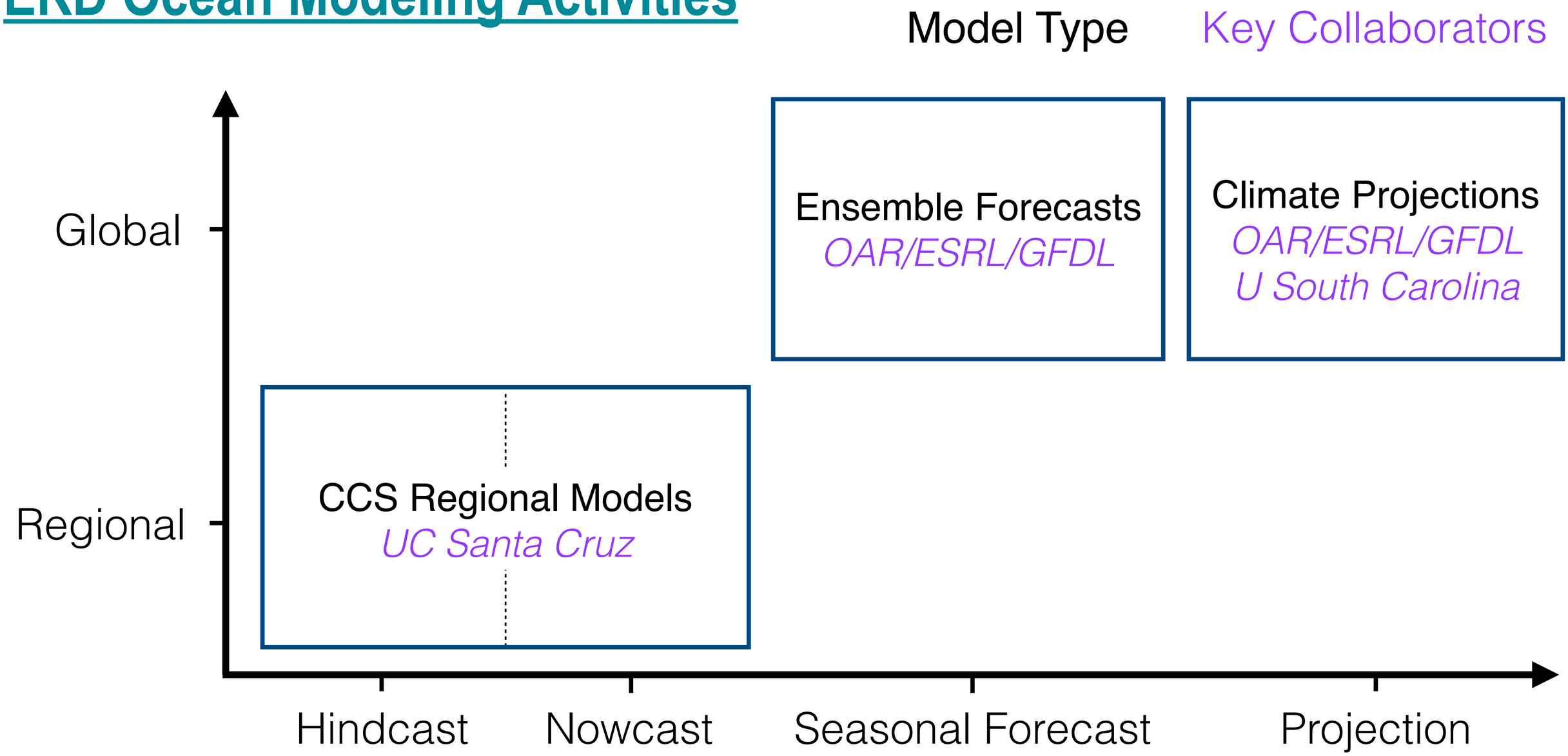
3.0 Ocean Modeling in the California Current System

Michael Jacox

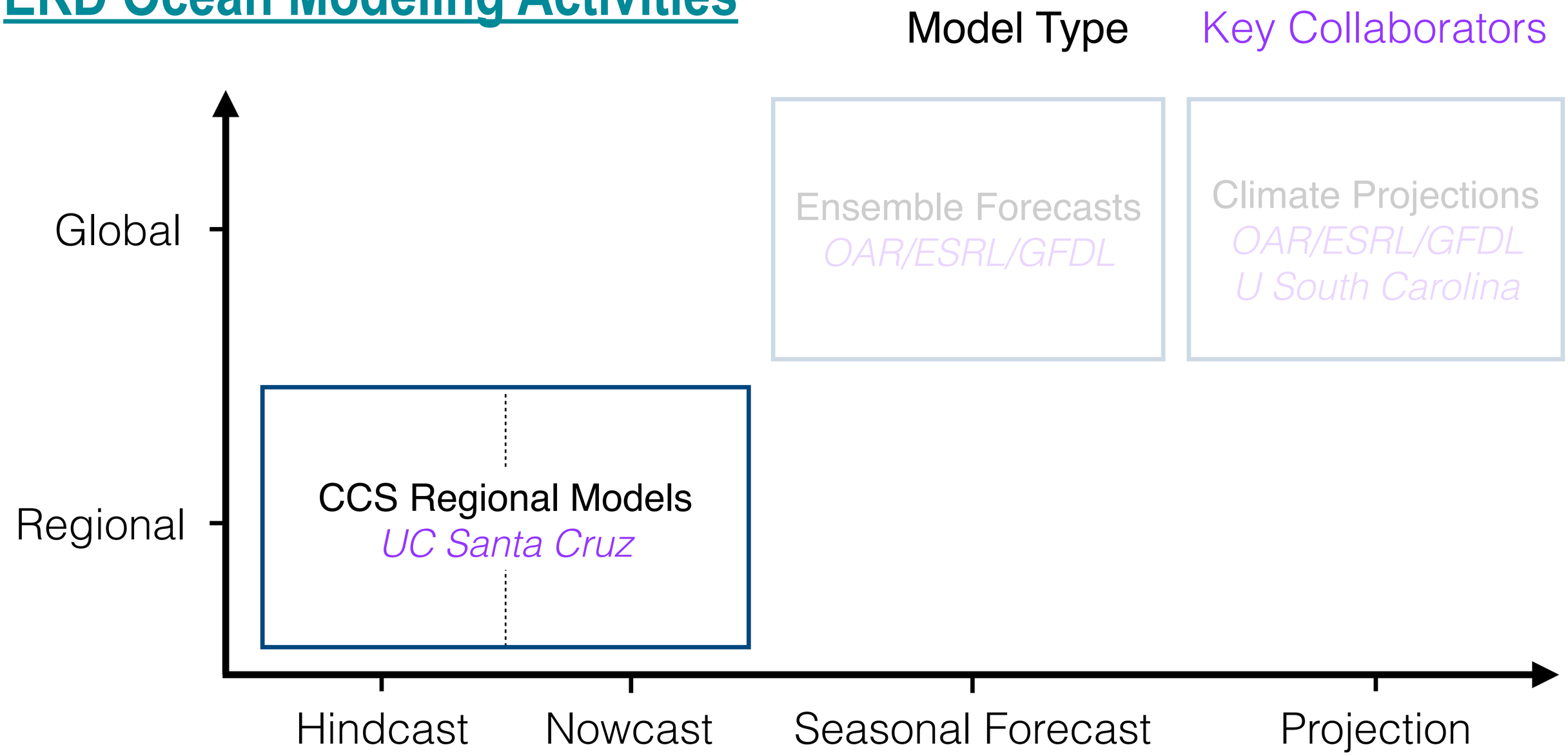
April 20, 2016

NOAA FISHERIES
SWFSC

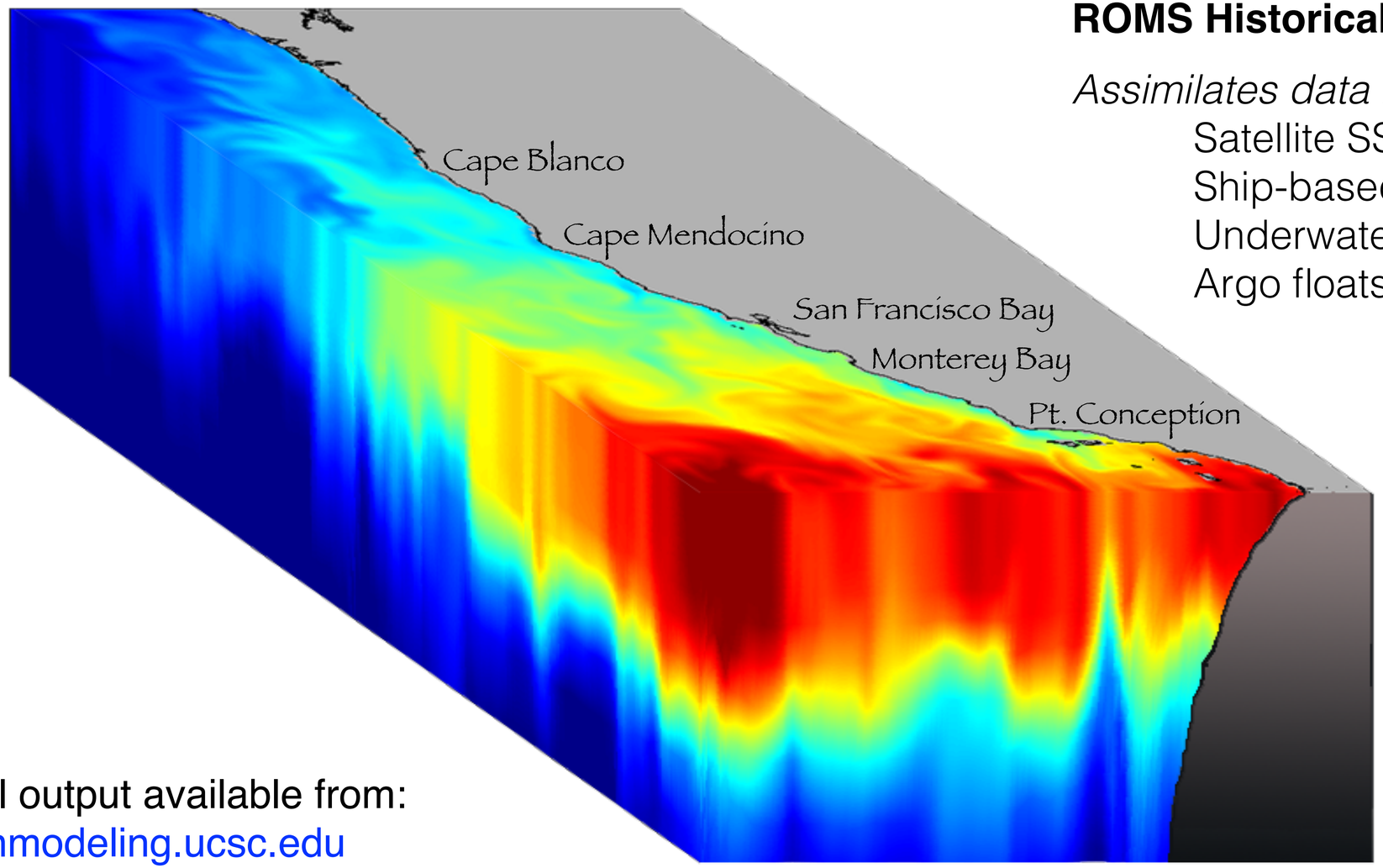
ERD Ocean Modeling Activities



ERD Ocean Modeling Activities



Regional Ocean Models



ROMS Historical Reanalyses (10km resolution)

Assimilates data from multiple sources:

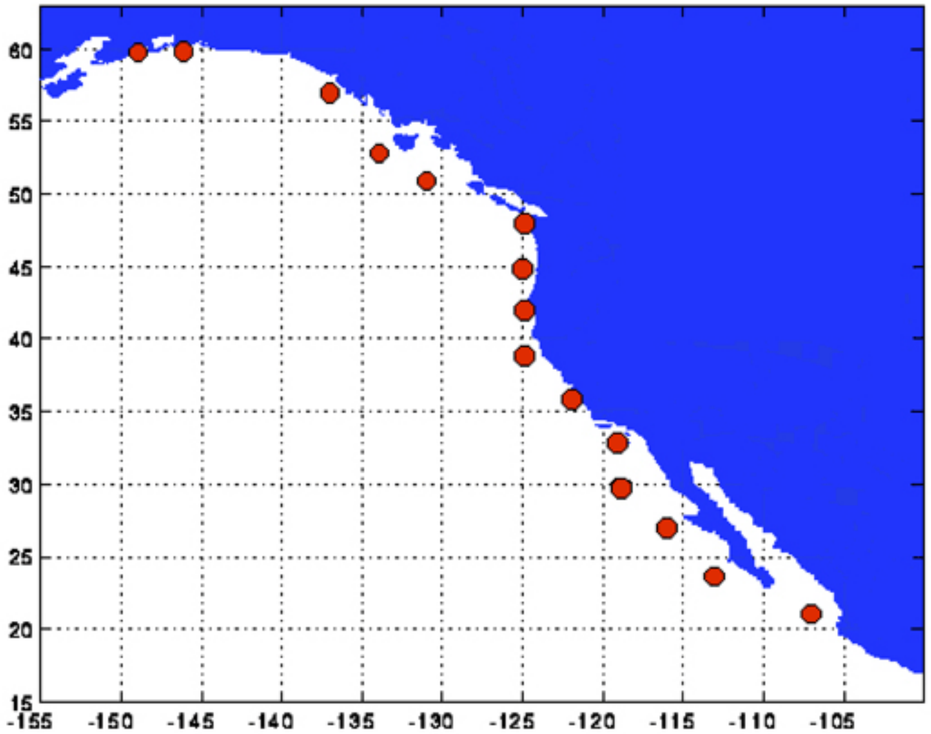
- Satellite SST and SSH
- Ship-based measurements (e.g., CalCOFI)
- Underwater gliders
- Argo floats

Multiple Versions:

1980-2010 (Historical)
1999-2012 (Historical)
2011-Present (Near real time)

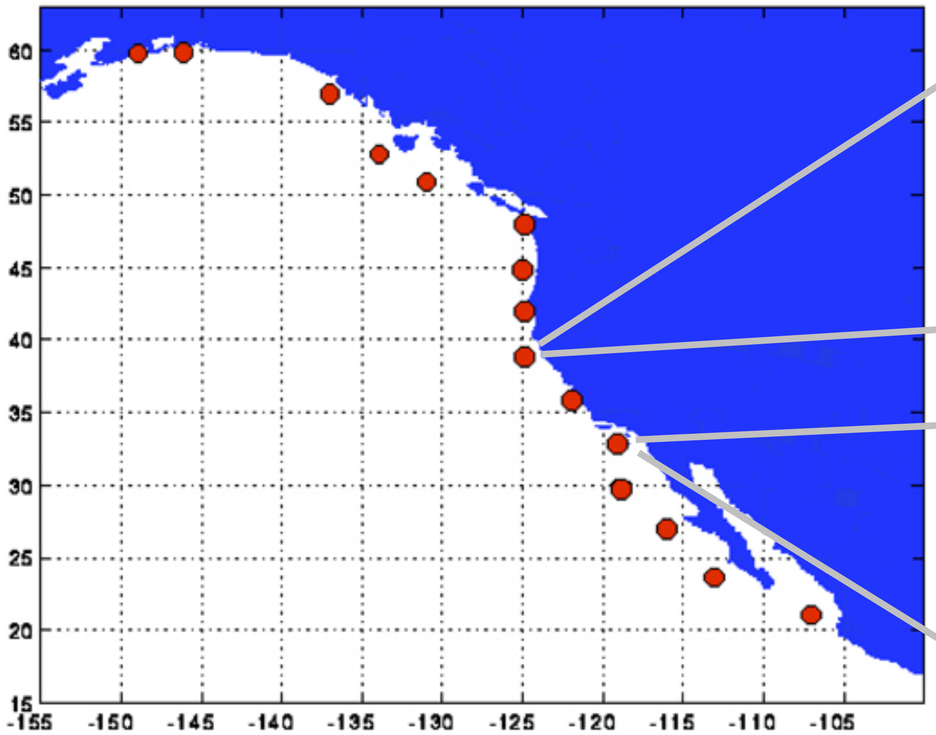
Model output available from:
oceanmodeling.ucsc.edu

