Nonstationary ocean climate effects on Pacific salmon productivity

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Fishes Without Borders II
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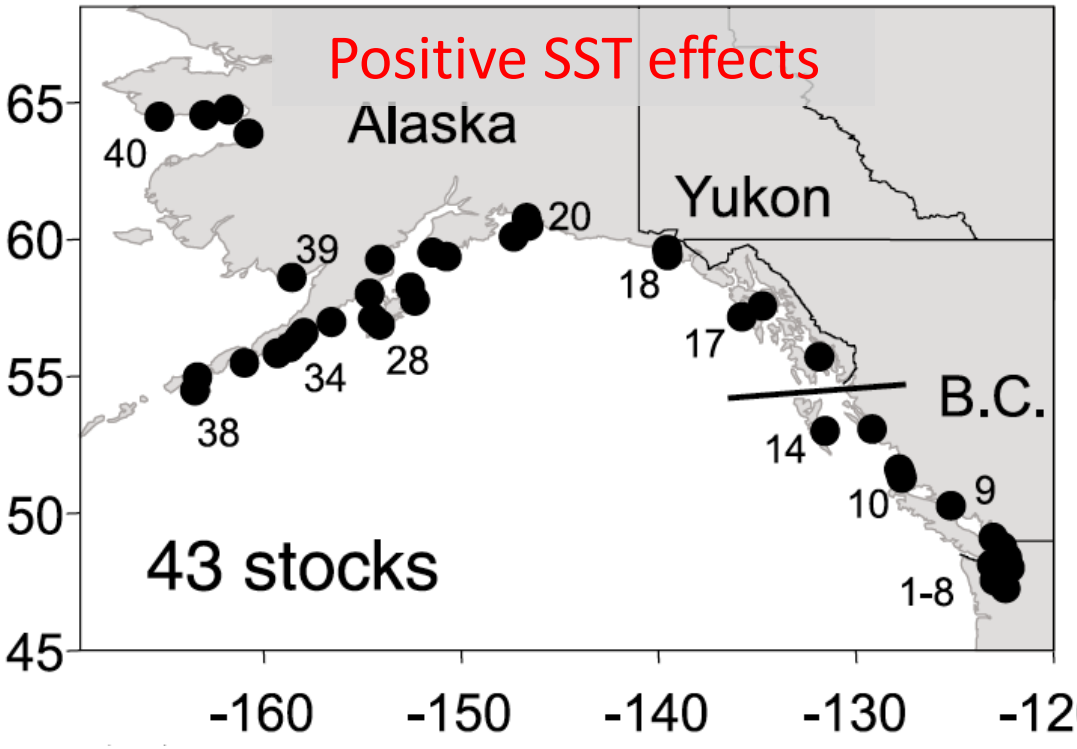
Ocean temperature (SST) effects on early marine survival

Pink salmon



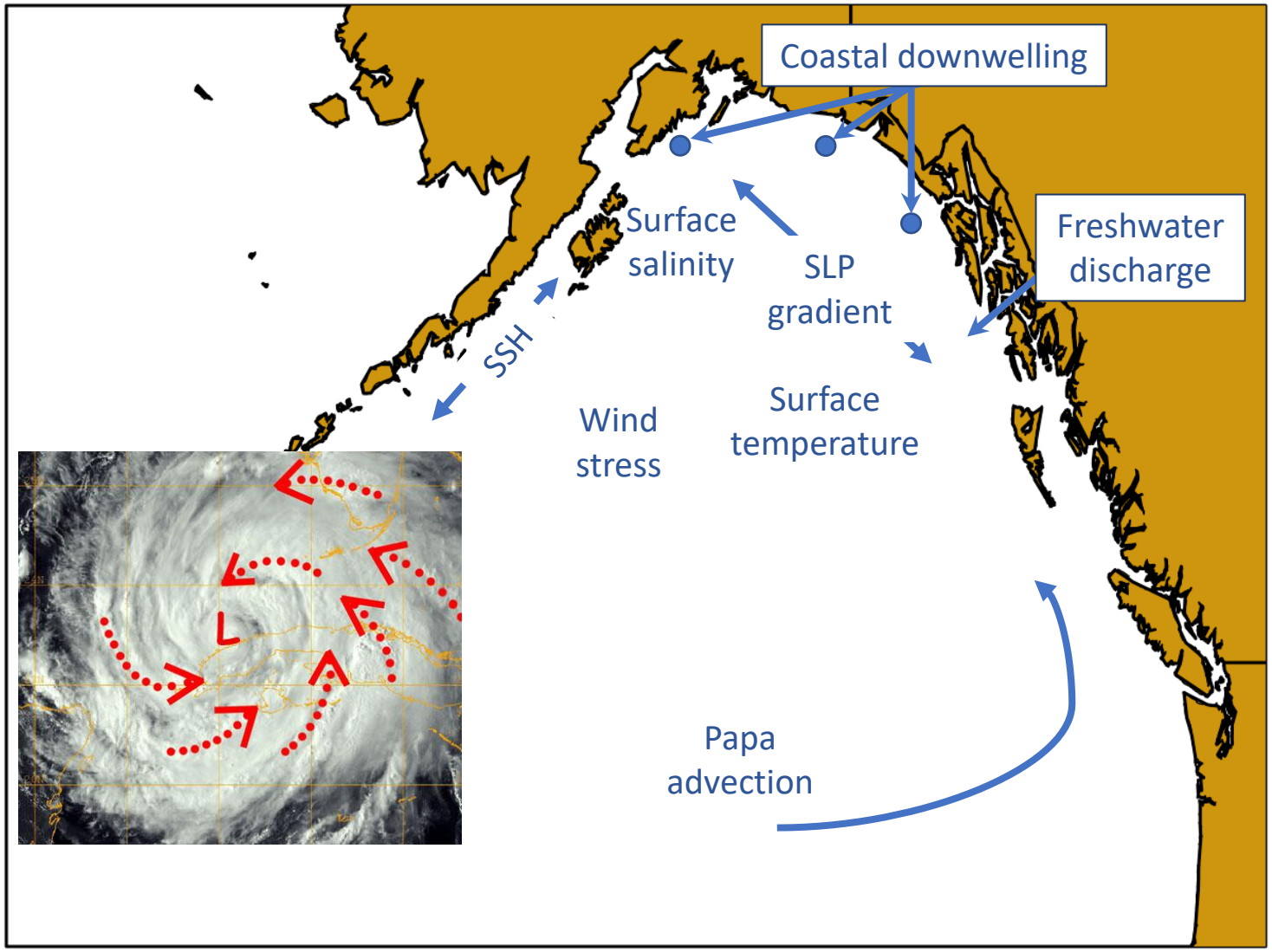
Negative SST effects

Mueter et al. 2002 CJFAS

SST effects on productivity are created by correlation between SST and other environmental variables

