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San Diego, USA

North Pacific Marine
Science Organization
2016 Annual Meeting

S5: BIO/MONITOR/MEQ Topic Session
Understanding our Changing Oceans through Species Distributions & Habitat Models based on Remotely Sensed Data

Bioclimatic velocity for walleye pollock in the Bering Sea

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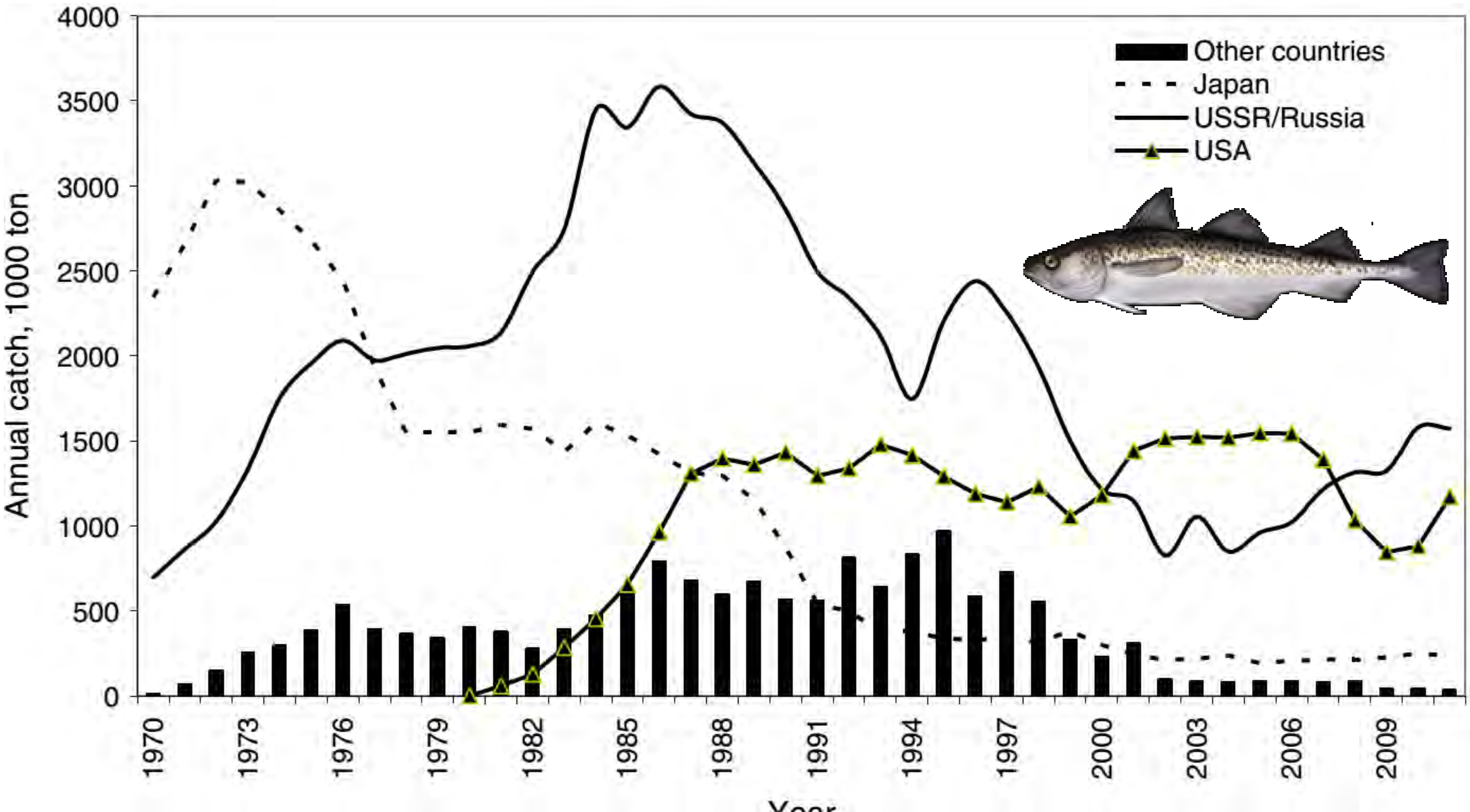
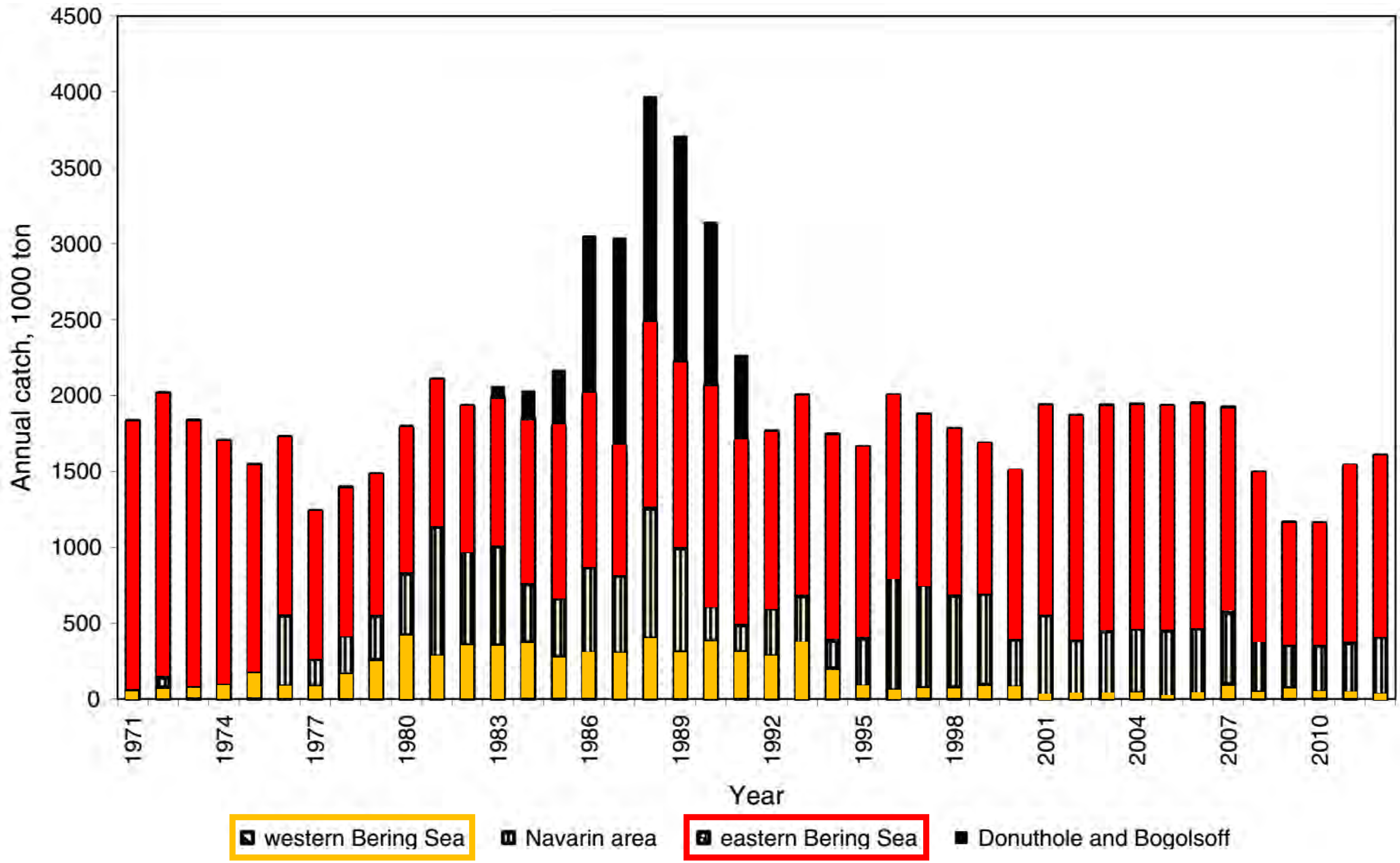
Introduction