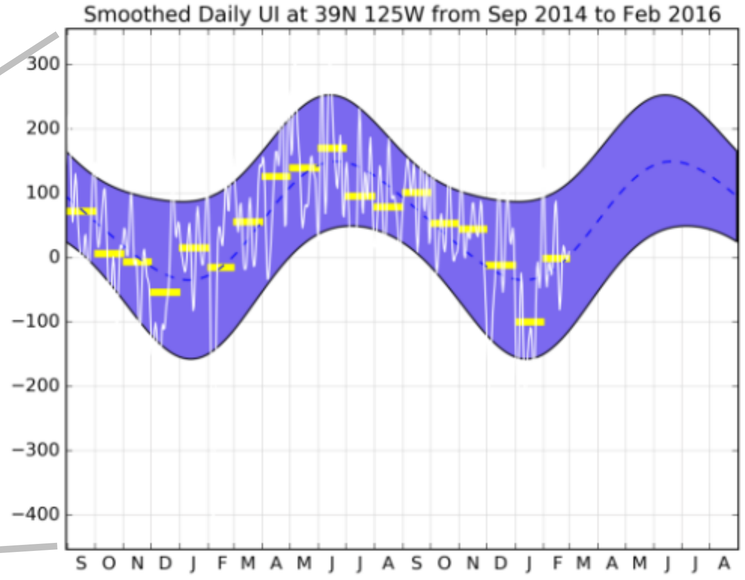
The PFEL Upwelling Index

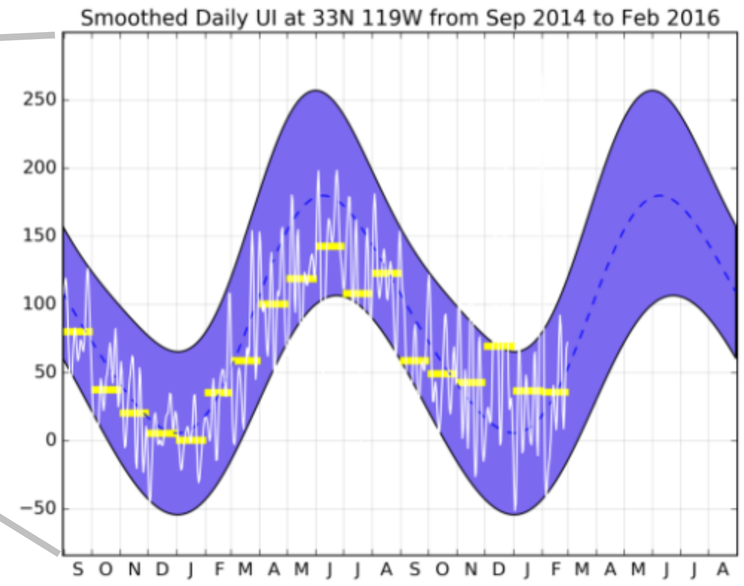


Bakun, NOAA Tech. Rep. 1973,1975
Schwing et al., NOAA Tech. Rep., 1996

The PFEL Upwelling Index

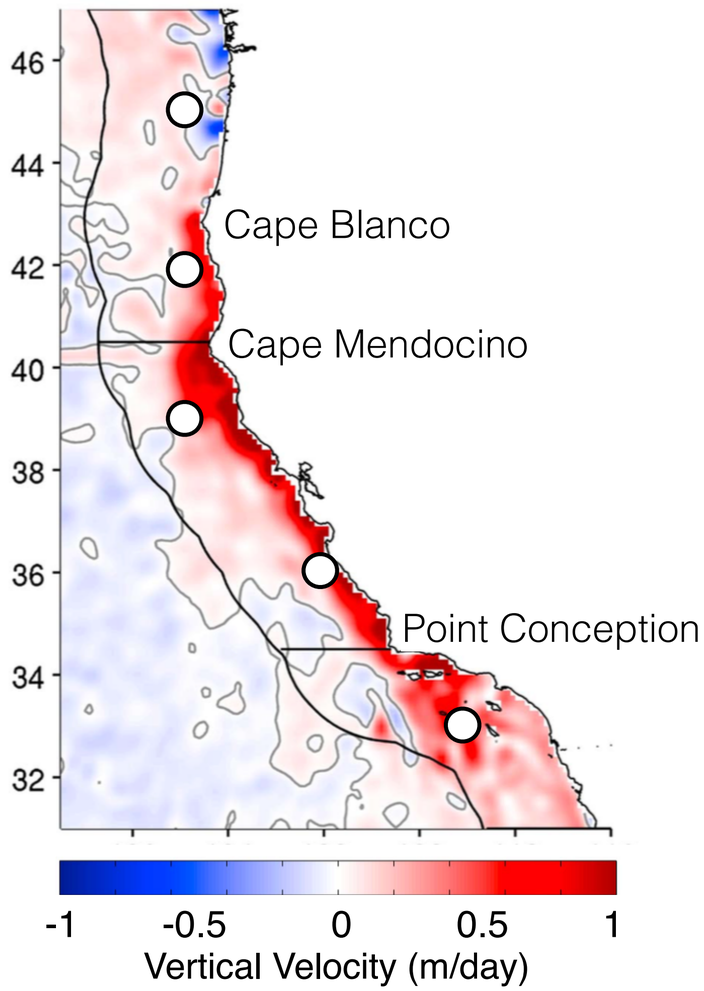




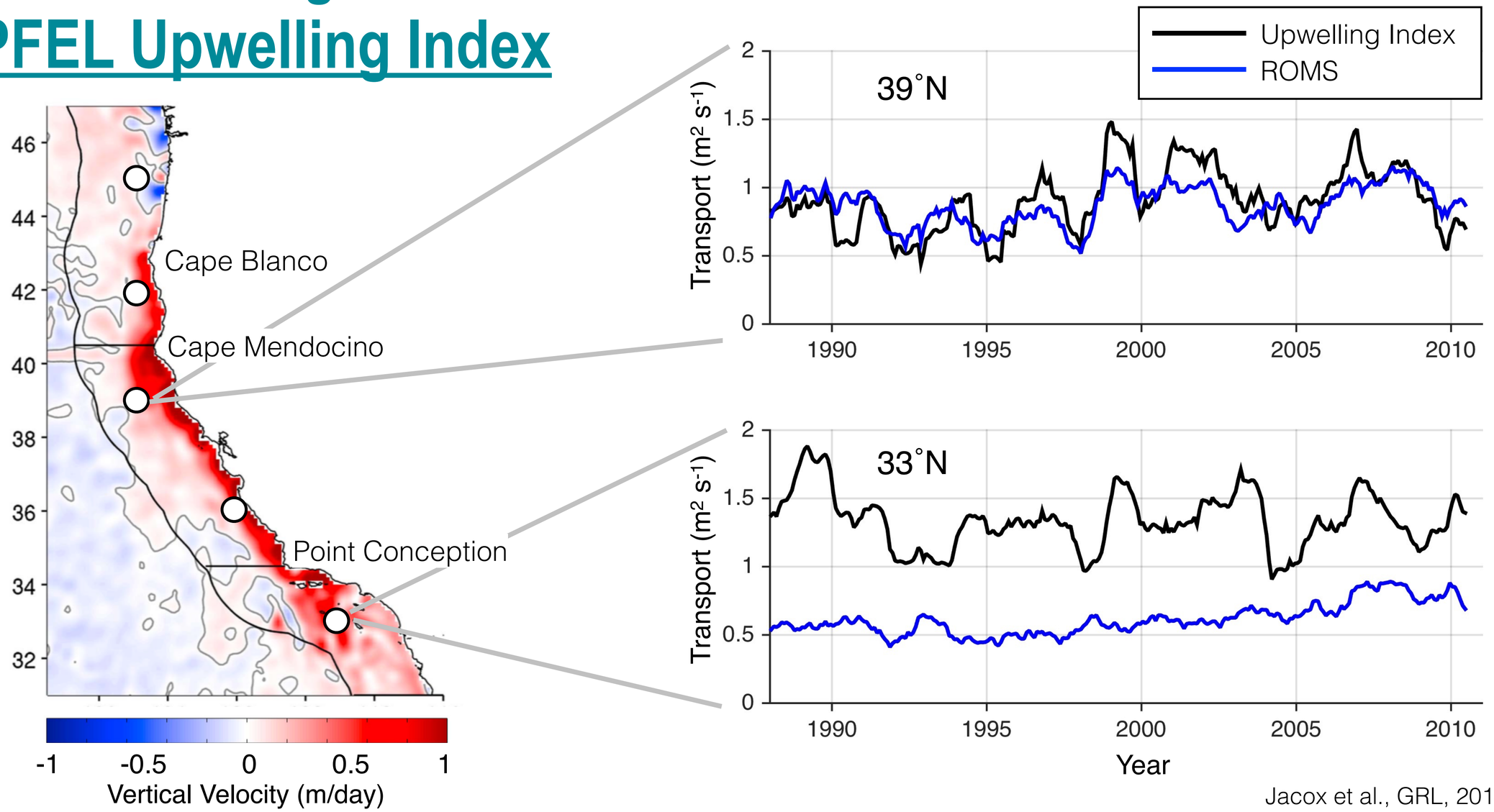


Bakun, NOAA Tech. Rep. 1973,1975
Schwing et al., NOAA Tech. Rep., 1996

Revisiting
The PFEL Upwelling Index

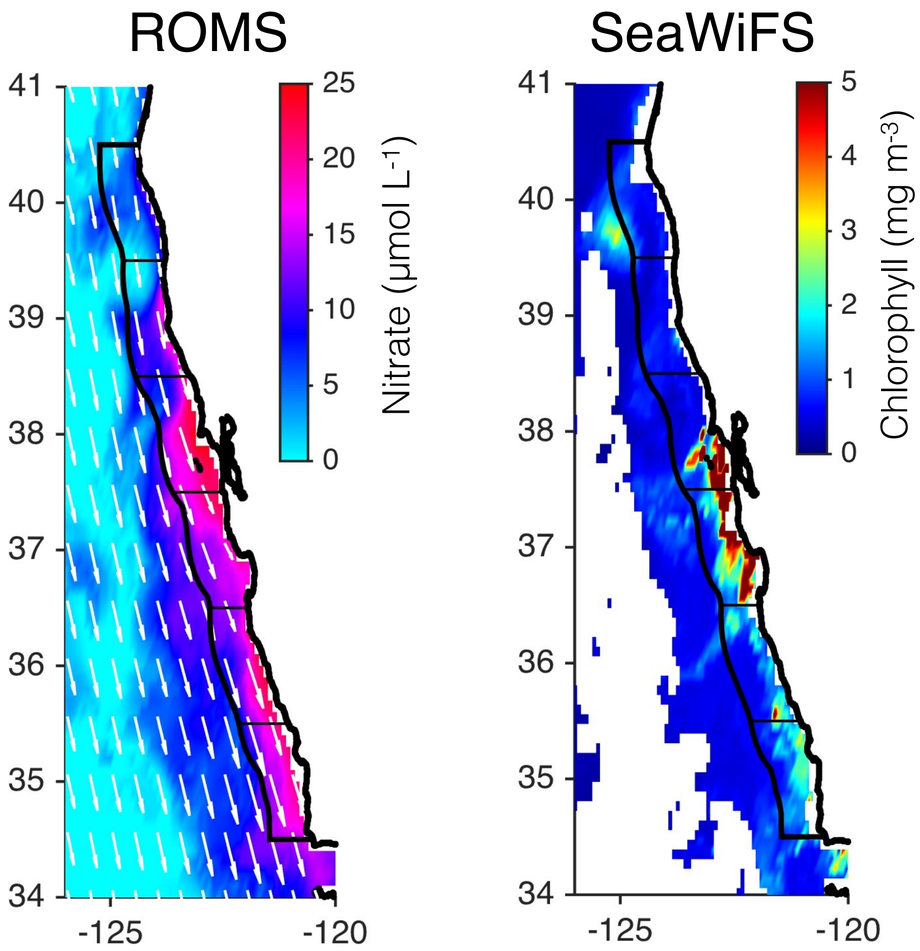


Revisiting