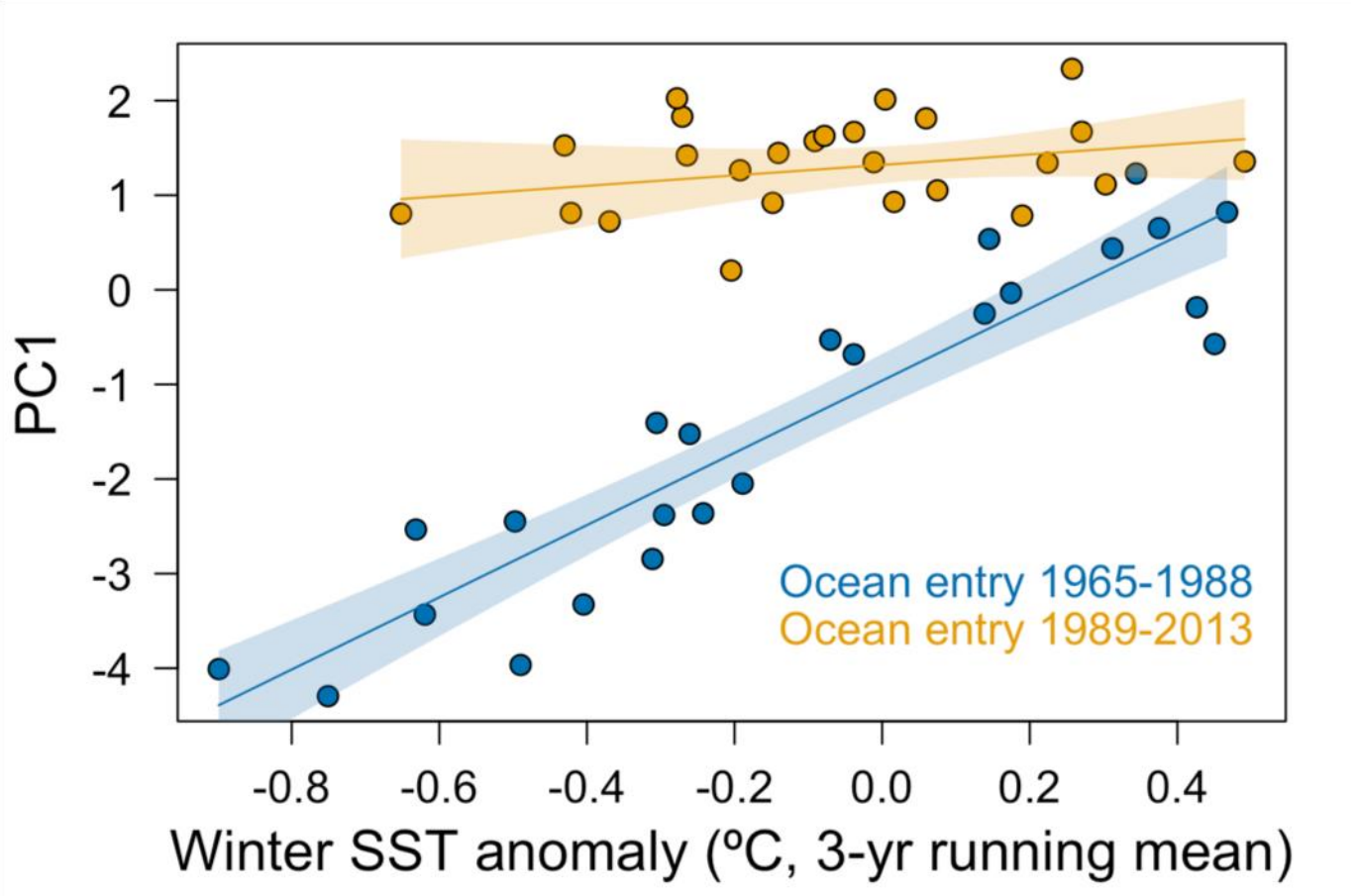
-Mueter et al. 2002 CJFAS

The Aleutian Low creates collinear environmental variability

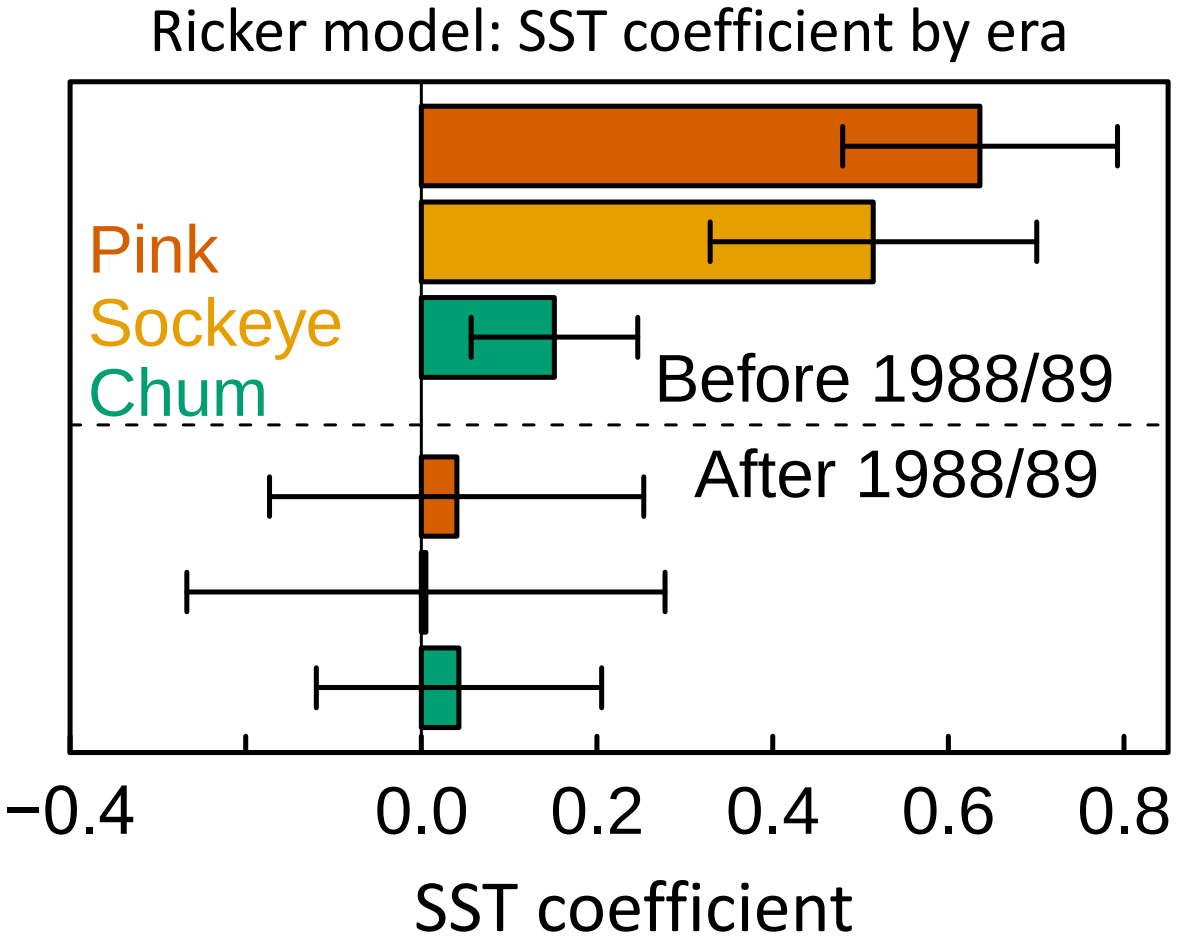


Hypothesis:
Temperature effects are nonstationary

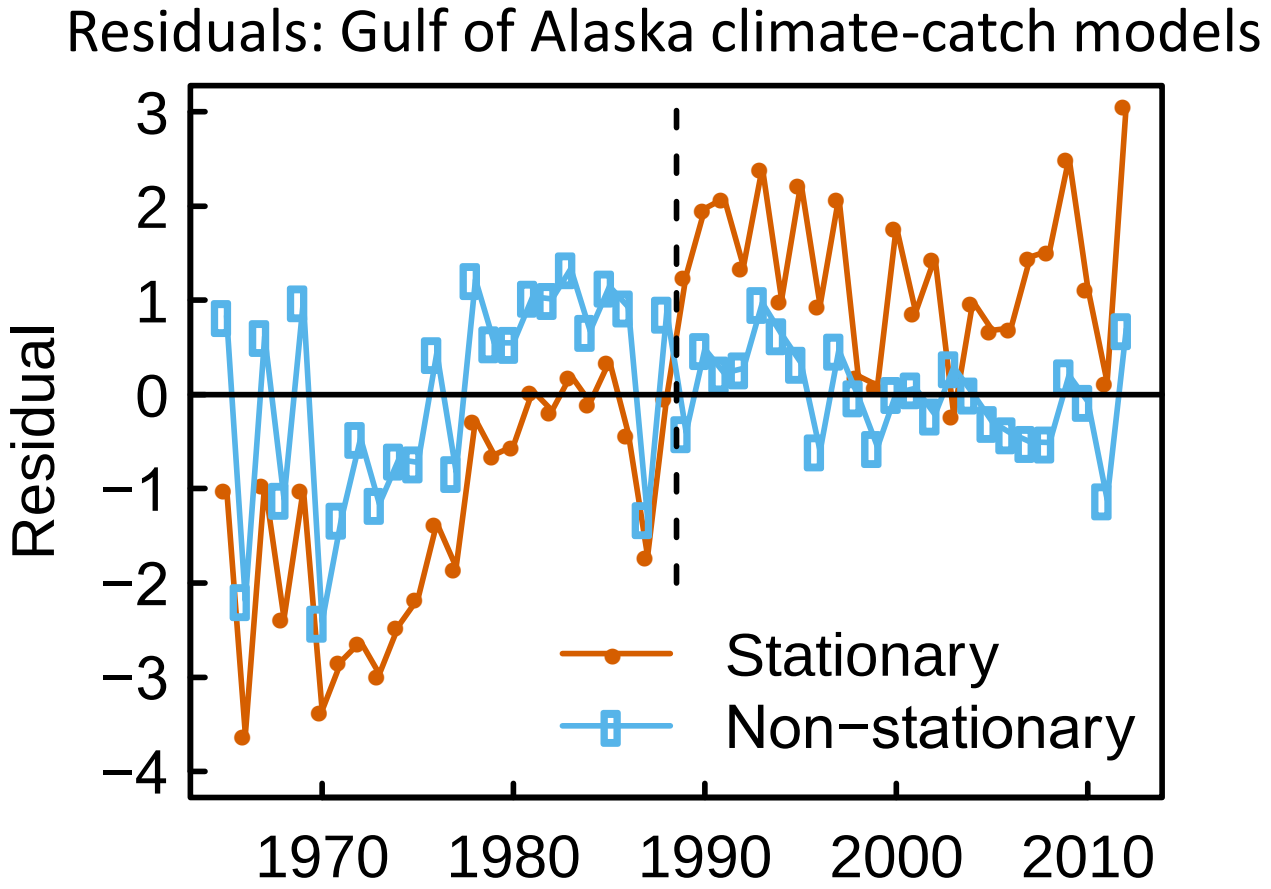
PC1 of Gulf of Alaska log salmon catch vs. SST



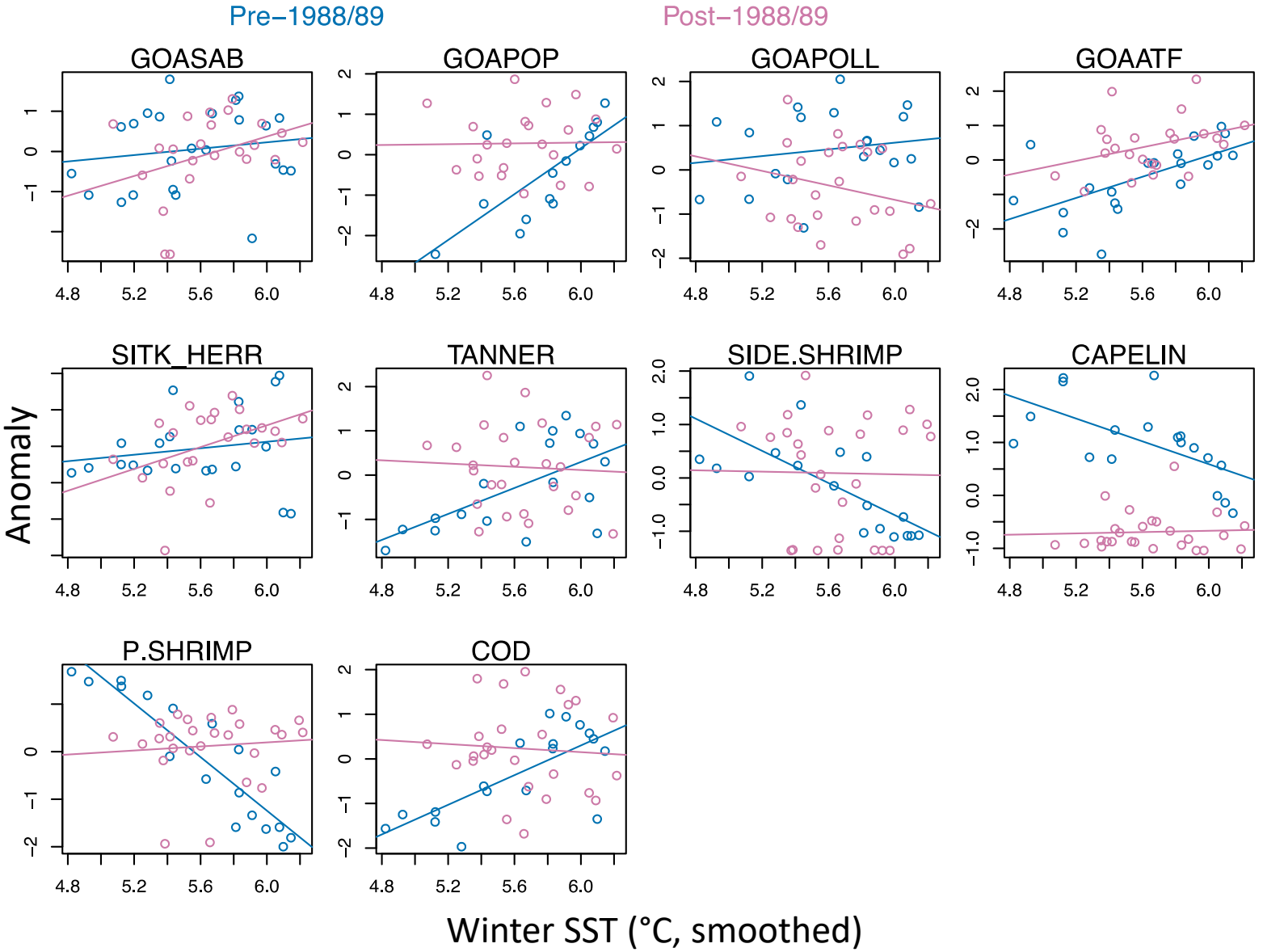
Hypothesis:
Temperature effects are nonstationary