Walleye pollock (*Gadus chalcogrammus*) is the second most extensively fished species in the world



Bulatov, 2014

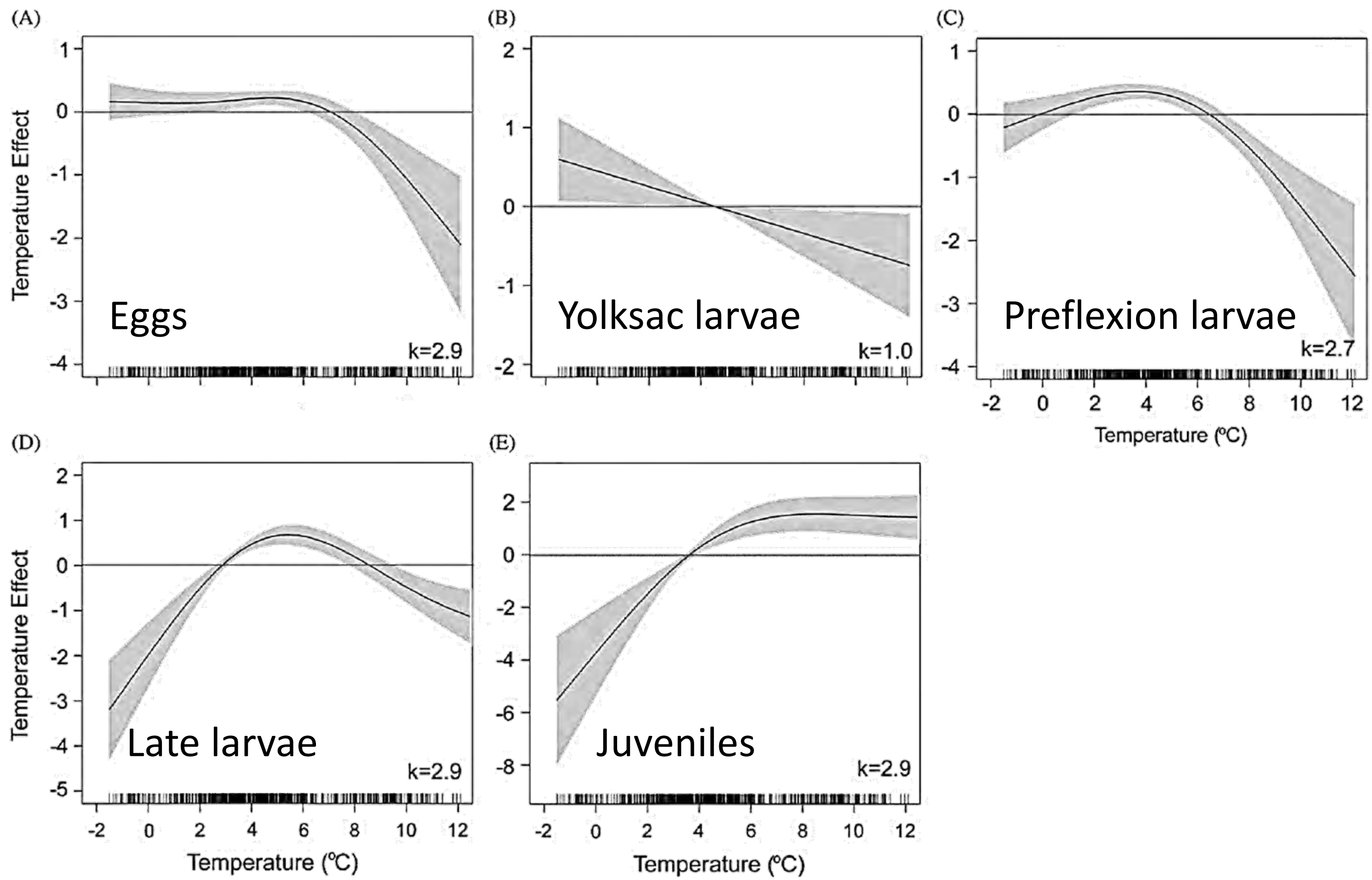
Introduction



Bulatov, 2014

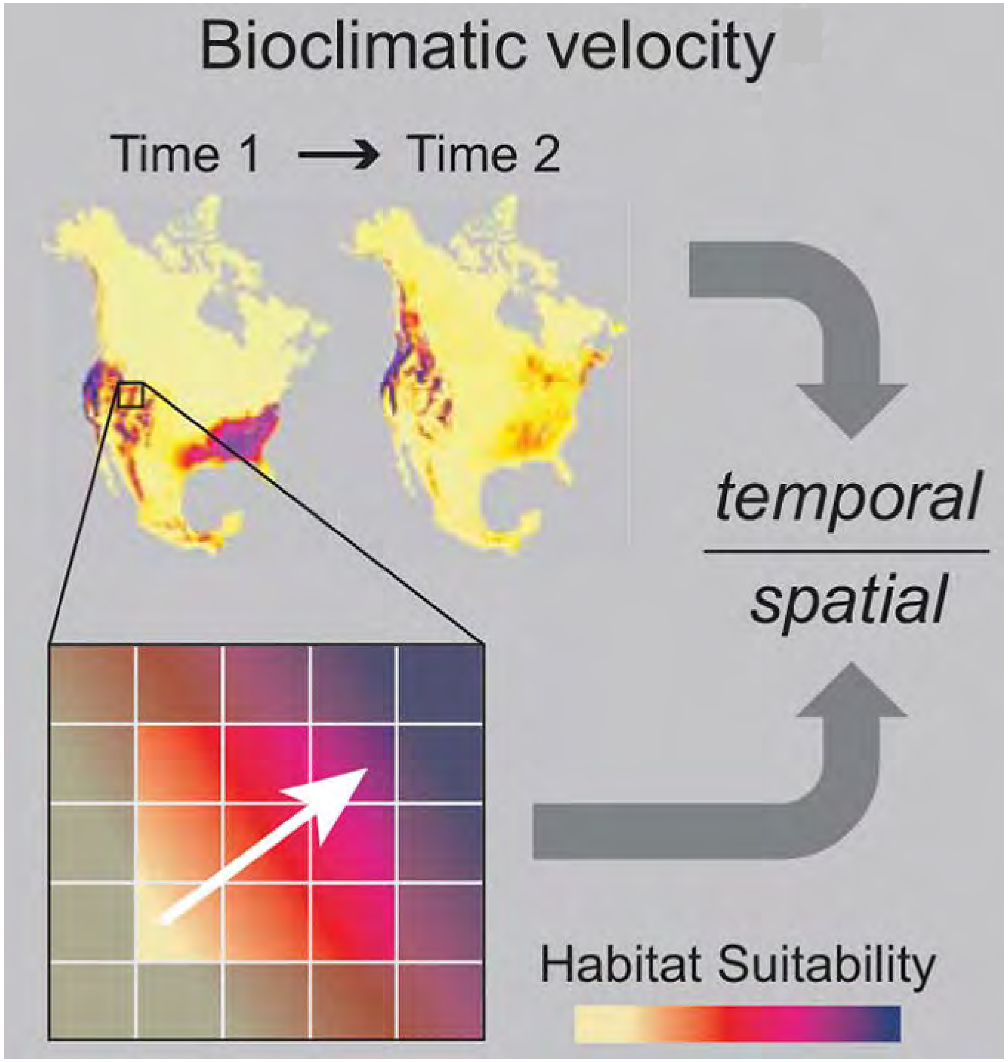
Introduction

Environmental and climate conditions influence abundance & distribution of walleye pollock in the Bering Sea inferred from statistical model (GAM)



Swartzman et al. 1995, Smart et al, 2012

Introduction



- **Bioclimatic velocity:** rate at a species must migrate to maintain constant habitat conditions.
- Distribution-based analysis of climate-induced shift on species suitable habitat