The PFEL Upwelling Index

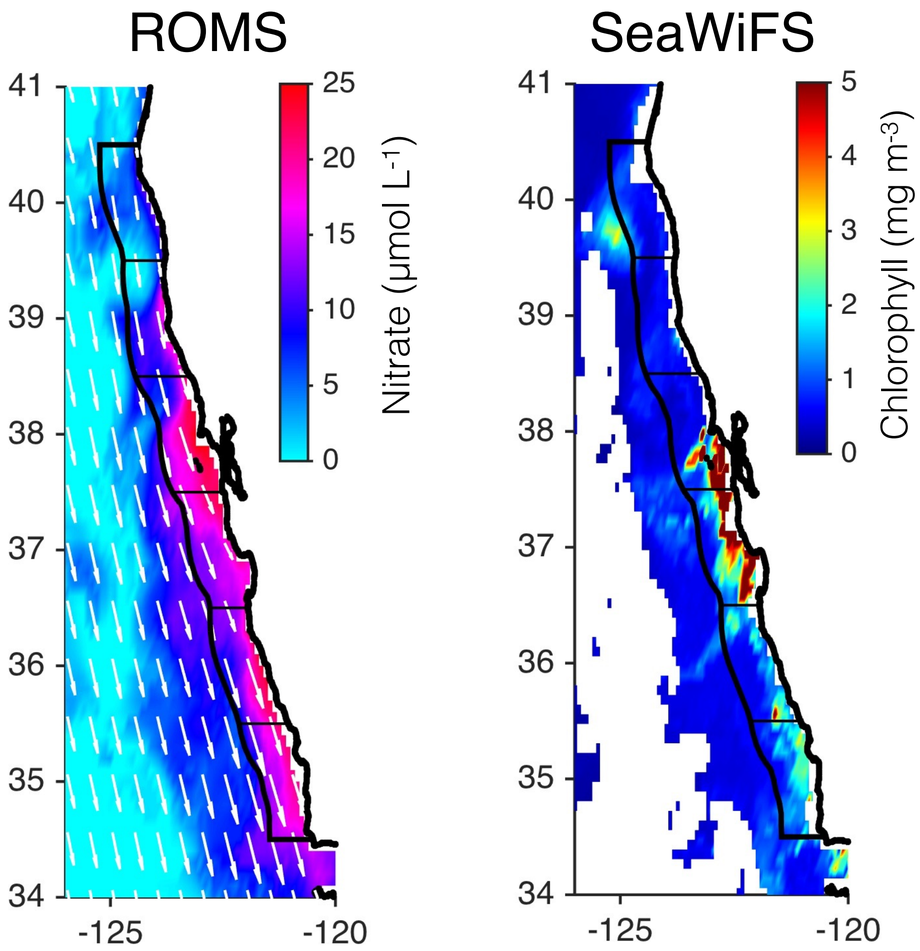


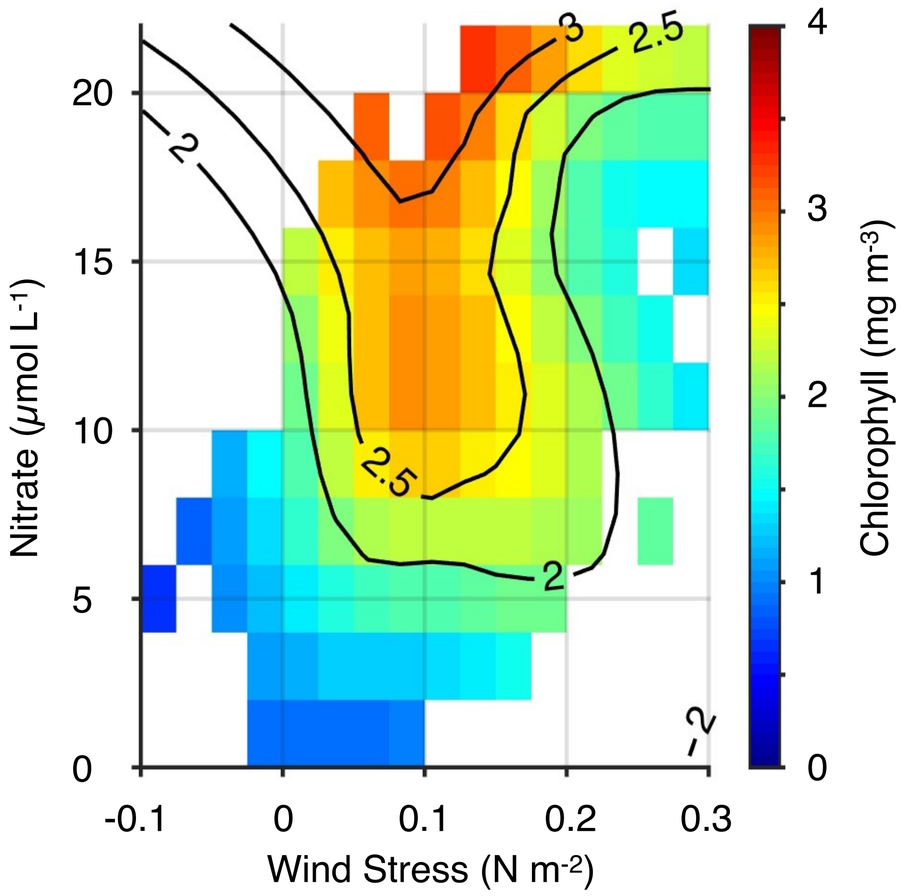
Jacox et al., GRL, 2014

Linking Environmental Data to Biological Responses



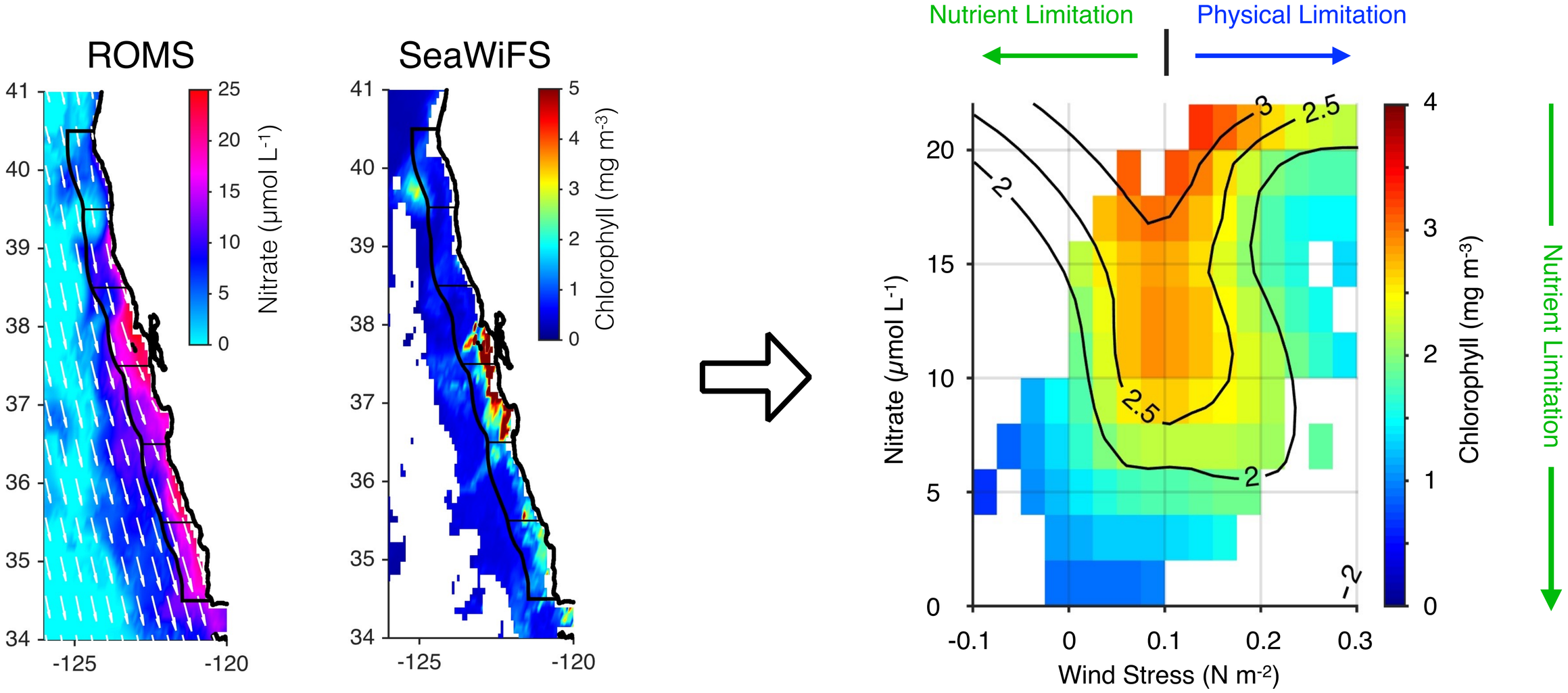
Linking Environmental Data to Biological Responses





Jacox et al., Nat. Sci. Rep., in revision.

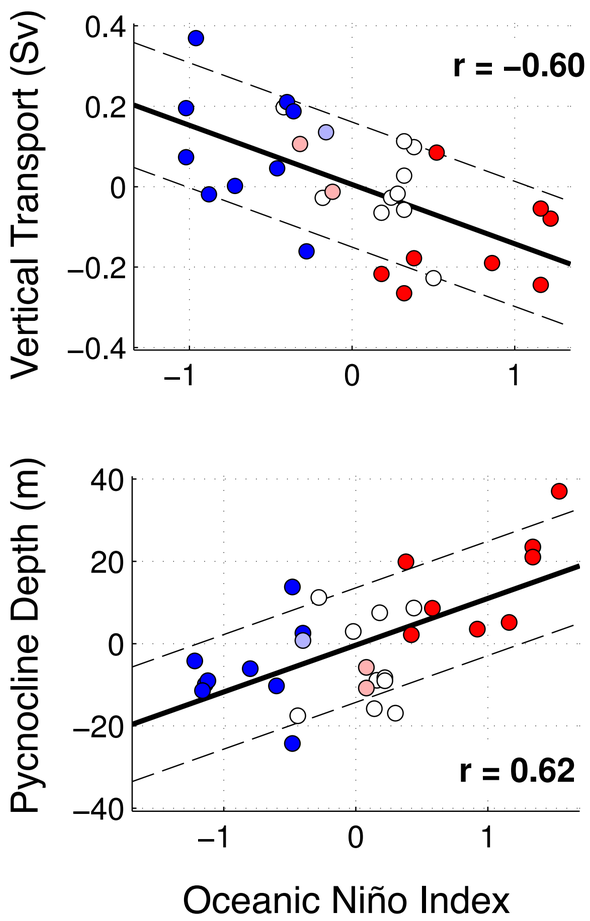
Linking Environmental Data to Biological Responses



Jacox et al., Nat. Sci. Rep., in revision.