Stationary models are mis-specified

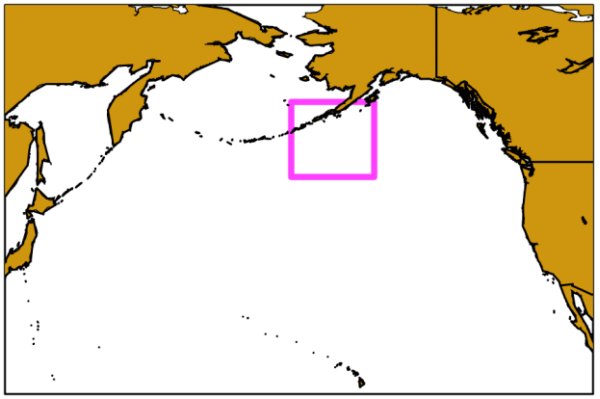


Broader community changes – abundance/recruitment



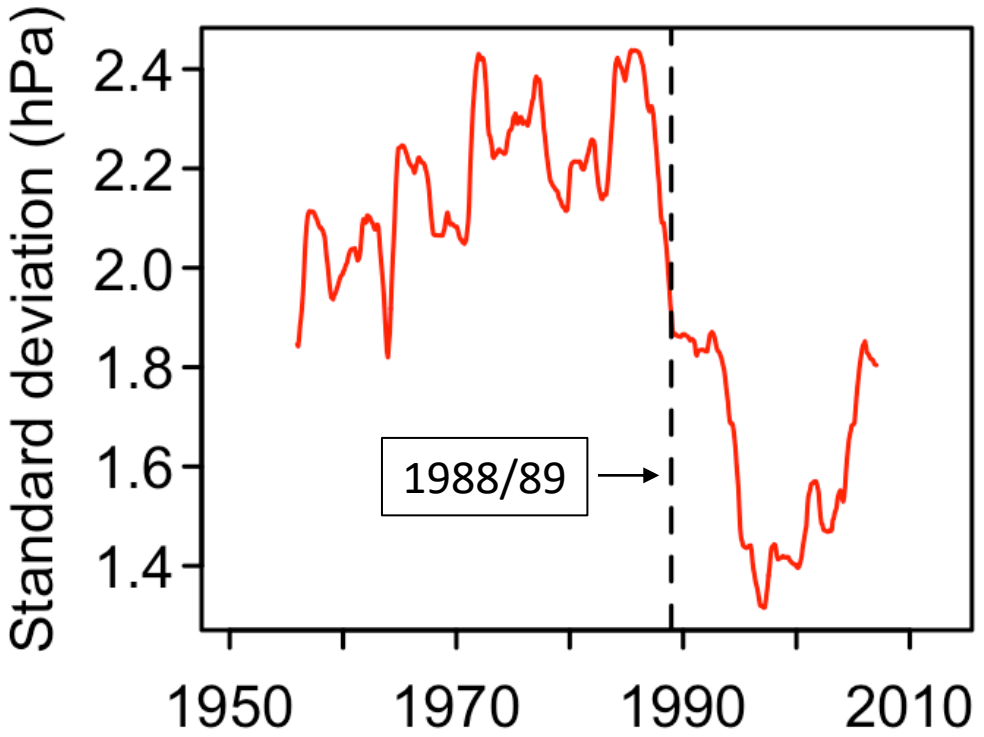
Aleutian Low variance is nonstationary

SLP area



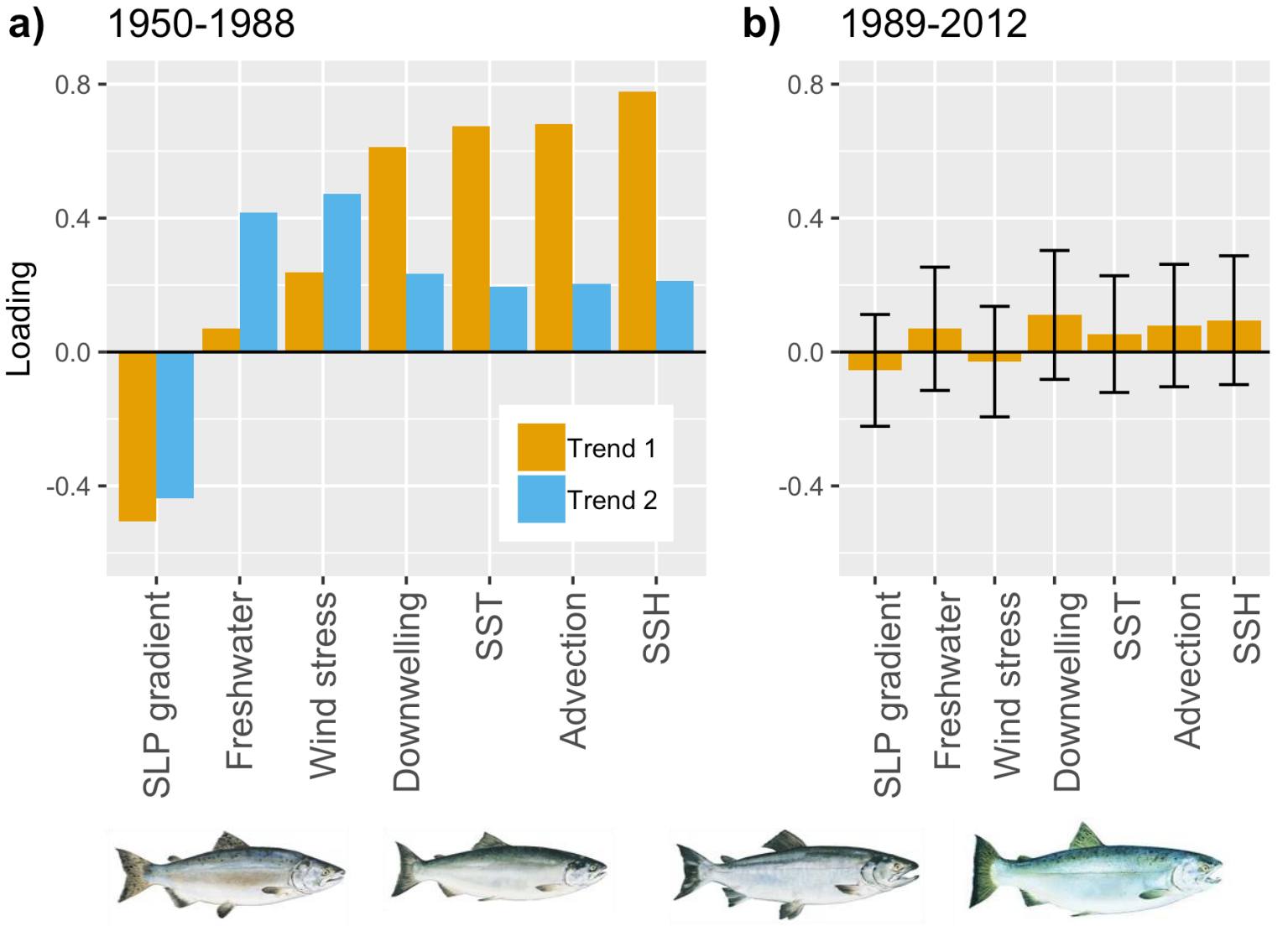
SLPa standard deviation

(low-pass filtered, 11-year rolling windows)



Nonstationary Aleutian Low: implications