Serra-Diaz et al, 2014; Comte & Grenouillet, 2015, Carroll et al. 2015

Introduction

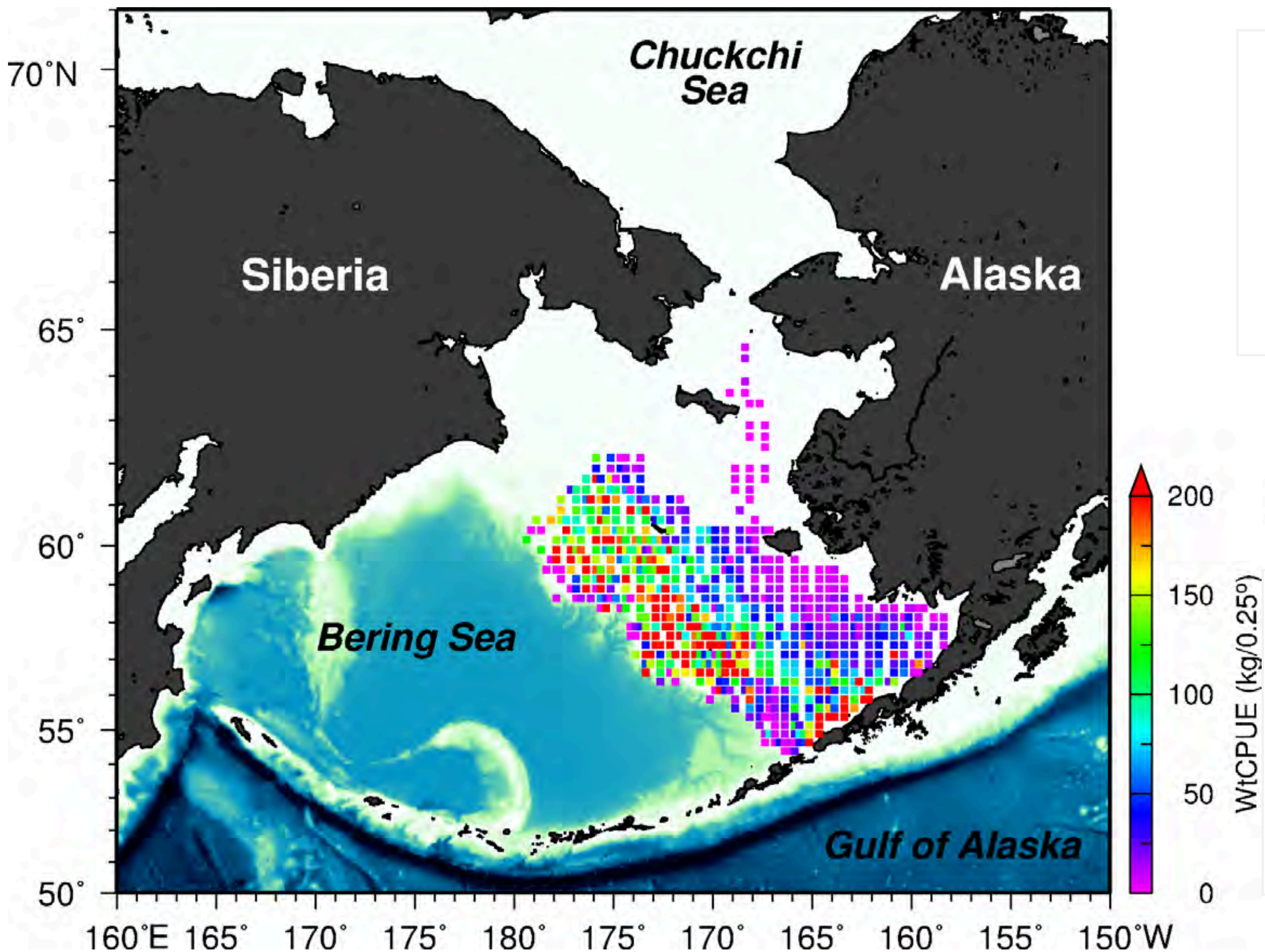
Objectives

- Map the preferential habitat of walleye pollock in Bering Sea using species distribution models
- Examine the sensitivity of walleye pollock to climate changes within a sub-decadal (7-8 years) temporal scale
- Compare the spatio-temporal trends of climatic and bioclimatic velocities in Bering Sea

Rationale

Climate & environmental impacts vary across species and climate shifts from multiple bioclimatic variables show more complex and informative patterns than those of temperature change alone