ENSO Impacts on the CCS

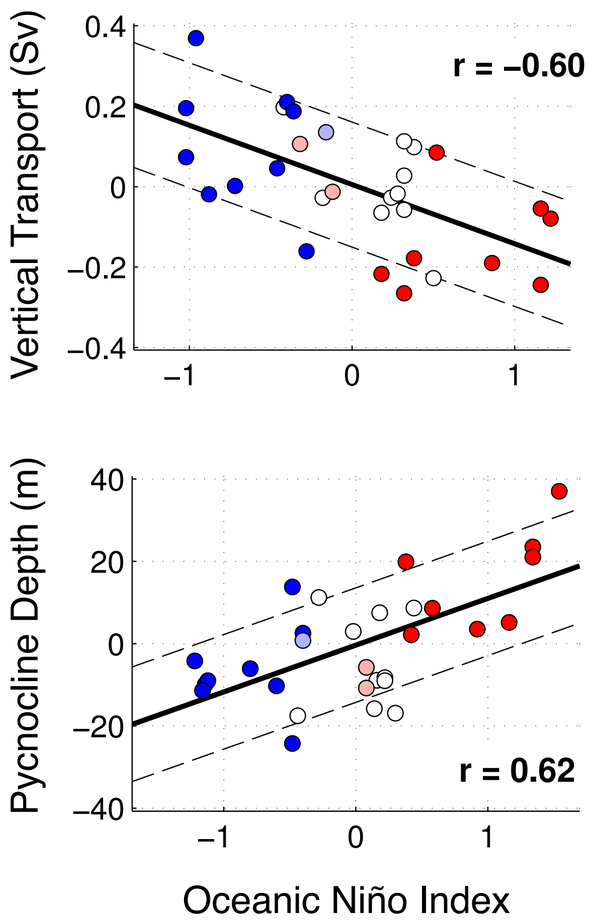
Physical Impacts

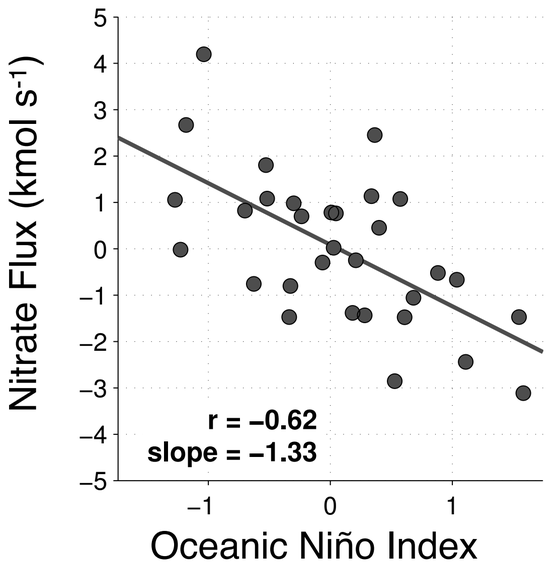


Jacox et al., JGR, 2015; GRL, 2015

ENSO Impacts on the CCS

Physical Impacts → Biogeochemical Impacts

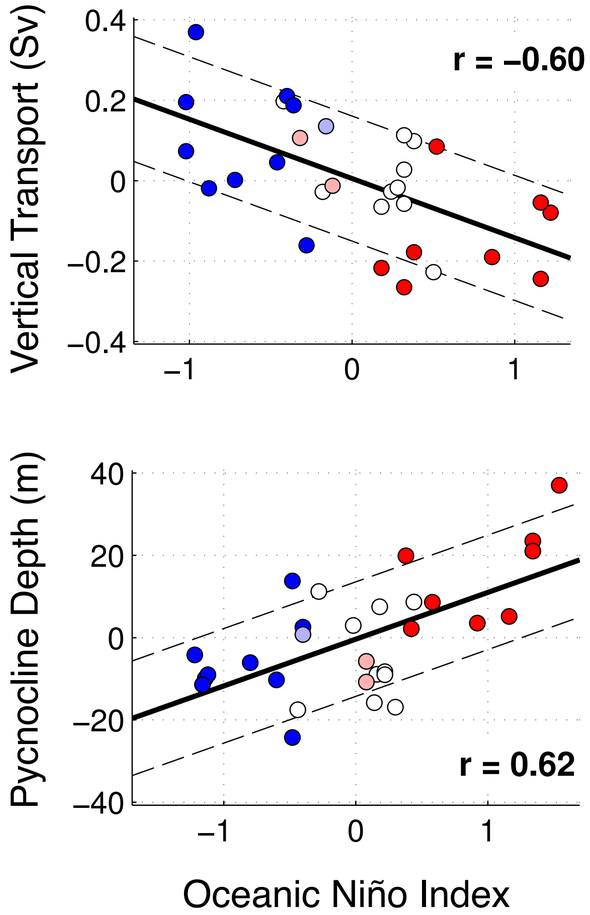


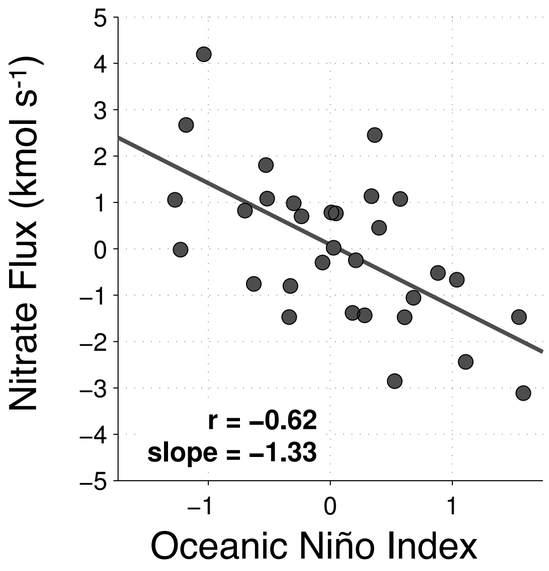


Jacox et al., JGR, 2015; GRL, 2015

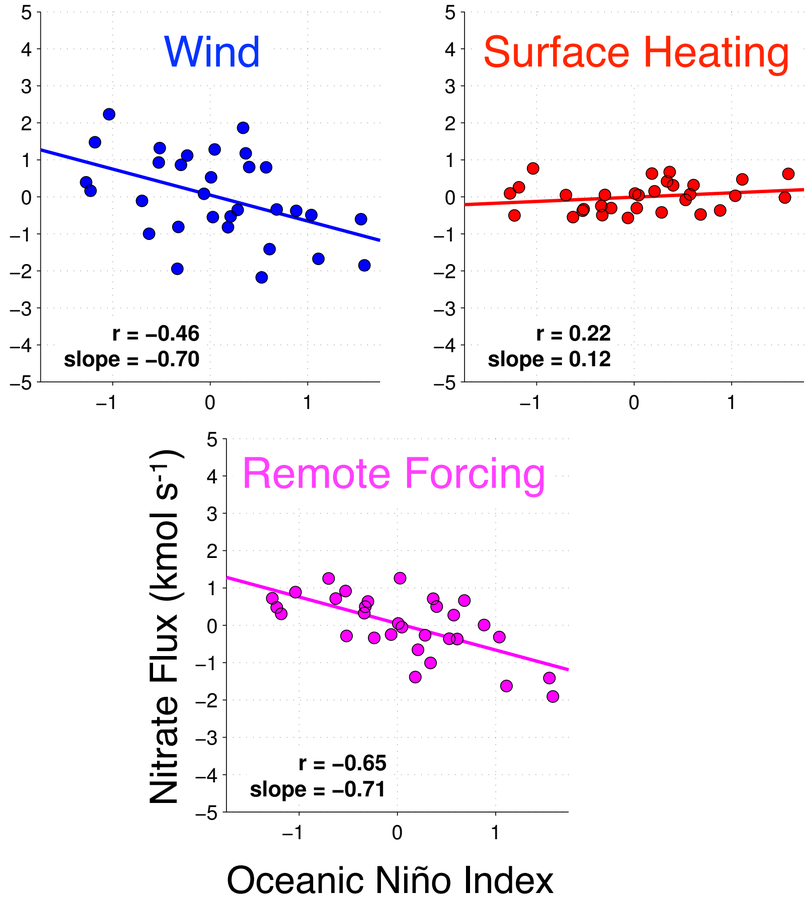
ENSO Impacts on the CCS

Physical Impacts → Biogeochemical Impacts → Mechanistic Understanding

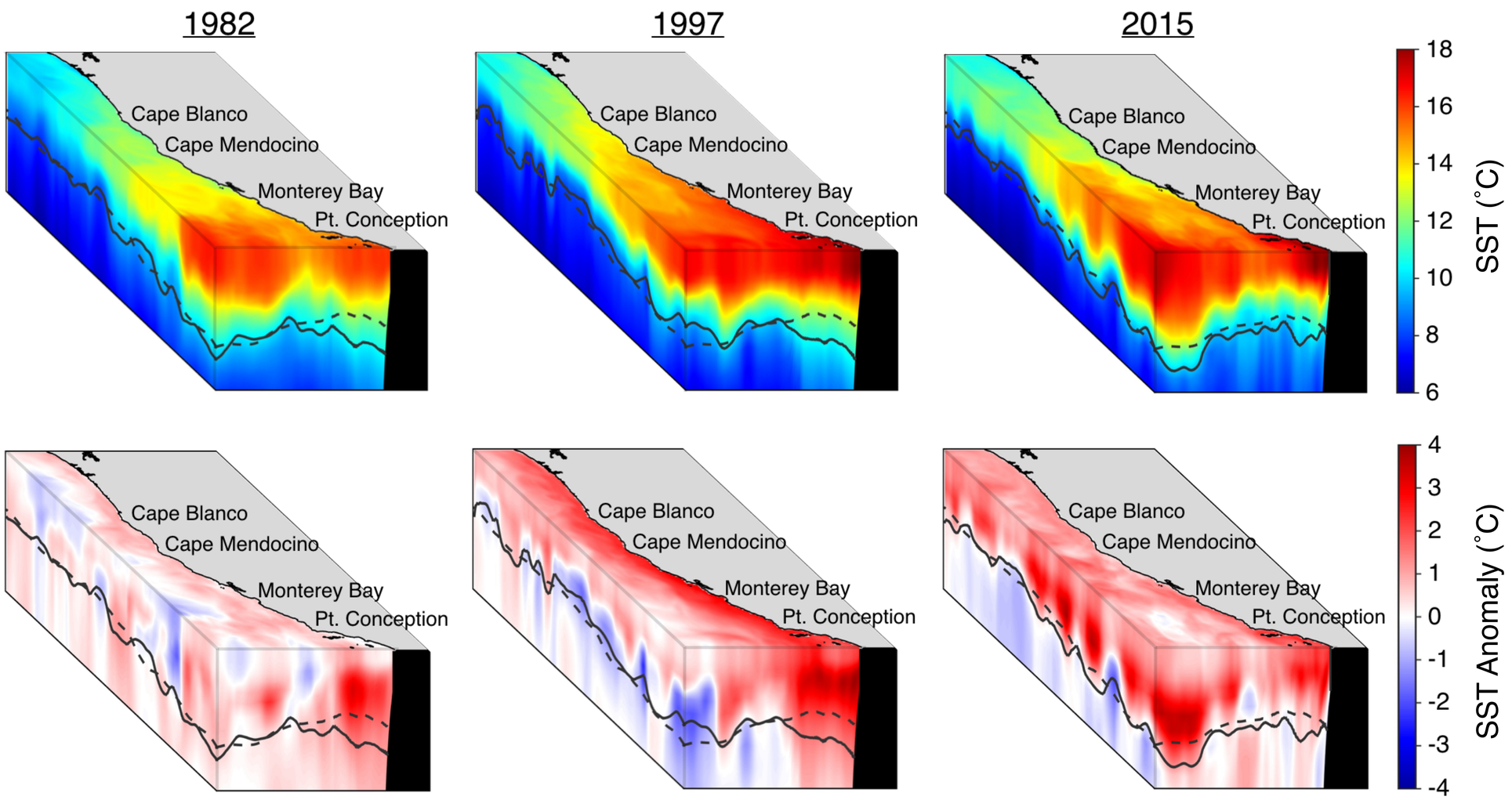




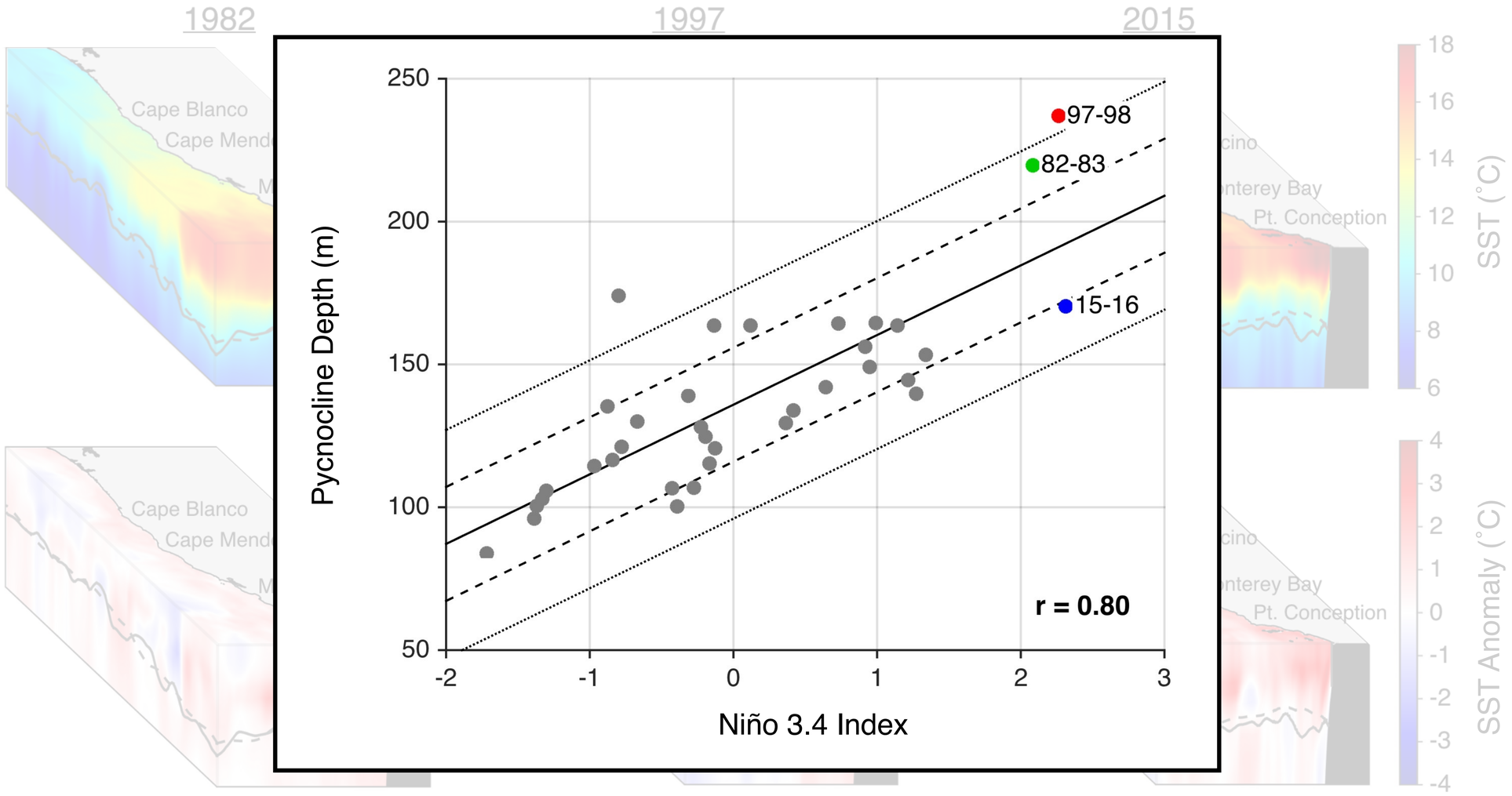
