid
- 2) Initial detrending using Principle Component Analysis
- 3) Hierarchical cluster analysis applied to first 2 PC loadings (HCPC)



# Baseline Spatial Pattern in Communities



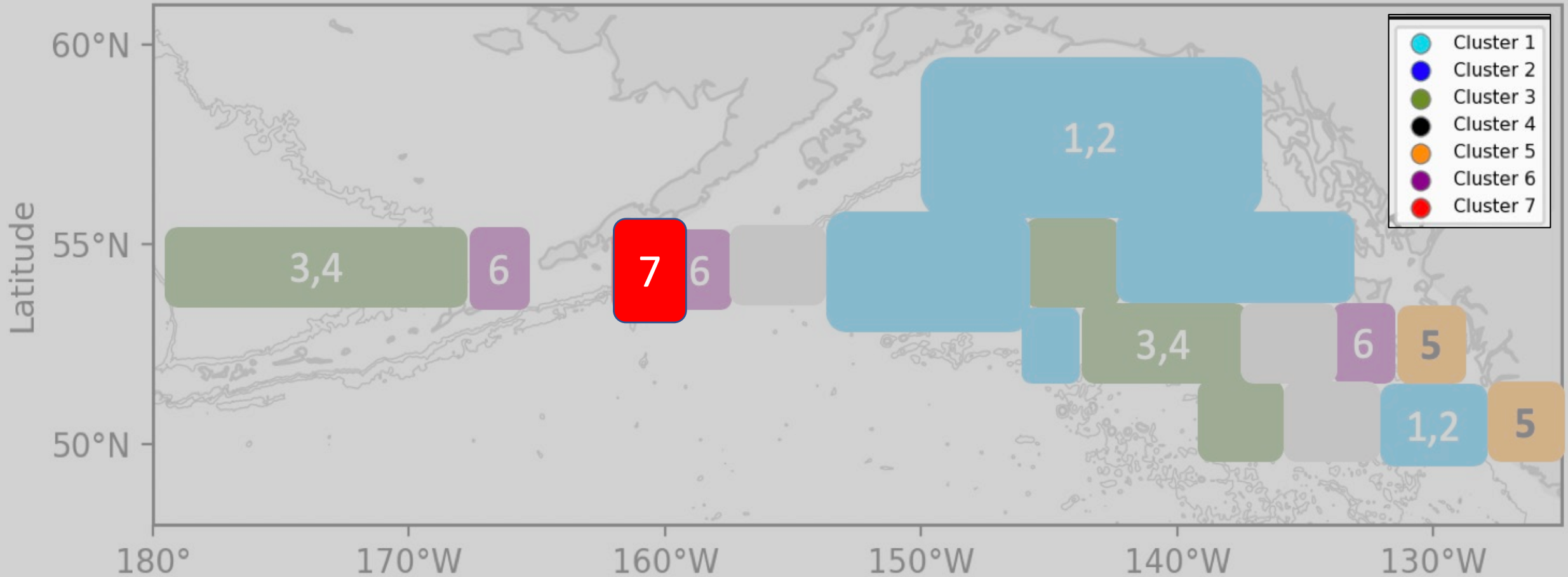


 Central gyre