Data and Methods



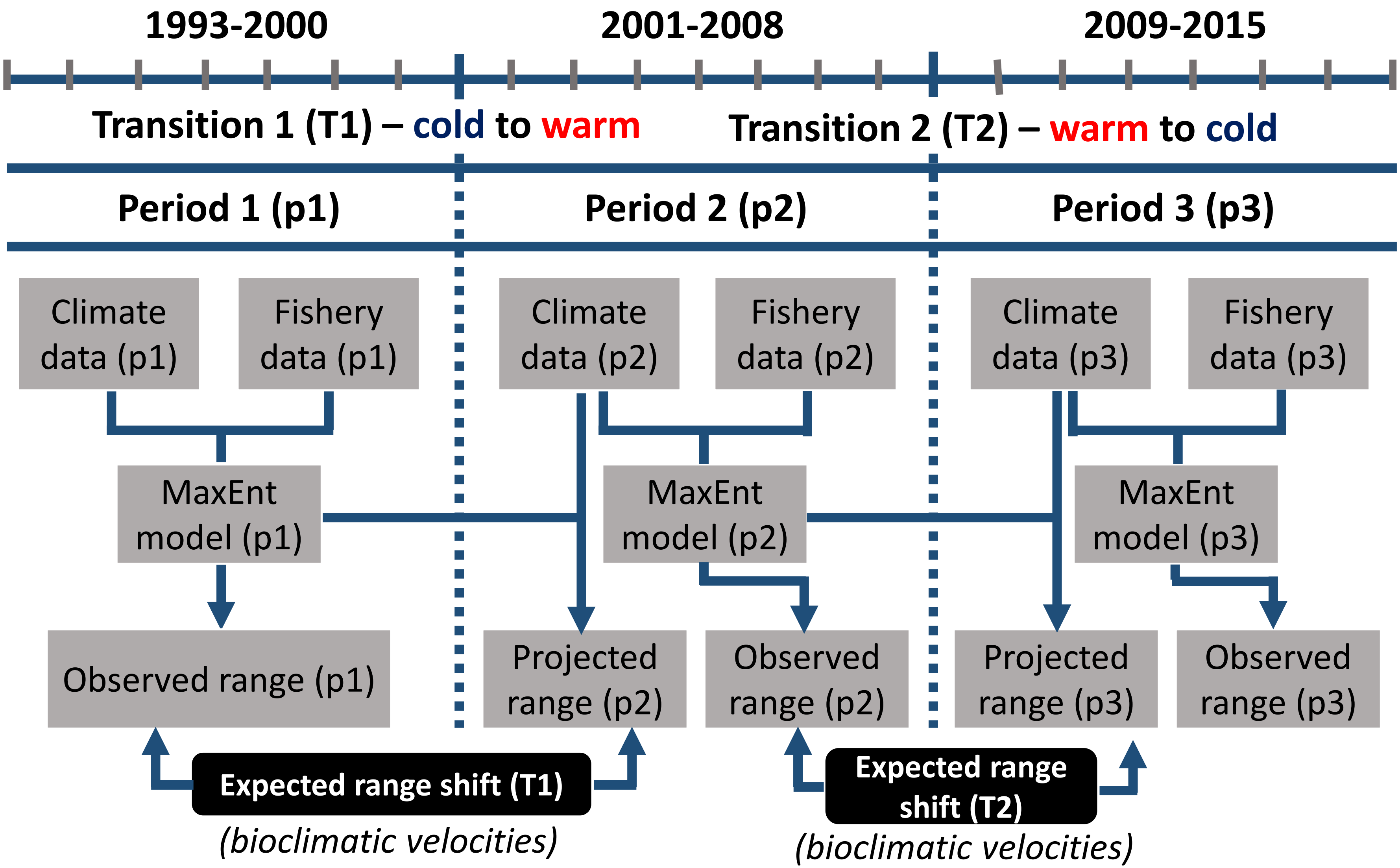
Data and Methods

Environmental variables	Abbreviation	Unit	Raw spatial resolution	Raw temporal resolution	Source
Mean Sea surface temperature (SST)	sstmean	°C	0.25°	Daily	AVHRR-OI
SST standard deviation	sstsd	°C	0.25°	Daily	AVHRR-OI
SST maximum	sstmax	°C	0.25°	Daily	AVHRR-OI
SST minimum	sstmin	°C	0.25°	Daily	AVHRR-OI
SSHA	ssha	cm	0.33°	Daily	AVISO
Geostrophic *u*	*u*	cm/s	0.33°	Daily	AVISO
Geostrophic *v*	*v*	cm/s	0.33°	Daily	AVISO
Depth	dep	m	0.02°	–	ETOPO1
Fishery-independent data					
Catch-per-unit-effort & geographic survey position	CPUE	kg/ha	37 km x 37 km	Daily	NOAA-RACE