Jacox et al., JGR, 2015; GRL, 2015

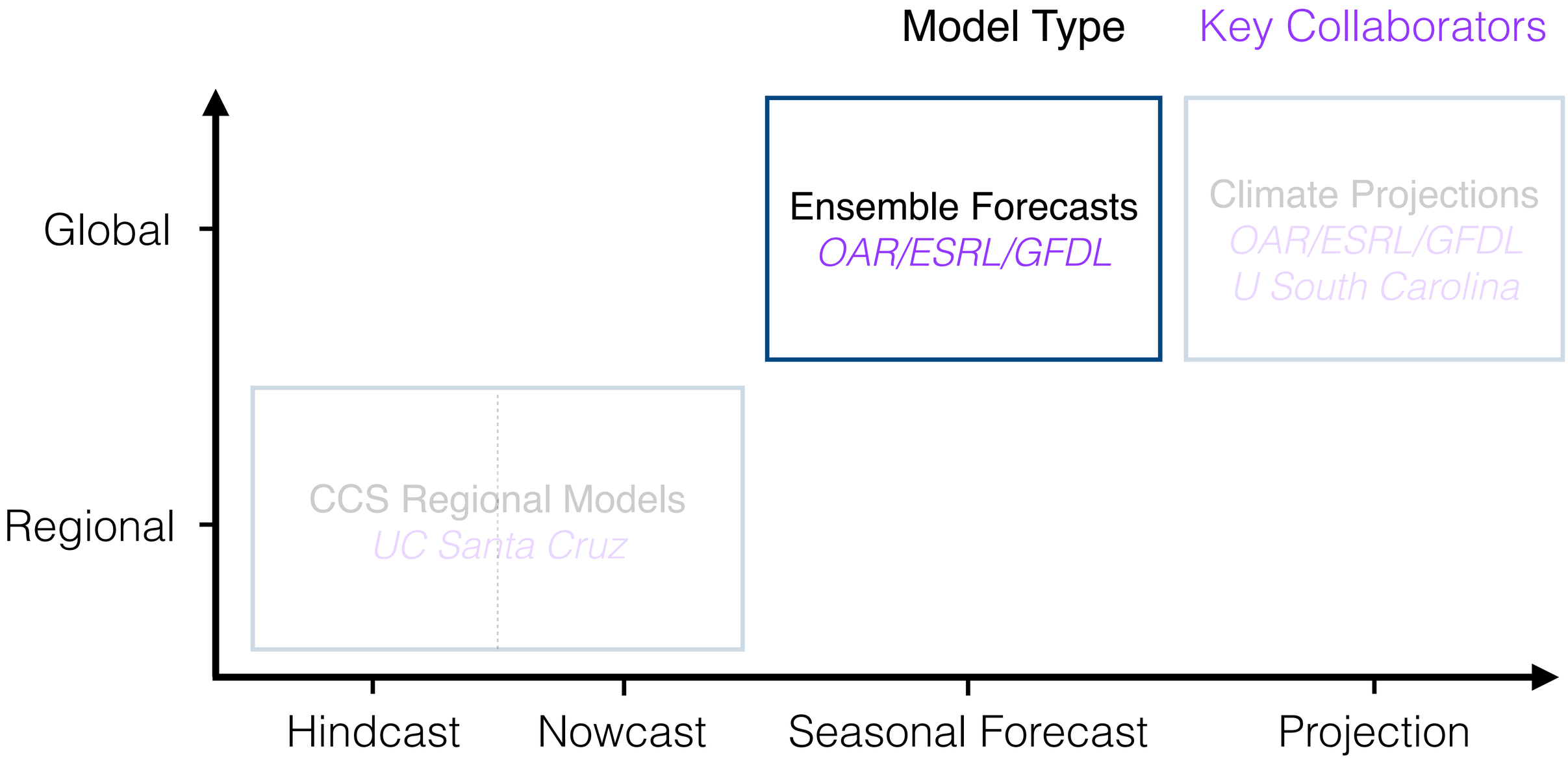


Real Time Assessment of Environmental Conditions



Real Time Assessment of Environmental Conditions

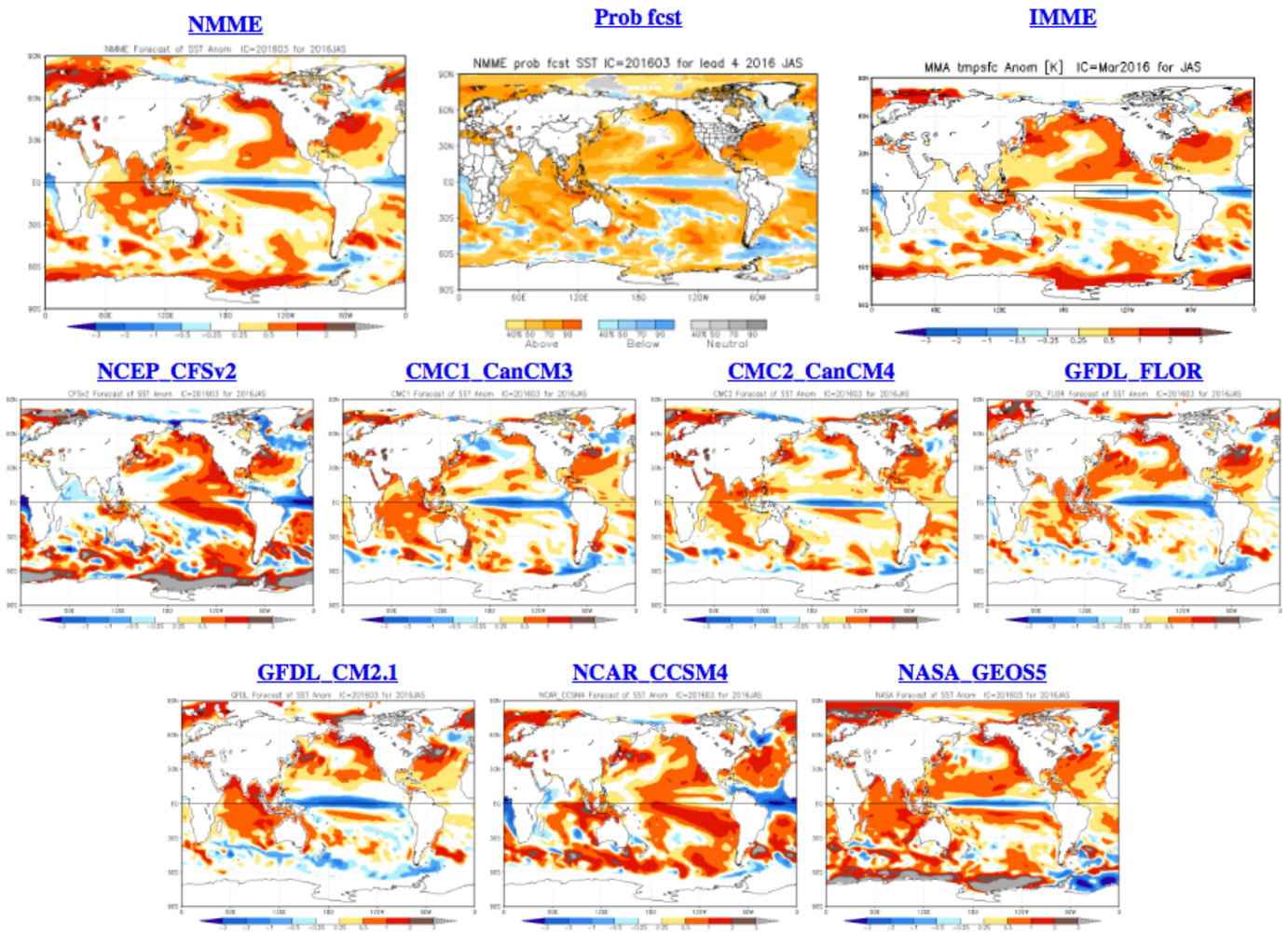



Model Type
Key Collaborators
Ensemble Forecasts
OAR/ESRL/GFDL
Climate Projections
OAR/ESRL/GFDL
U South Carolina
CCS Regional Models
UC Santa Cruz
Global
Regional
Hindcast
Nowcast
Seasonal Forecast
Projection

Seasonal Predictability in the California Current System

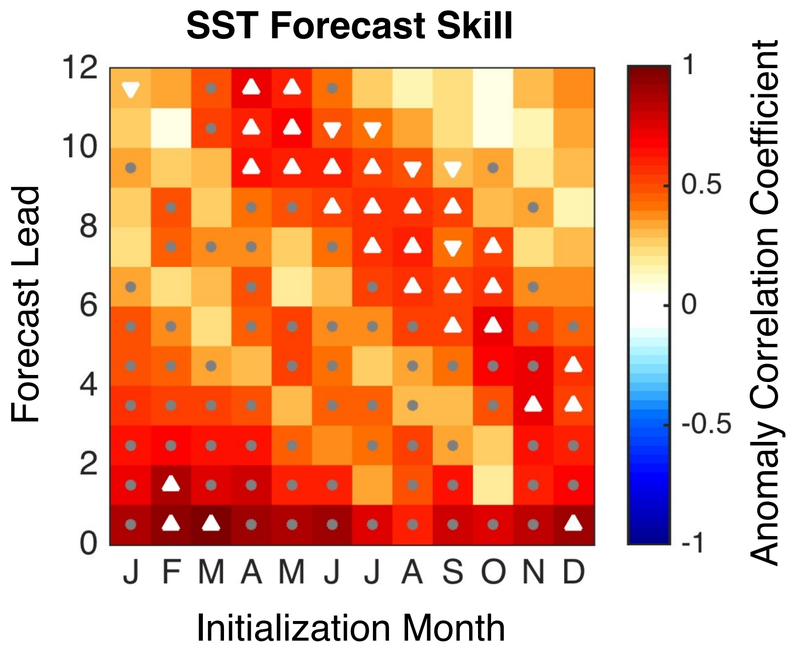
North American Multi-Model Ensemble (NMME)