 Aleutians & Pacific current

  Coastal sites

 Unimak





Central gyre



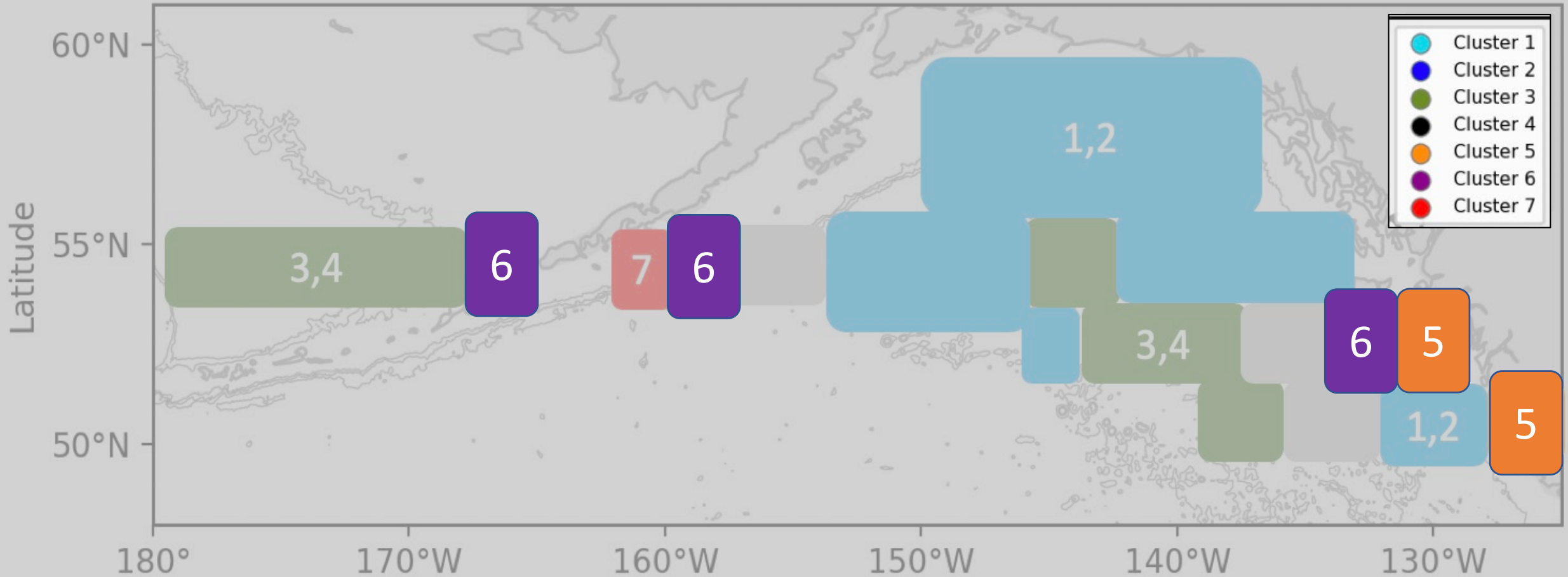
Aleutians & Pacific current



Coastal sites



Unimak

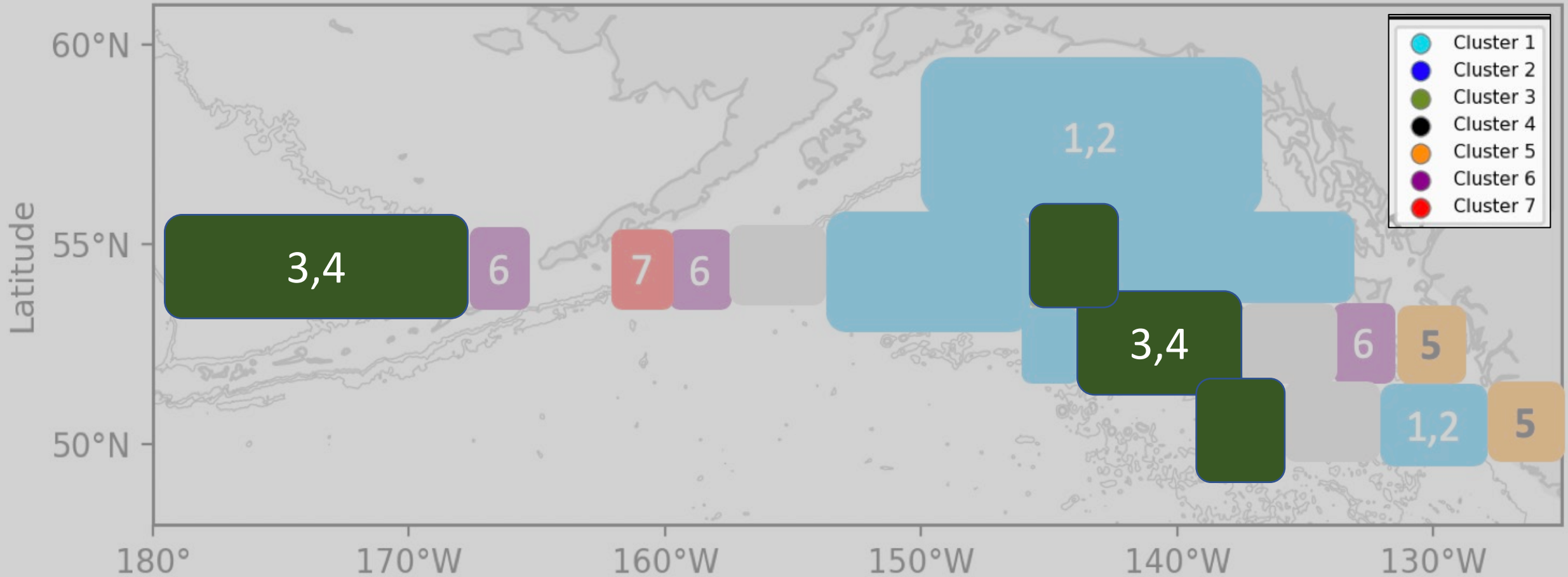


 Central gyre