Temporal coverage: June–July, 1993–2015 (Based on the earliest availability of environmental data for SSHA and geostrophic velocity)

Data and Methods

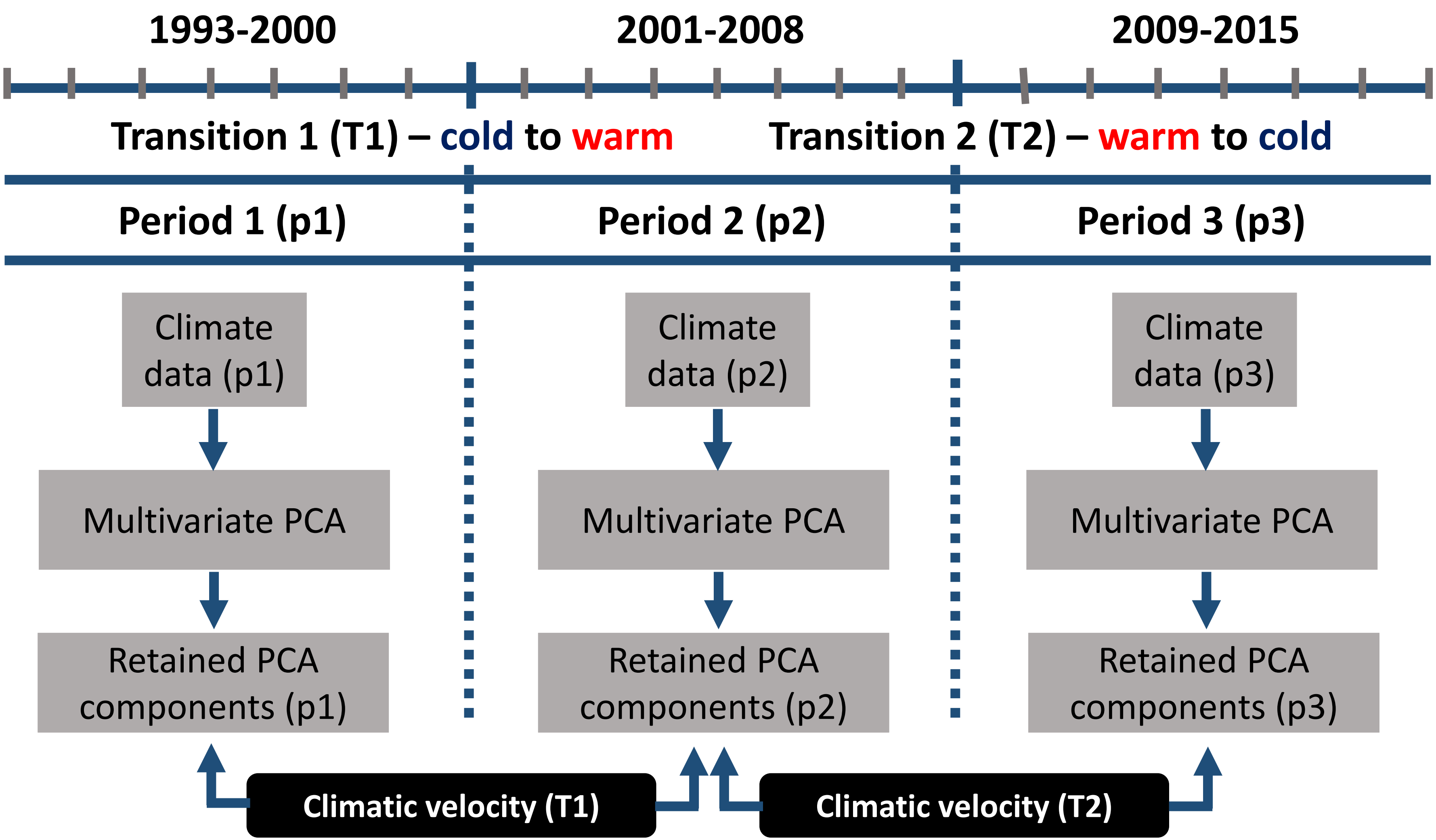
Bioclimatic velocity



Redrawn from Comte & Grenouillet, 2015

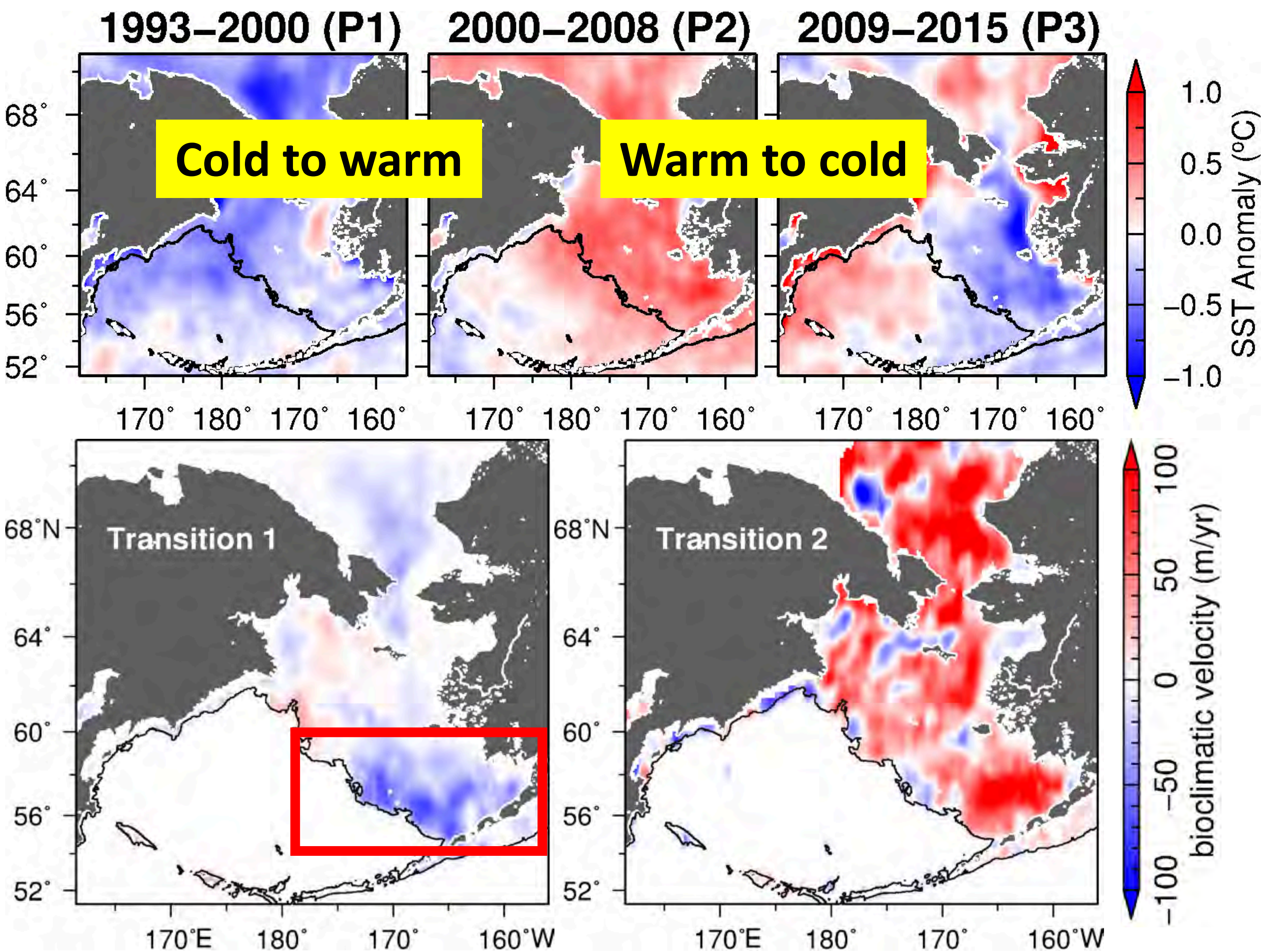