March 2016 Forecast of July-August-September SST anomalies

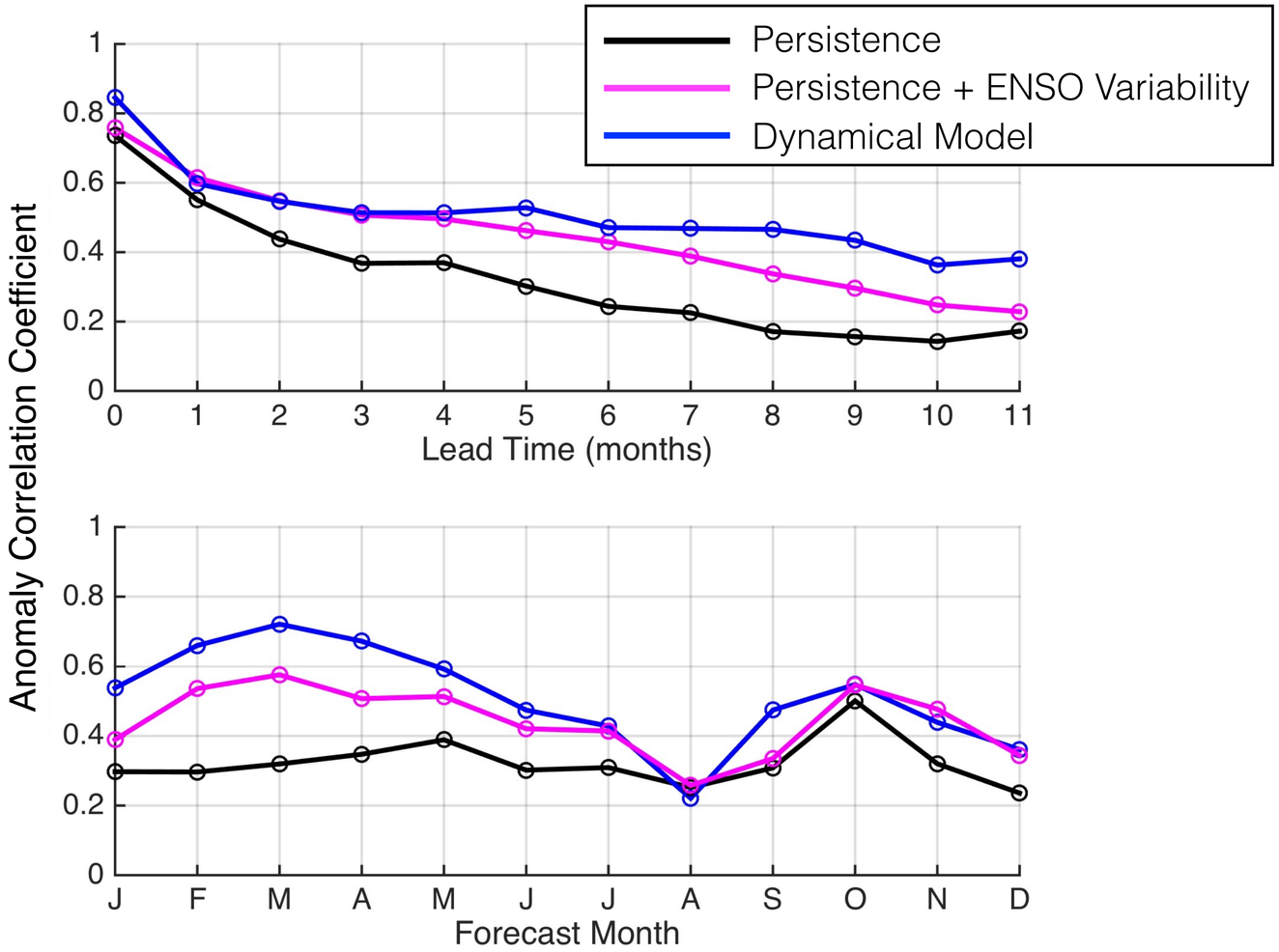


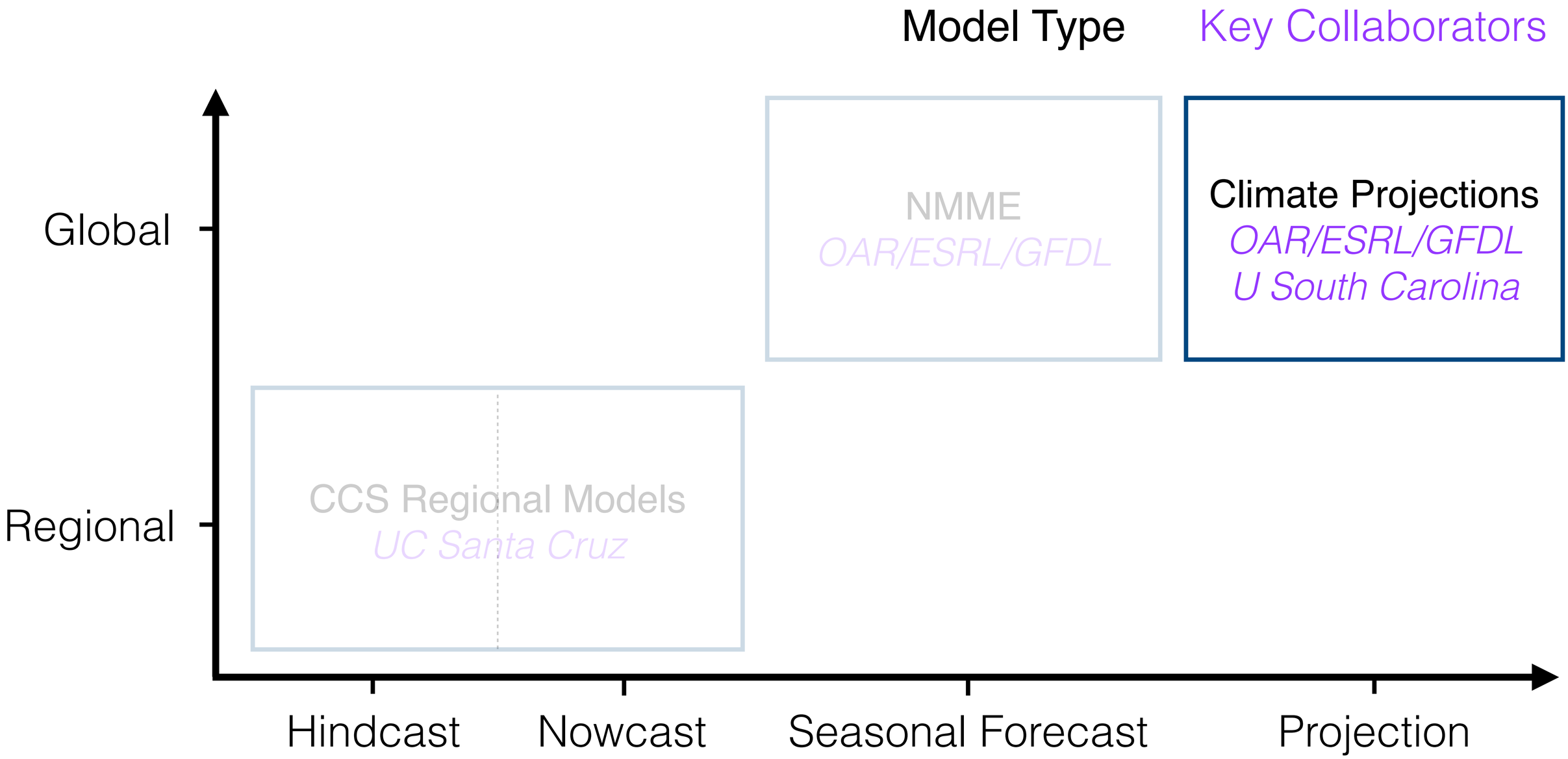
http://www.cpc.ncep.noaa.gov/products/NMME/current/tmpsfc_Seas4.html

Seasonal Predictability in the California Current System



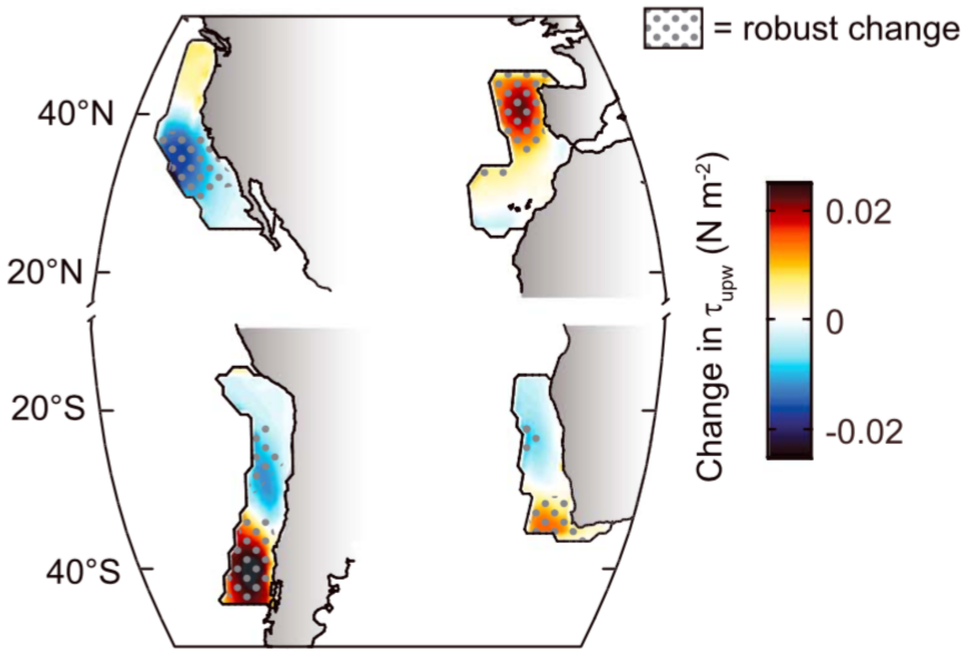
Adapted from Stock et al. (2015)



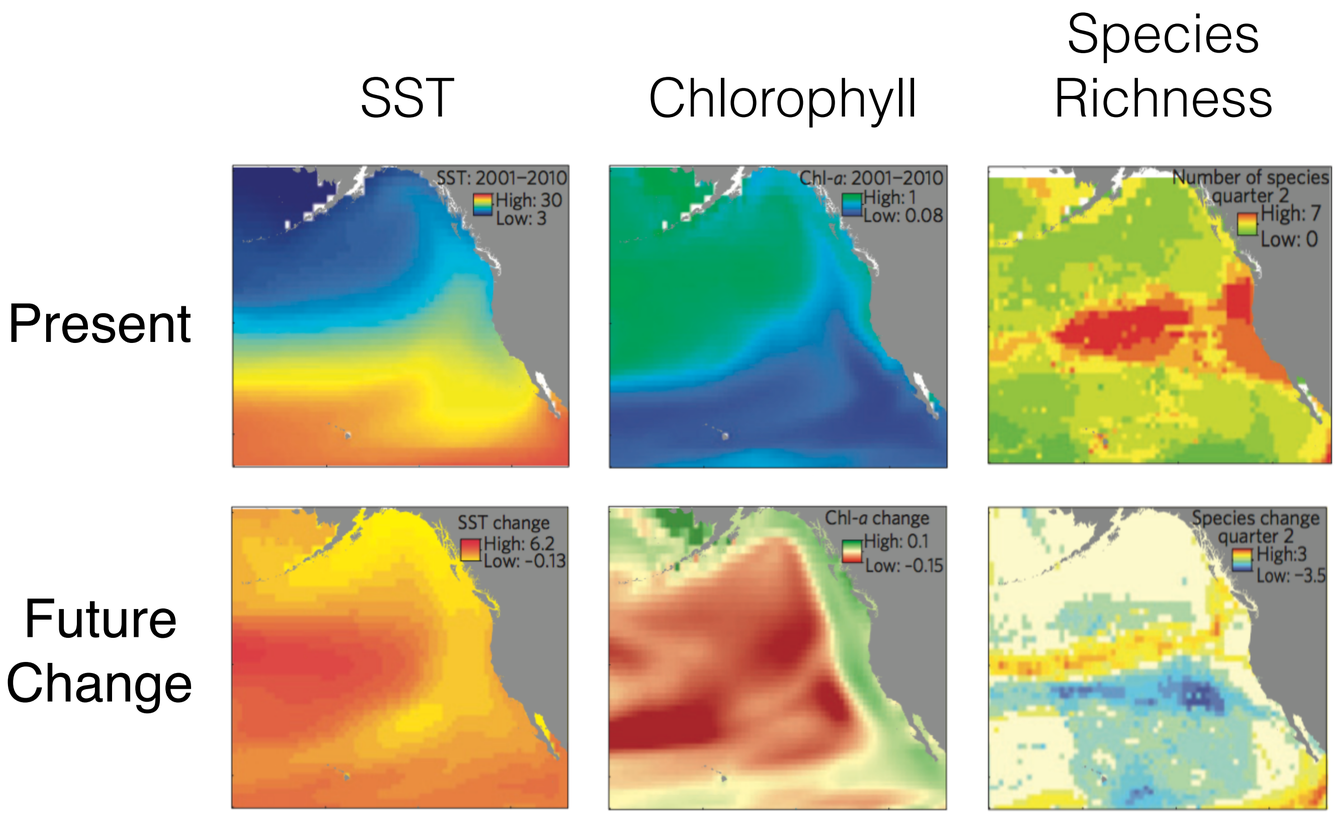

Model Type
Key Collaborators
Global
Regional
NMME
OAR/ESRL/GFDL
Climate Projections
OAR/ESRL/GFDL
U South Carolina
CCS Regional Models
UC Santa Cruz
Hindcast
Nowcast
Seasonal Forecast
Projection

Climate Projections and Ecosystem Implications

Future Change in Upwelling Winds



Rykaczewski et al., GRL (2015)



Hazen et al., Nat. Clim. Chang. (2013)