 Aleutians & Pacific current

  Coastal sites

 Unimak

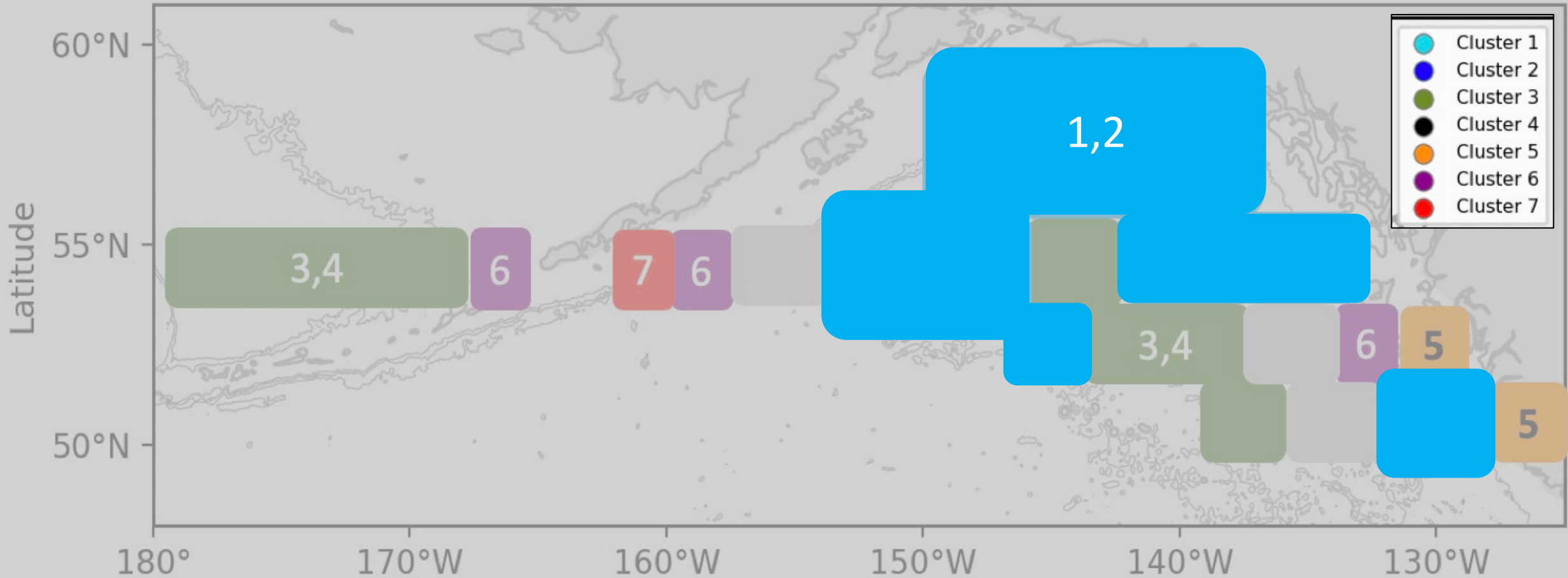


 Central gyre

 Aleutians & Pacific current

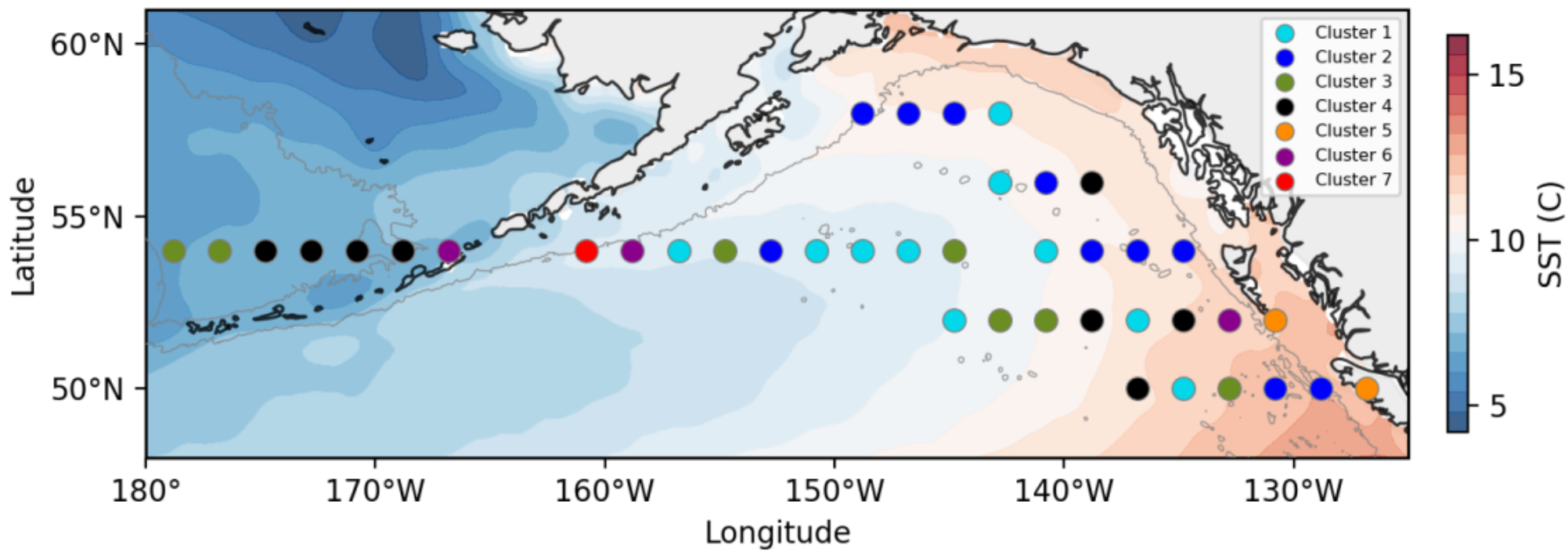
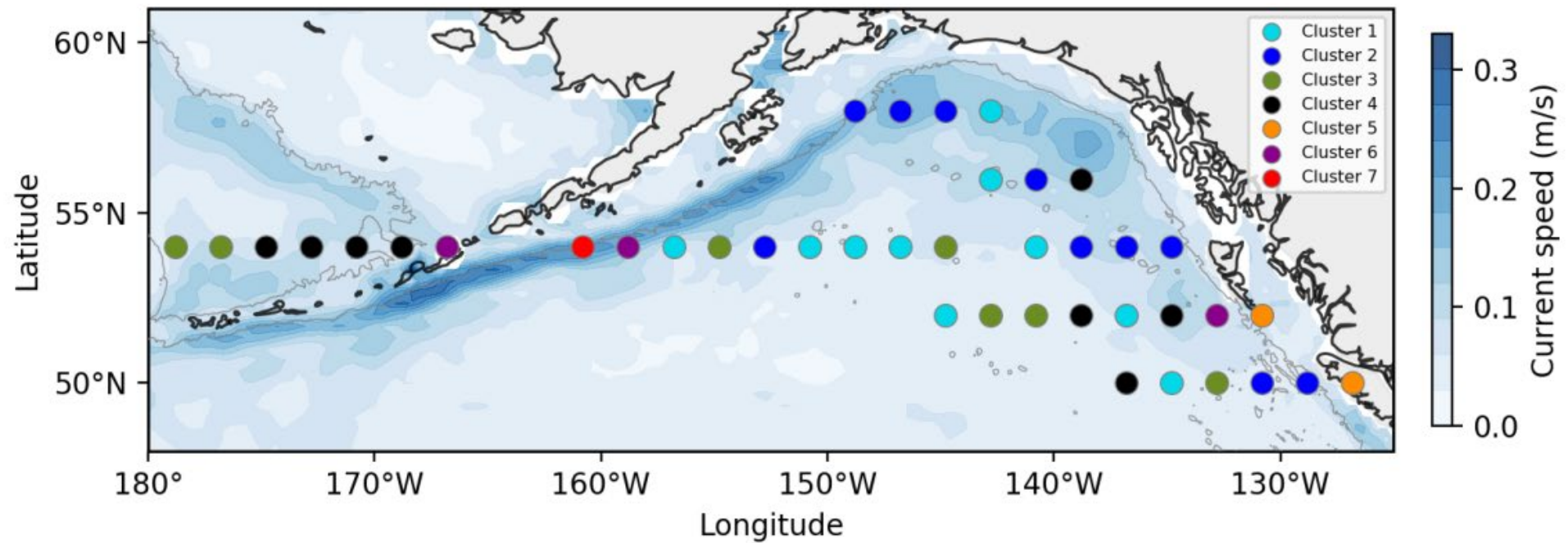
  Coastal sites