Data and Methods

Multivariate climatic velocity



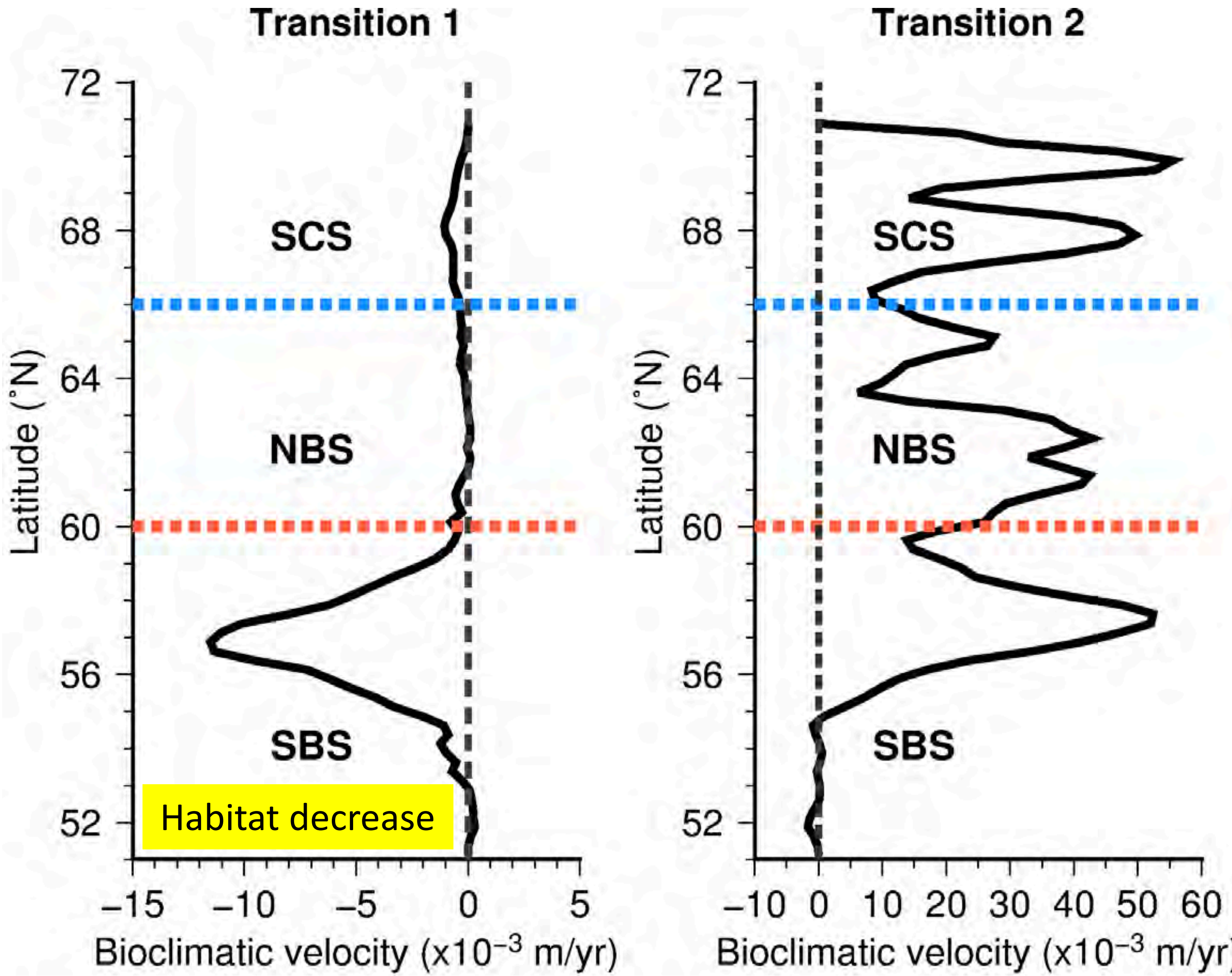
Results & Discussion

Magnitude of bioclimatic velocity between transitions



Results & Discussion

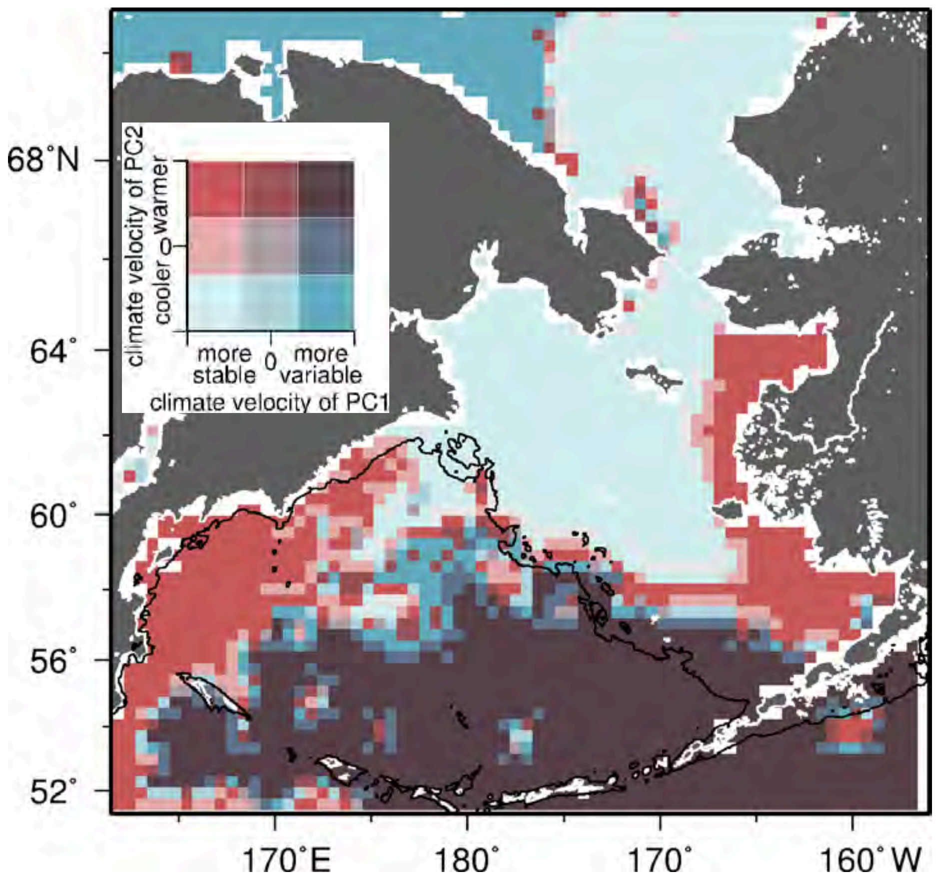
Regional patterns of bioclimatic velocity