Model Type | Key Collaborators | Example Projects/Products

Global

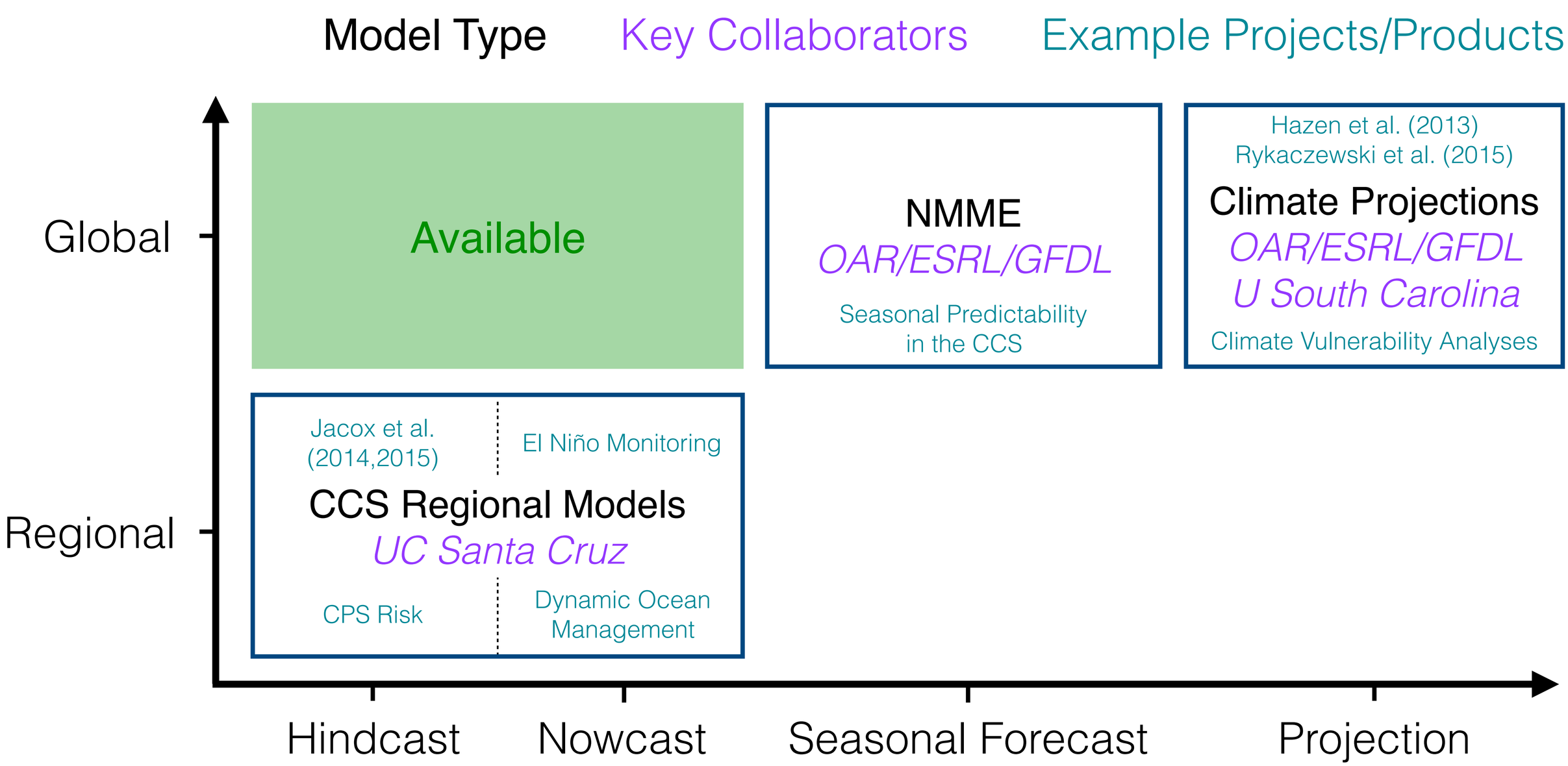
Regional

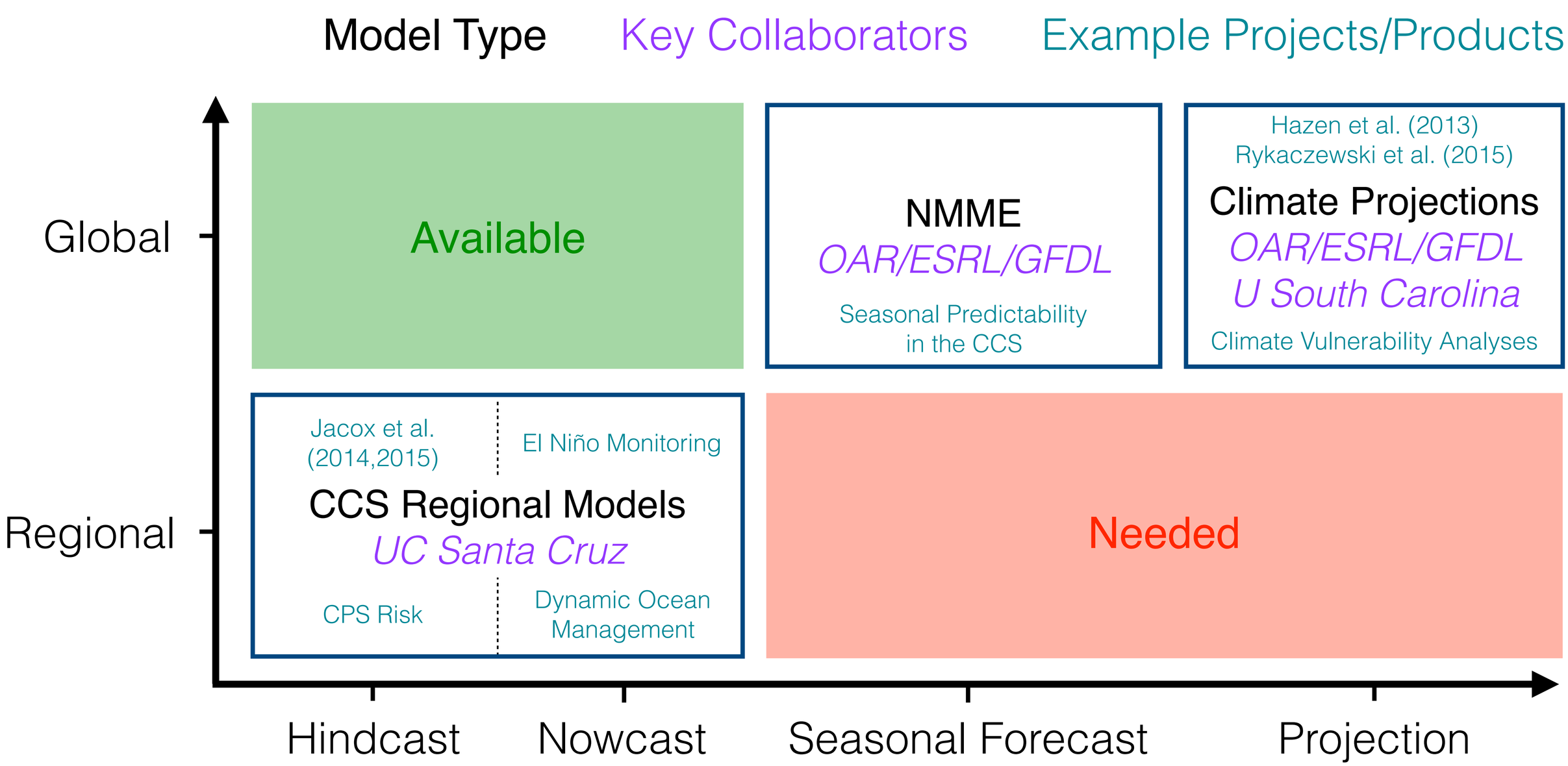
NMME
OAR/ESRL/GFDL
Seasonal Predictability in the CCS

Hazen et al. (2013)
Rykaczewski et al. (2015)
Climate Projections
OAR/ESRL/GFDL
U South Carolina
Climate Vulnerability Analyses

Jacox et al. (2014,2015)
El Niño Monitoring
CCS Regional Models
UC Santa Cruz
CPS Risk
Dynamic Ocean Management

Hindcast | Nowcast | Seasonal Forecast | Projection

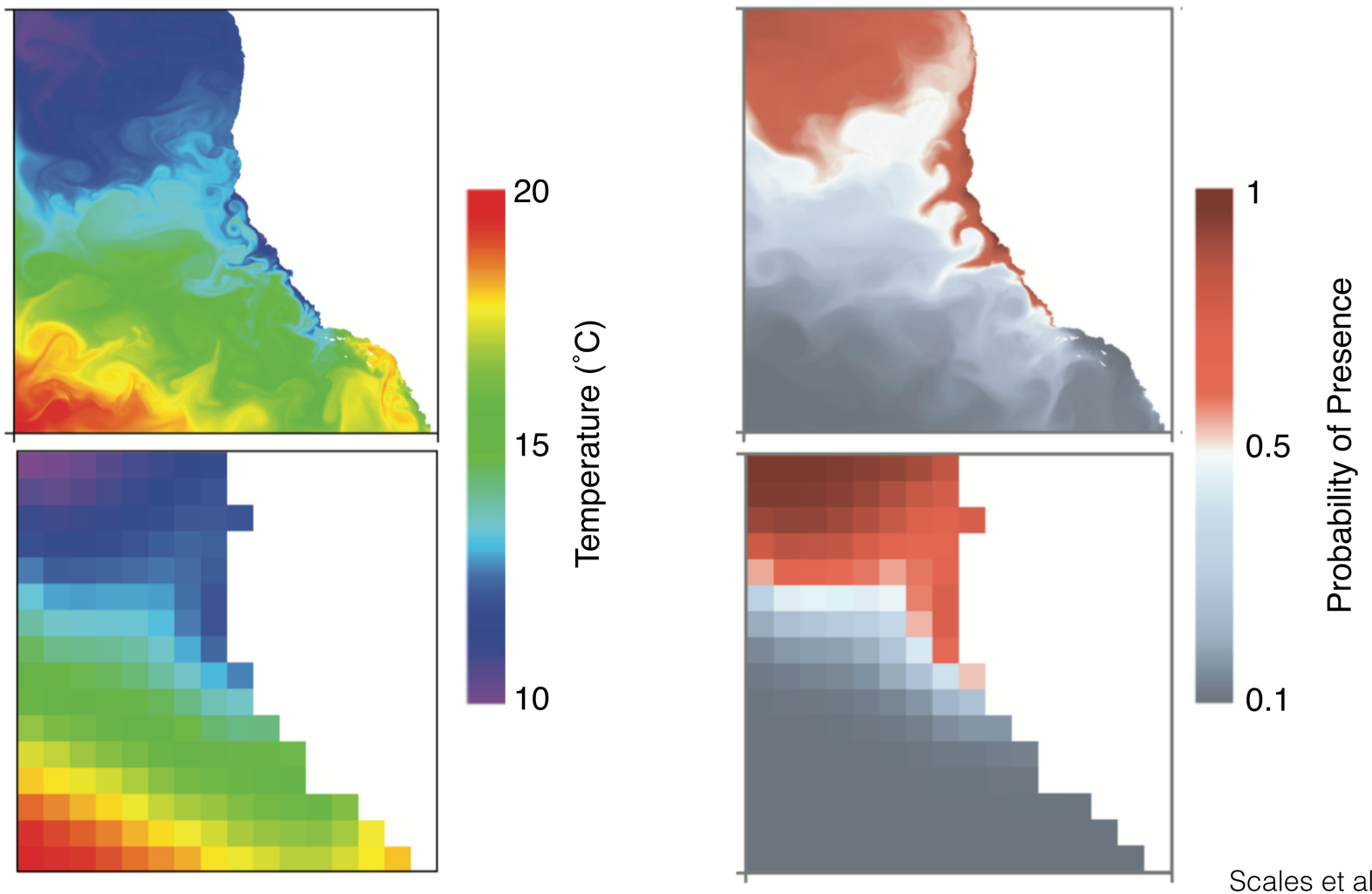

Model Type
Key Collaborators
Example Projects/Products
Global
Regional
Available
NMME
OAR/ESRL/GFDL
Seasonal Predictability in the CCS
Hazen et al. (2013)
Rykaczewski et al. (2015)
Climate Projections
OAR/ESRL/GFDL
U South Carolina
Climate Vulnerability Analyses
Jacox et al. (2014,2015)
El Niño Monitoring
CCS Regional Models
UC Santa Cruz
CPS Risk
Dynamic Ocean Management
Hindcast
Nowcast
Seasonal Forecast
Projection


Model Type
Key Collaborators
Example Projects/Products
Global
Regional
Available
NMME
OAR/ESRL/GFDL
Seasonal Predictability in the CCS
Hazen et al. (2013)
Rykaczewski et al. (2015)
Climate Projections
OAR/ESRL/GFDL
U South Carolina
Climate Vulnerability Analyses
Jacox et al. (2014,2015)
El Niño Monitoring
CCS Regional Models
UC Santa Cruz
CPS Risk
Dynamic Ocean Management
Needed
Hindcast
Nowcast
Seasonal Forecast
Projection

Sensitivity of Habitat Models to Data Resolution

3 km, Daily

1˚, Seasonal Climatology



Scales et al., Ecography, in press

Strengths

- Academic and NOAA (OAR) collaborations
- Spatiotemporally resolved (gap-free) environmental products
- Mechanistic understanding of physical processes

Challenges

- Regional model output dependent on academic research funding/needs
- Linking scales: regional - global, hindcast/nowcast - forecast, physical - biological
- Translating climate scenarios to management activities

Strategies

- Strengthen cross line office collaborations
- Pursue regional forecasting (academic/OAR collaboration)
- Models provide the foundation for eco-forecasting and climate strategy

Strengths

- Academic and NOAA (OAR) collaborations
- Spatiotemporally resolved (gap-free) environmental products
- Mechanistic understanding of physical processes

Challenges

- Regional model output dependent on academic research funding/needs
- Linking scales: regional - global, hindcast/nowcast - forecast, physical - biological
- Translating climate scenarios to management activities

Strategies

- Strengthen cross line office collaborations
- Pursue regional forecasting (academic/OAR collaboration)
- Models provide the foundation for eco-forecasting and climate strategy

Strengths

- Academic and NOAA (OAR) collaborations
- Spatiotemporally resolved (gap-free) environmental products
- Mechanistic understanding of physical processes

Challenges

- Regional model output dependent on academic research funding/needs
- Linking scales: regional - global, hindcast/nowcast - forecast, physical - biological
- Translating climate scenarios to management activities

Strategies

- Strengthen cross line office collaborations
- Pursue regional forecasting (academic/OAR collaboration)
- Models provide the foundation for eco-forecasting and climate strategy