 Unimak

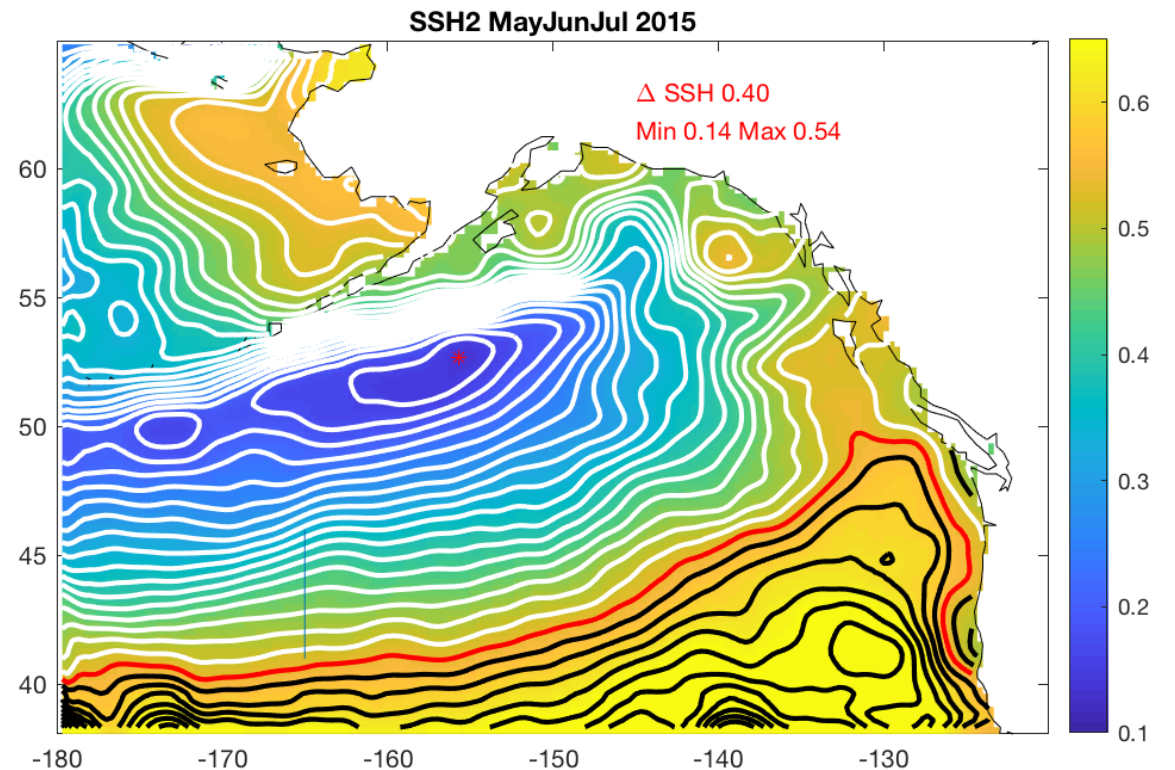
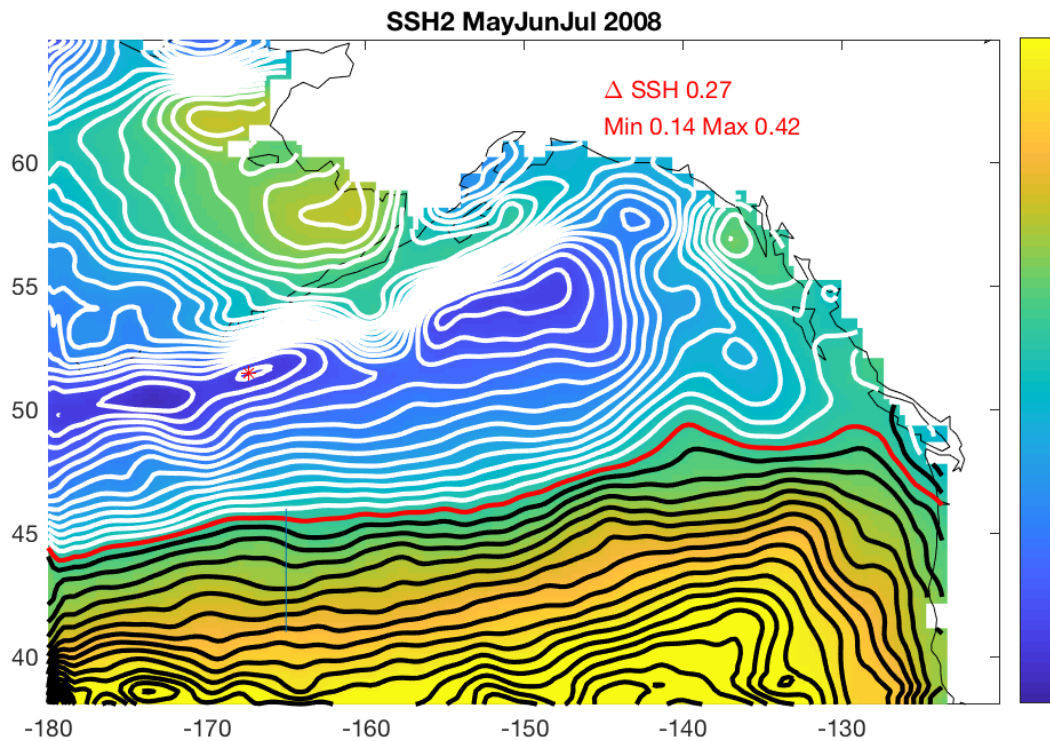
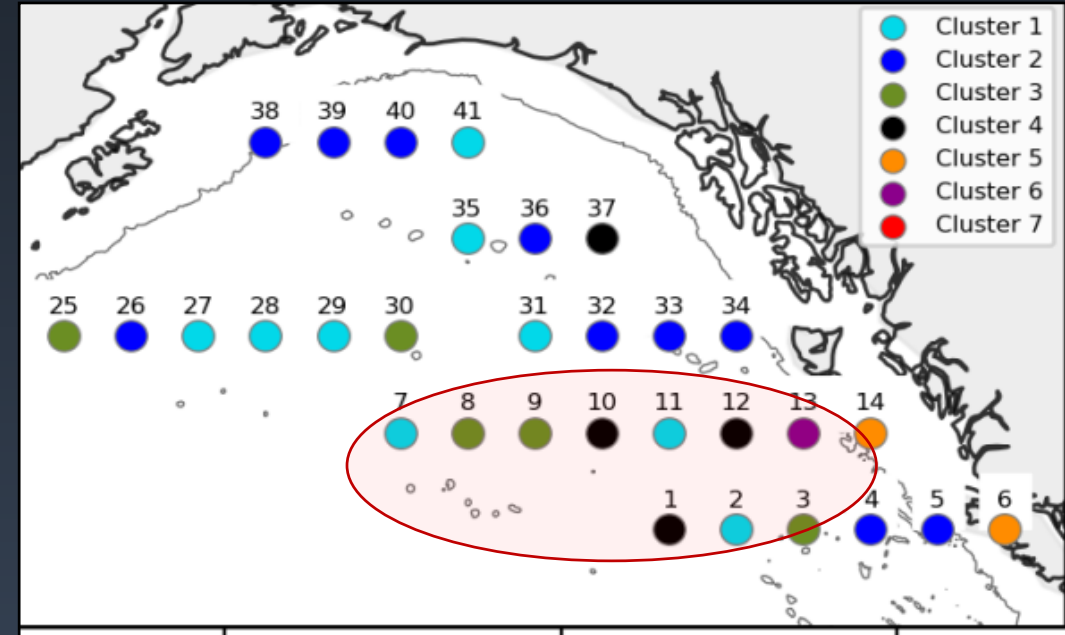