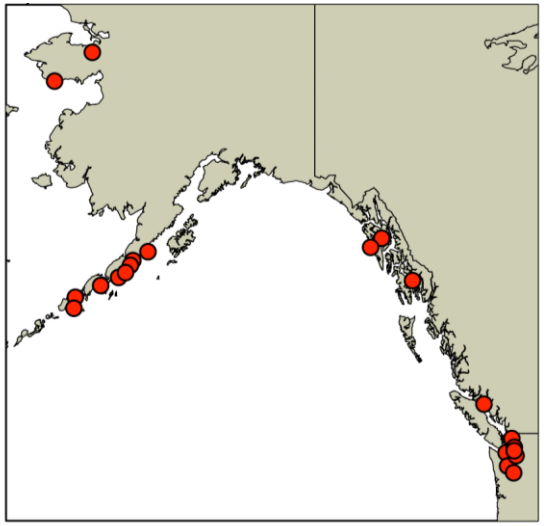
Gulf of Alaska environmental variables: Dynamic factor analysis loadings



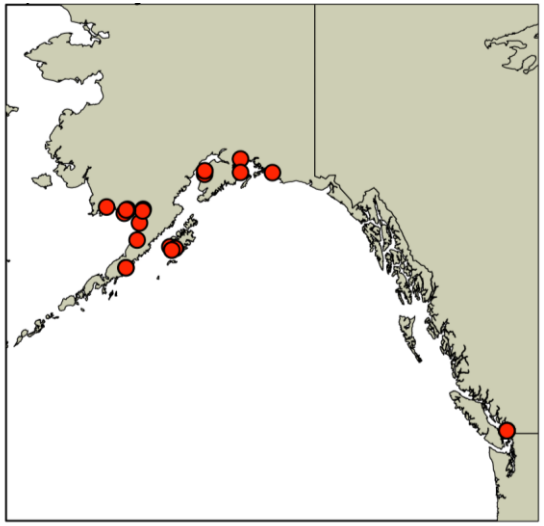
Prediction:
Nonstationary Aleutian Low should create nonstationary SST-productivity relationships throughout the NE Pacific

Wild population spawner-recruit time series
Ocean entry 1972-2005 or longer

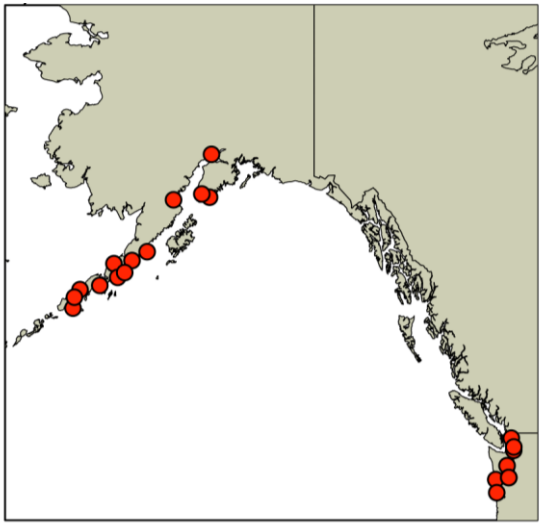
Pink (n = 35)