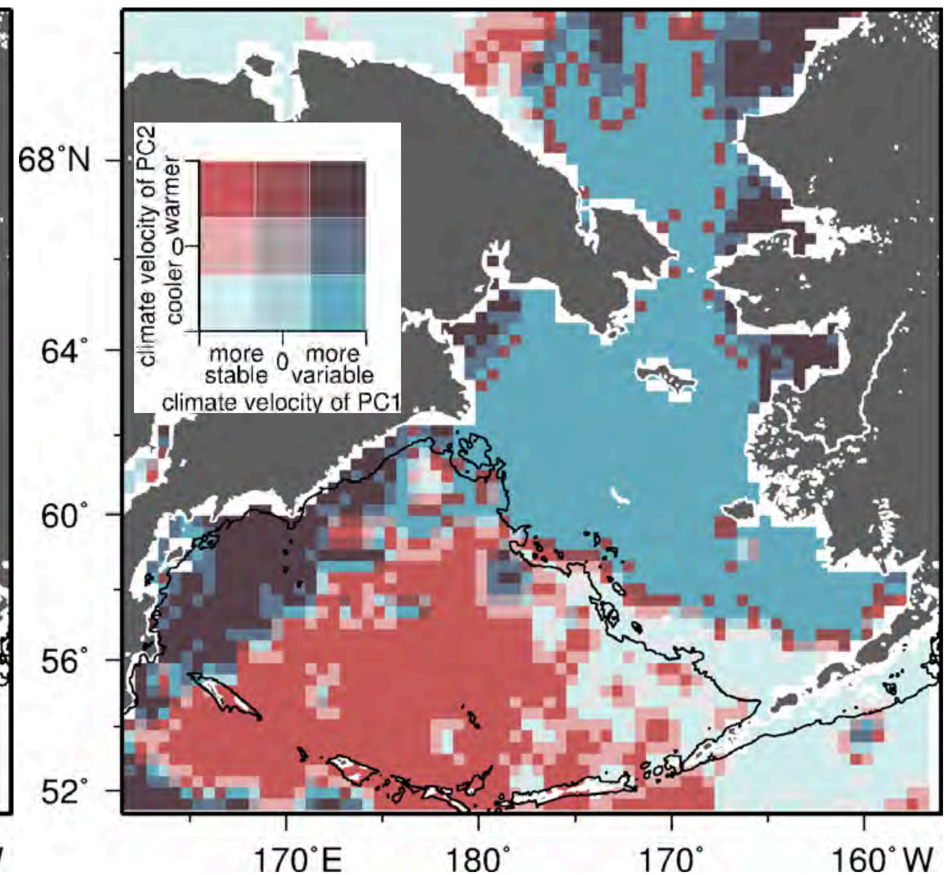
Results & Discussion

Climatic velocity patterns between transitions

Transition 1

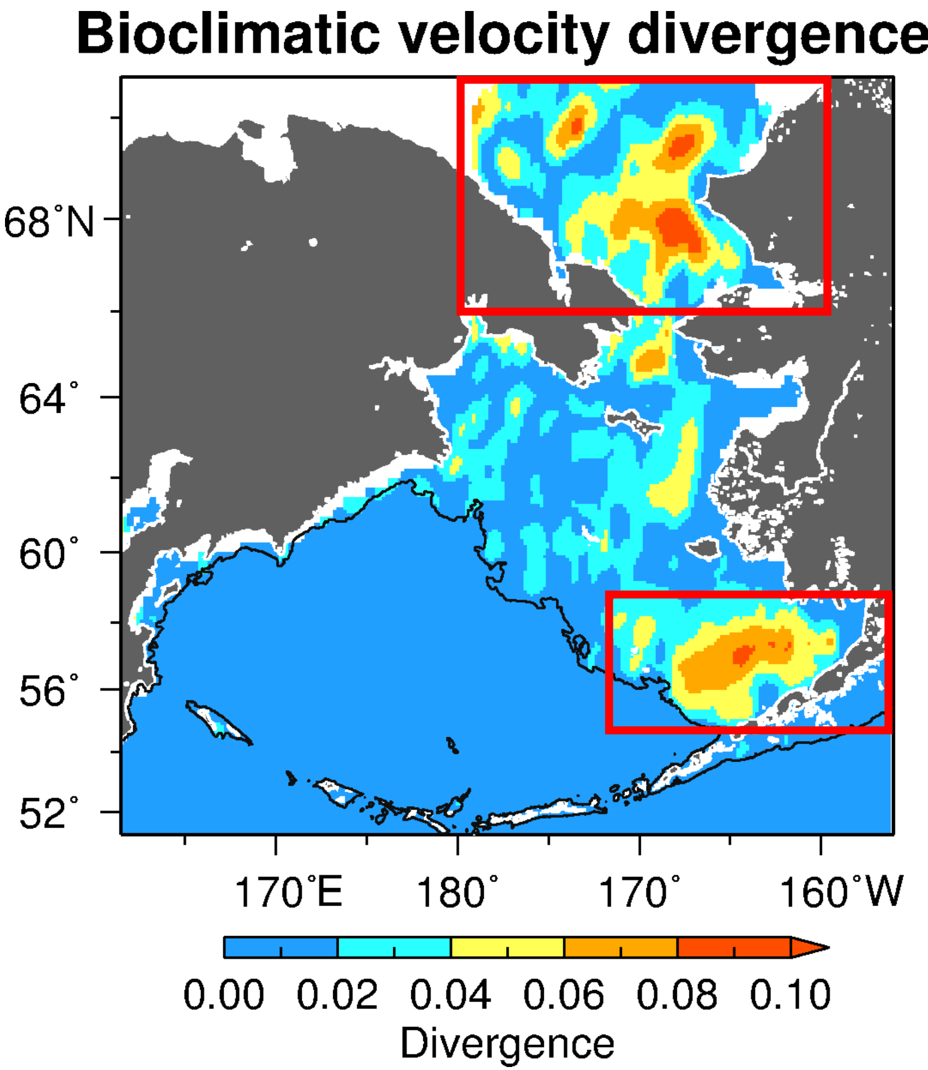


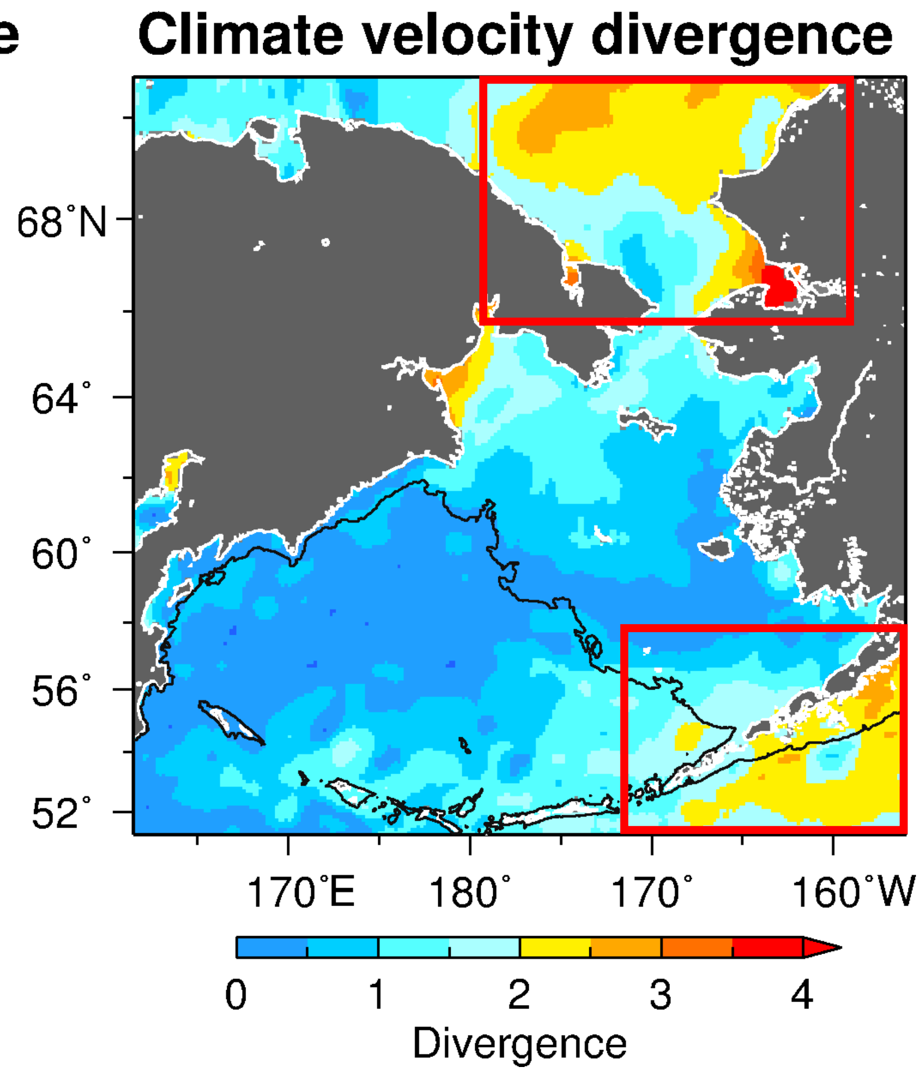
Transition 2



Results & Discussion

Bioclimatic & climatic divergence for all transitions





Summary & Conclusion

Cold to warm transition

- Cooling/warming patterns were spatially homogeneous in Eastern Bering Sea & SCS
- Promotes habitat loss for walleye pollock in SBS, with no apparent habitat change in NBS & SCS
- Potential ill effects of warming on food availability in SBS (Stabeno et al. 2012)

Warm to cold transition

- Regional cooling in SBS and warming off NBS & SCS
- Promotes habitat gain for walleye pollock in SBS
- Net northward expansion of favorable habitat for walleye pollock
- Implication on ecosystem shift in Bering-Chukchi Seas (Grebmeier et al. 2006)

Thank you for your attention.