- UNIMAK  
*E. bungii*  
*L. helicina*
- COAST  
*A. longiremis*;  
*C. abdominalis*;
- SHELF  
*Pseudocalanus*  
Euphausiids  
salps
- DEEP  
BASIN
- GOA



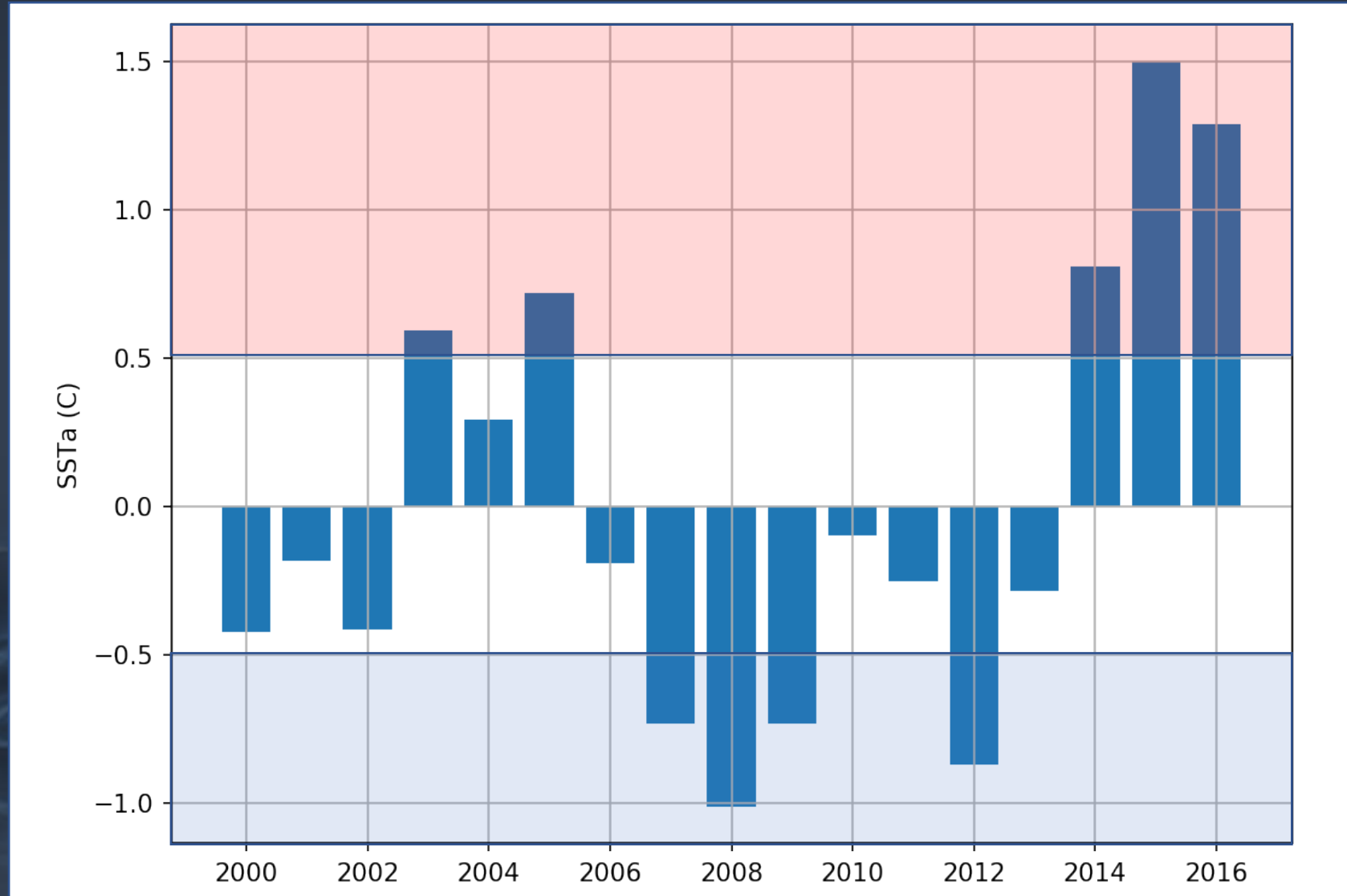