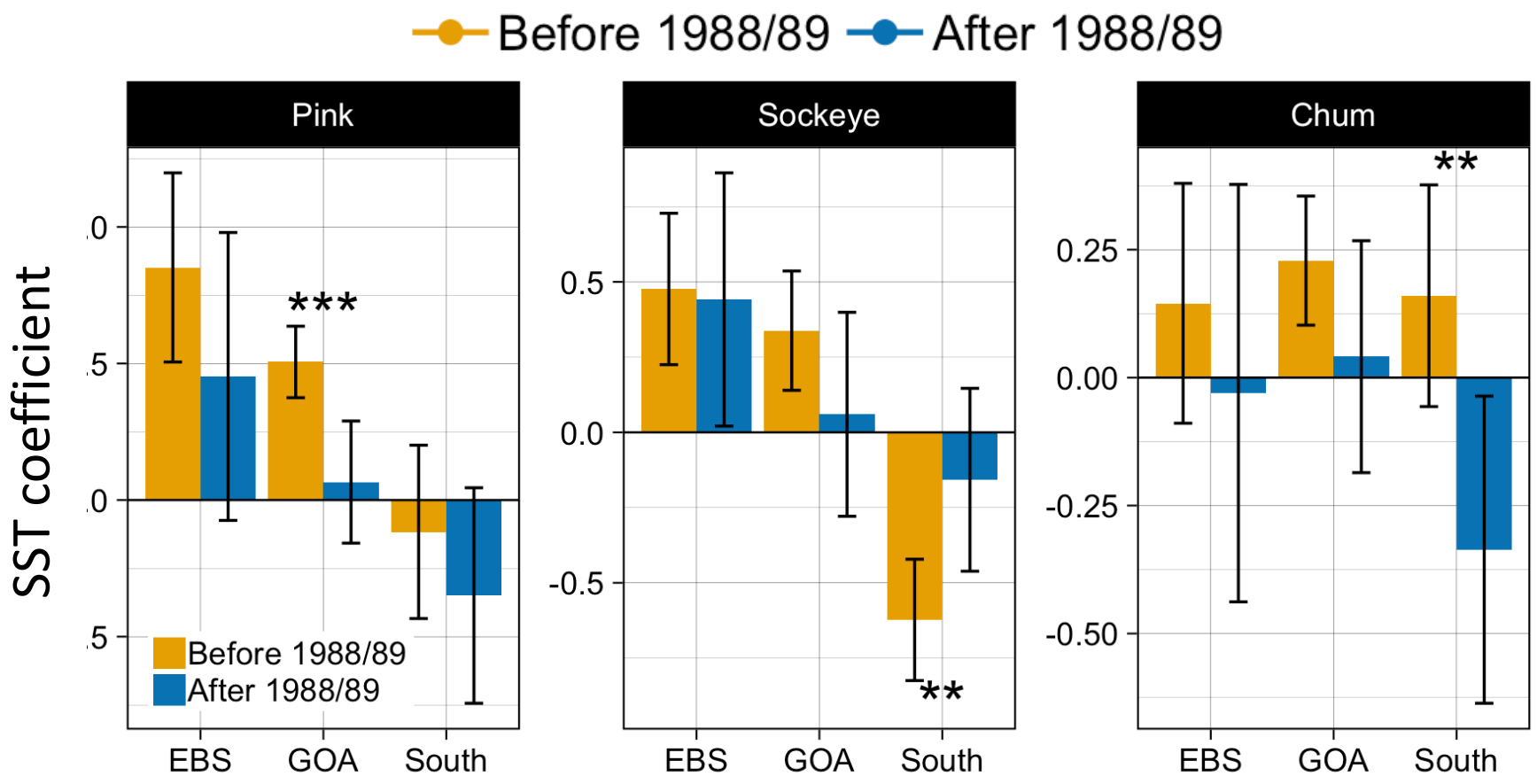
Sockeye (n = 30)



Chum (n = 21)



Mixed-effects models



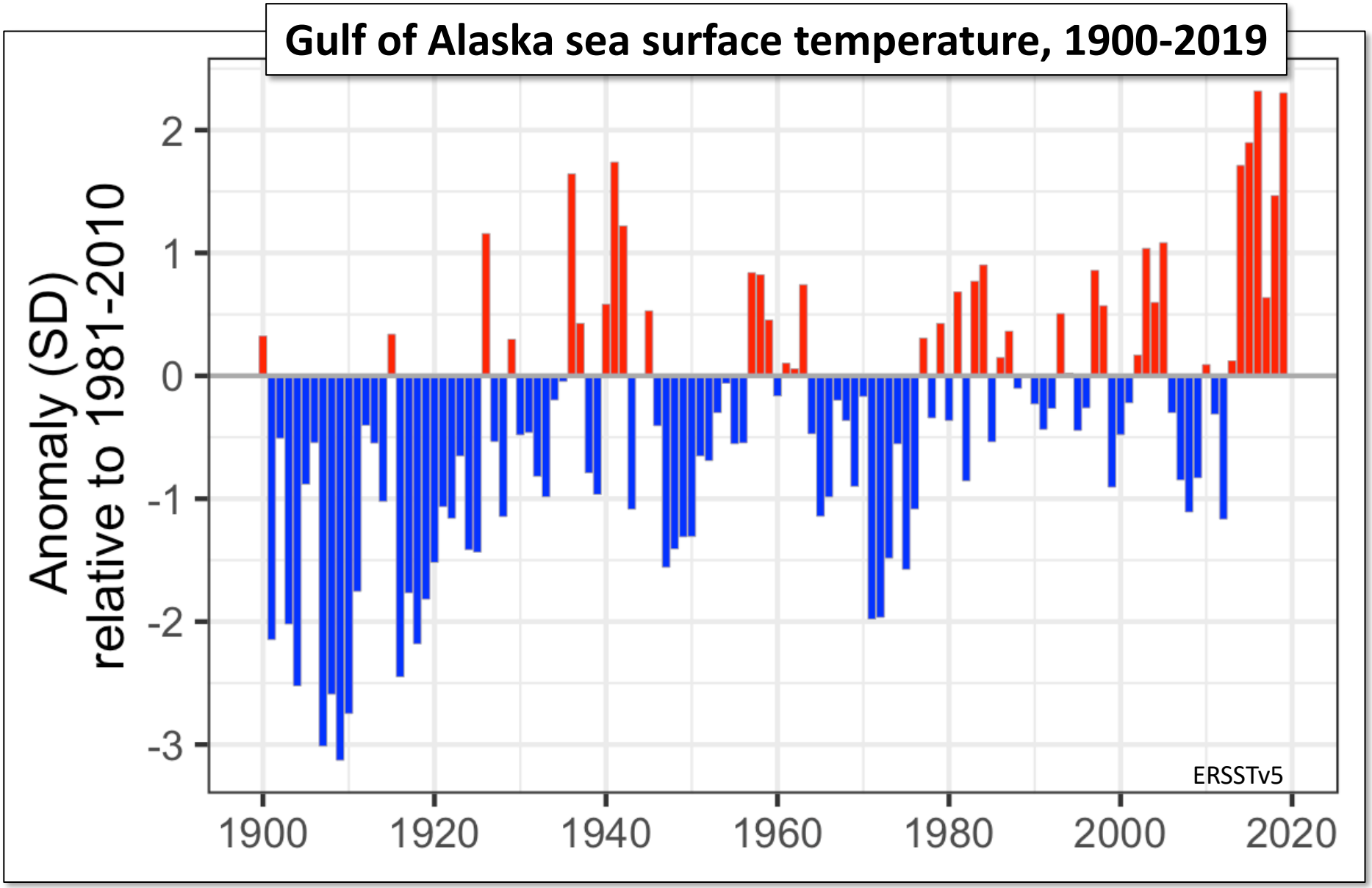
Support for nonstationary model:

Δ-AIC = 19.3

Δ-AIC = 115.7

Δ-AIC = 55.6

What about the years since the Blob?