# Other explanations: Current Positioning?



# Are Community Patterns Persistent?

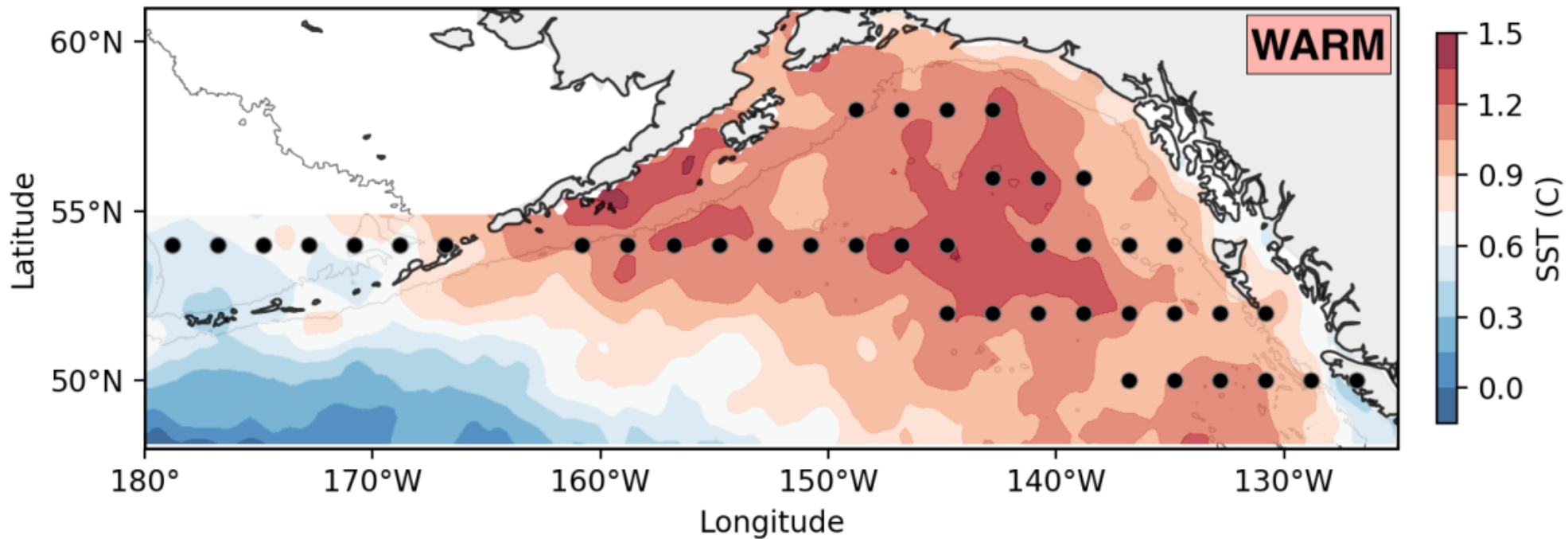
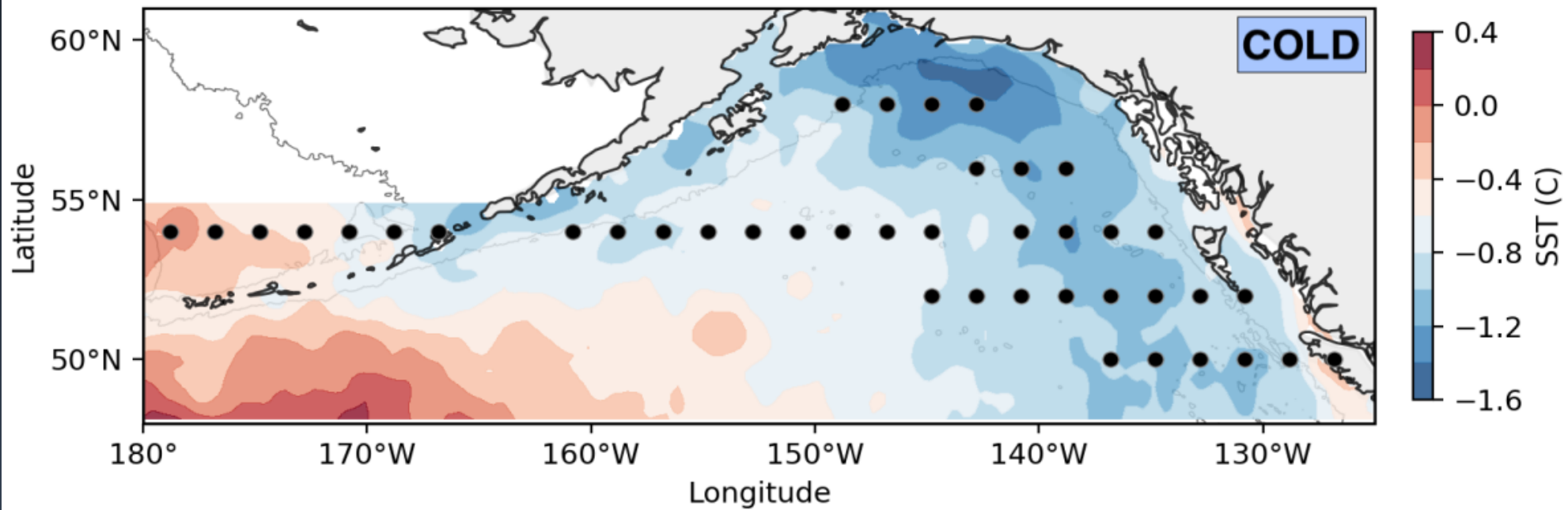
## Defining Temperature Anomalies

> 0.5°C  
WARM  
- 2003  
- 2005  
- 2014  
- 2015  
- 2016



< 0.5°C  
COLD  
- 2007  
- 2008  
- 2009  
- 2012

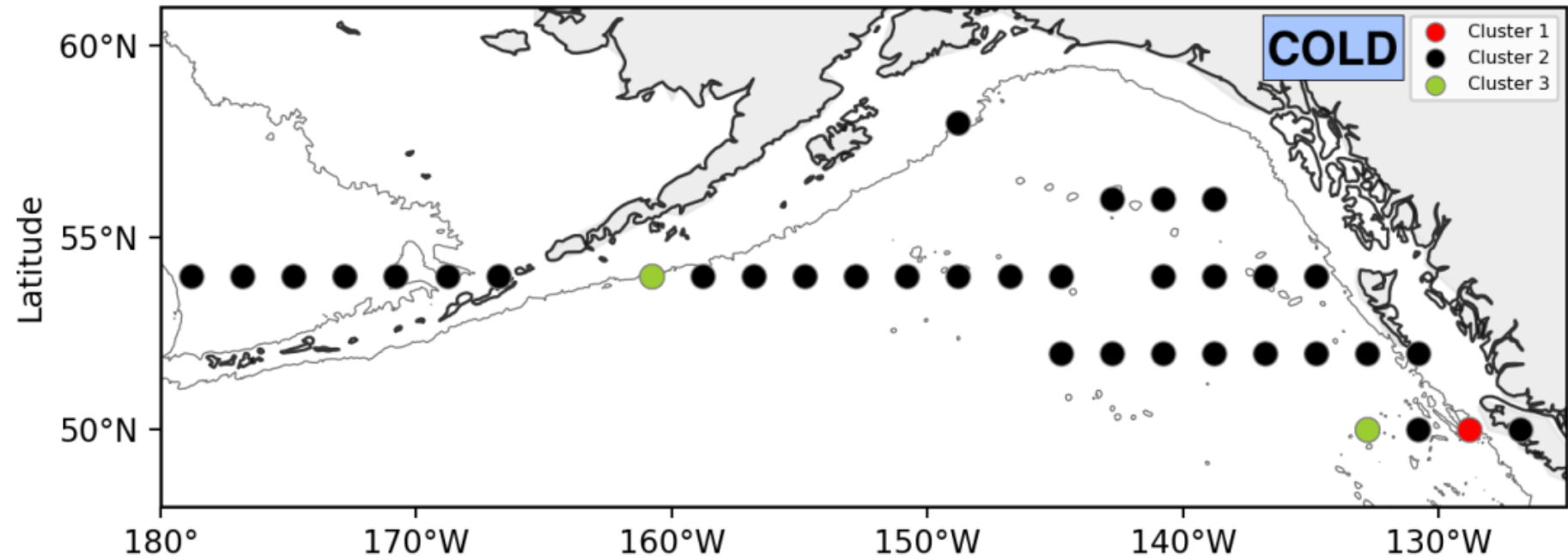






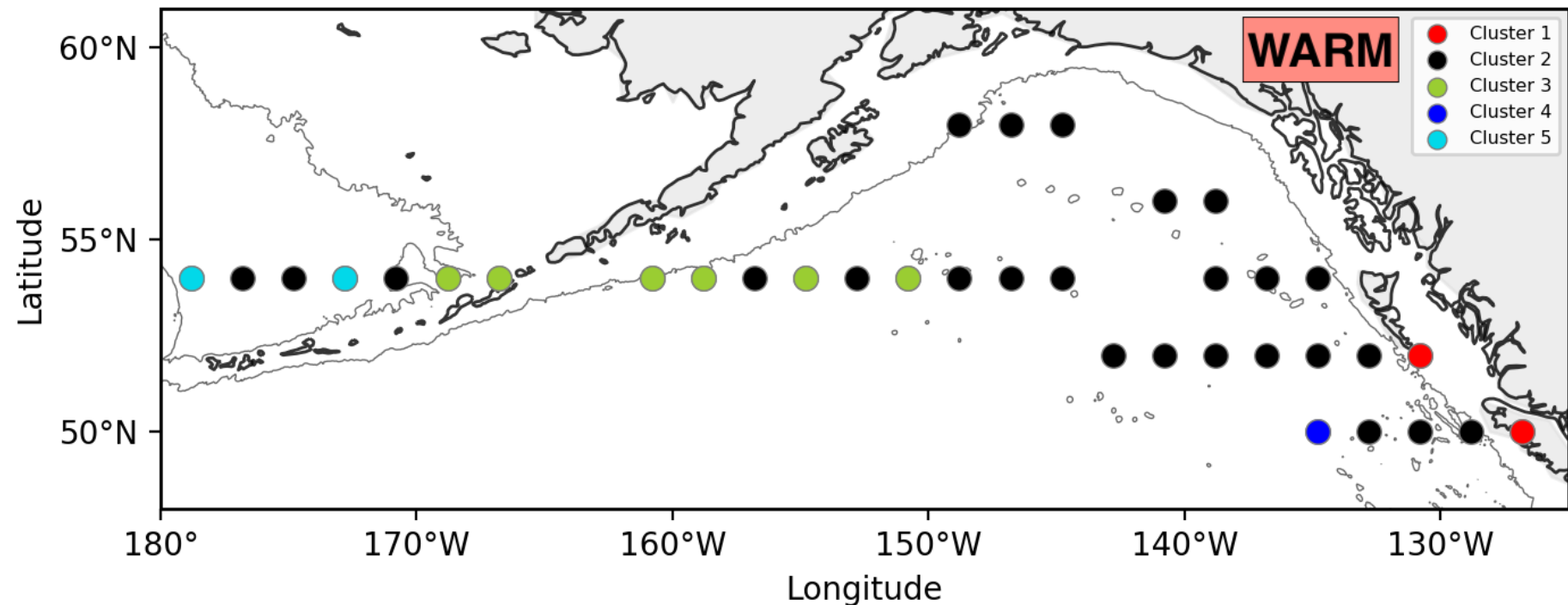
# COLD

- 3 clusters, little variation.
- Unique clusters are in Unimak and coastal sites.



# WARM

- Aleutian signal spreads
- More pronounced coastal effect
- Additional cluster in the Bering Sea and the south GOA



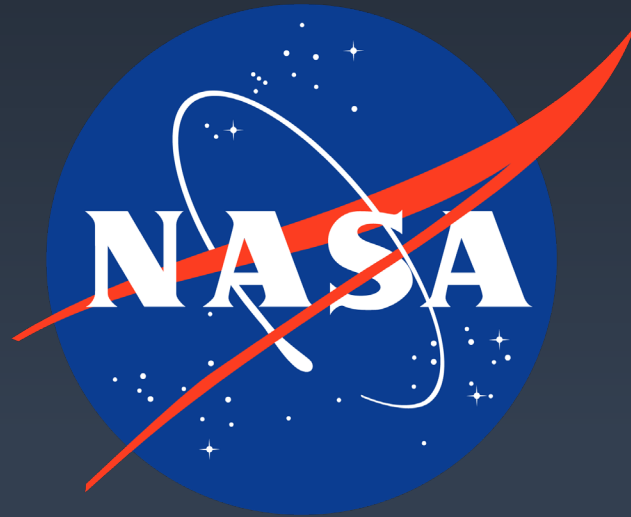
# Summary

HYPOTHESIS: Zooplankton communities in Northeast Pacific (NEP) are spatially persistent across years of varying condition

RESULTS:

- 1) Spatial shifts in coastal communities associated with thermal anomalies
- 2) Spatial persistence in central gyre
- 3) No study wide thermal effect on community assemblage, but significant structuring effects of Region (Bering vs. GOA;  $p = 0.012$ ) and Temp. \* Region ( $p = 0.04$ )

# Acknowledgements





# Cluster Traits



UNIMAK: medium SST,  
strong current, high variance

*E. bungii*; *L. helicina*



COASTAL: high SST, med.  
current, low variance

*A. longiremis*; *C. abdominalis*; *C. marshallae*



COASTAL: wide SST, high-  
current, mid-high variance

*Pseudocalanus* spp; euphausiids;  
salps



DEEP BASIN: wide SST,  
wide current, wide variance

*Clione* spp; *Oithona*; chaetognaths; *C. pacificus*  
*N. plumchrus/flem.*



GOA: wide SST, wide  
current, wide variance,

Decreased abundance of most common  
taxa, only *Clione* spp. show sig. increase.