What about the years since the Blob?

Sea level pressure was unusually high

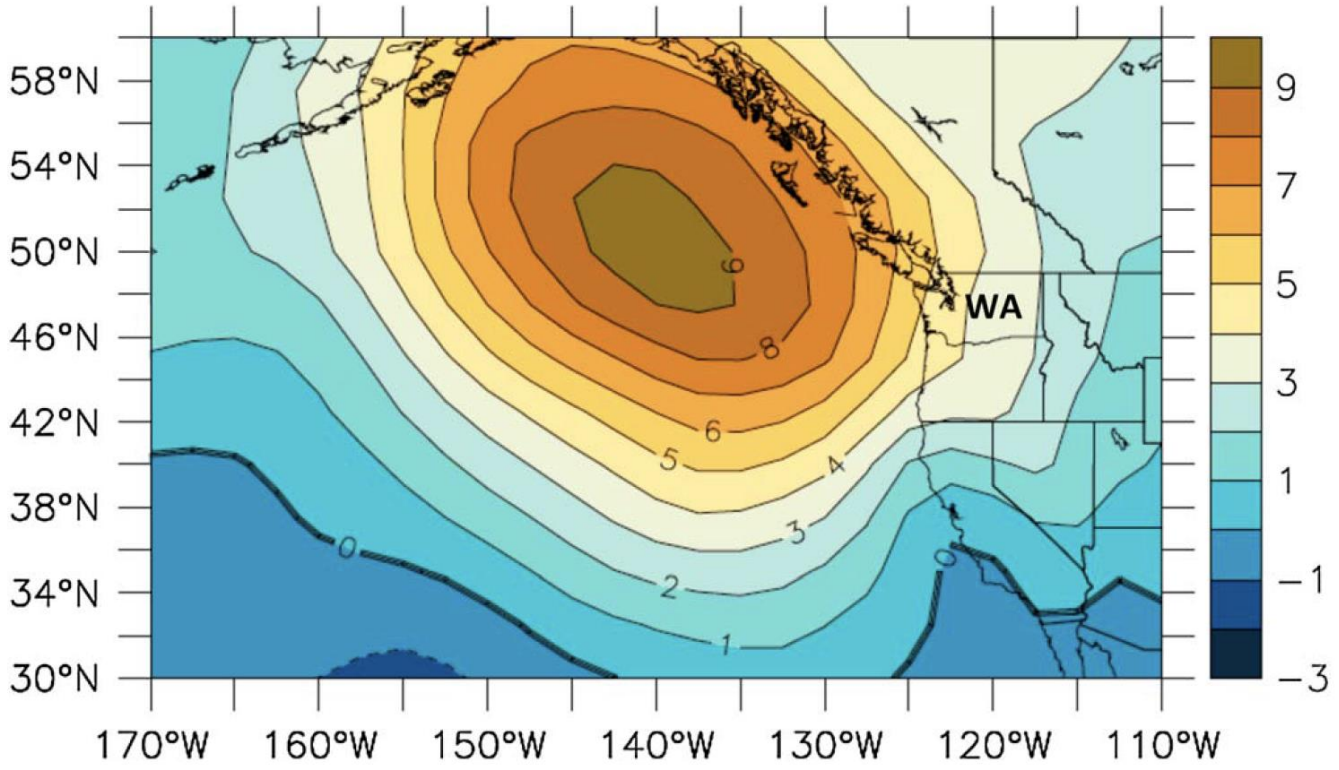
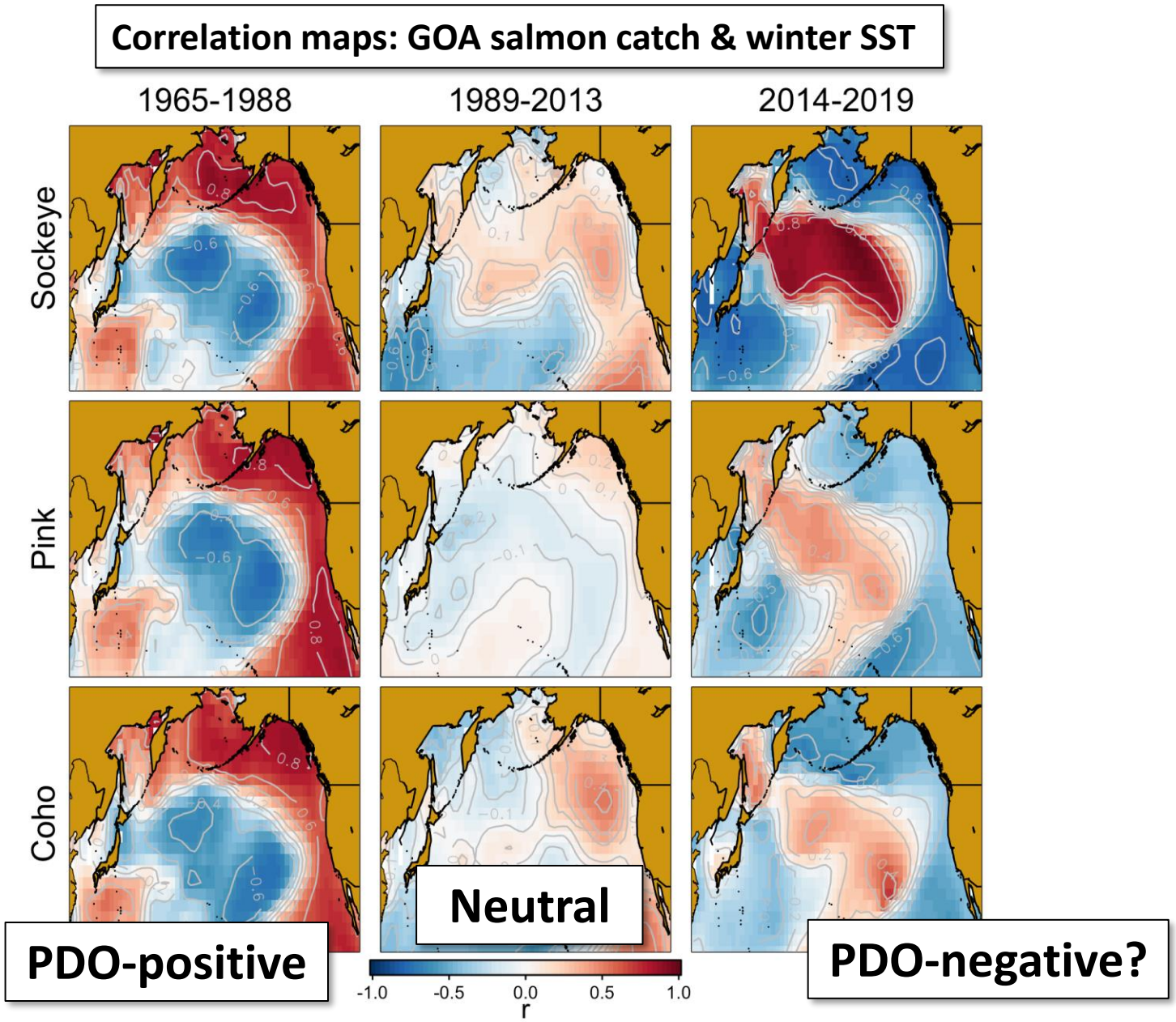


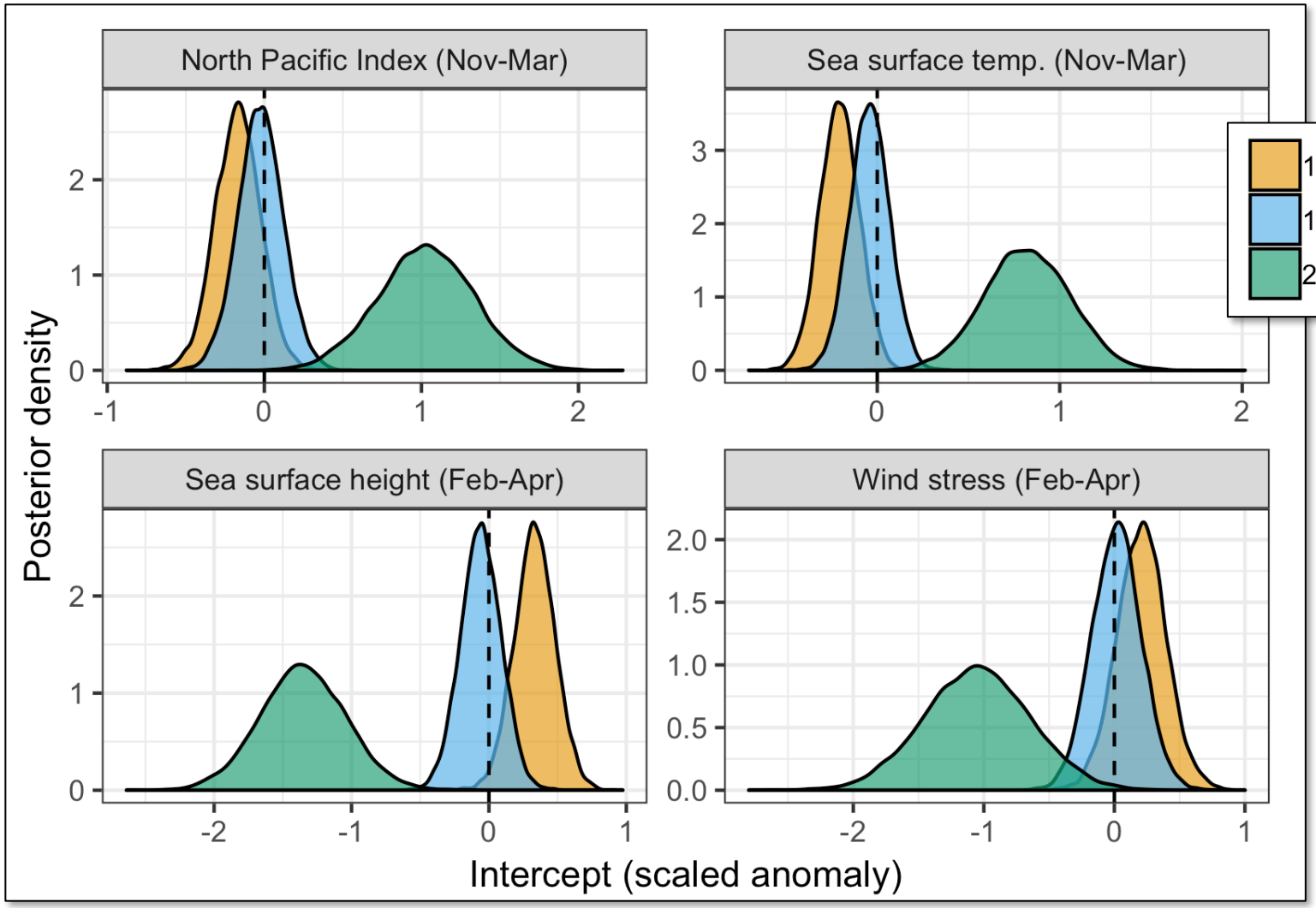
Figure 2. Mean sea level pressure anomalies (hPa) in the NE Pacific Ocean for the period of October 2013 through January 2014. Anomalies are calculated relative to the mean from 1981 to 2010.

Bond et al. 2015. GRL

Have salmon responses to large-scale climate patterns changed?



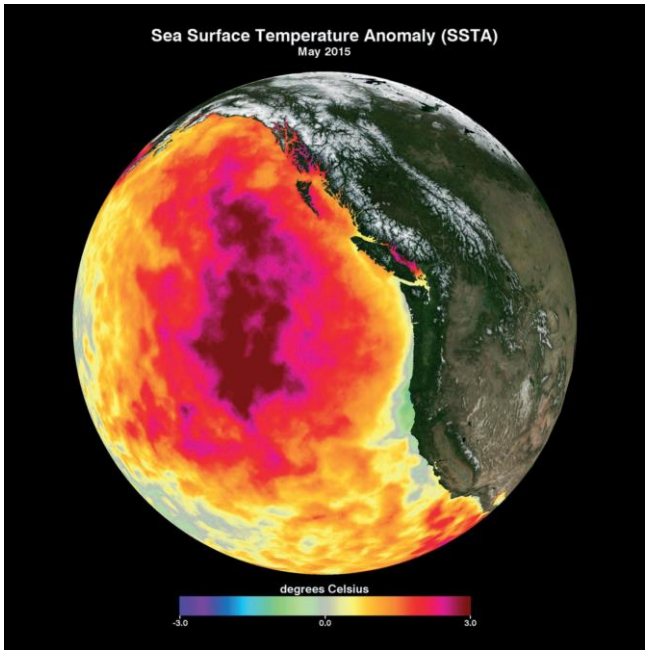
PDO-climate relationships changed in 2014-2019



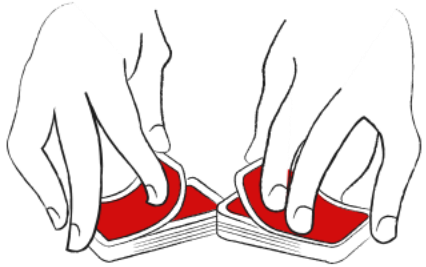
Bayesian regression: era-specific climate-PDO intercepts

Implications

- Collinearity predicts overall climate effects
- Climate change *reshuffles* collinearity
- The past is increasingly a poor guide to the present



Novel climates = new combinations of climate variables






Acknowledgements

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