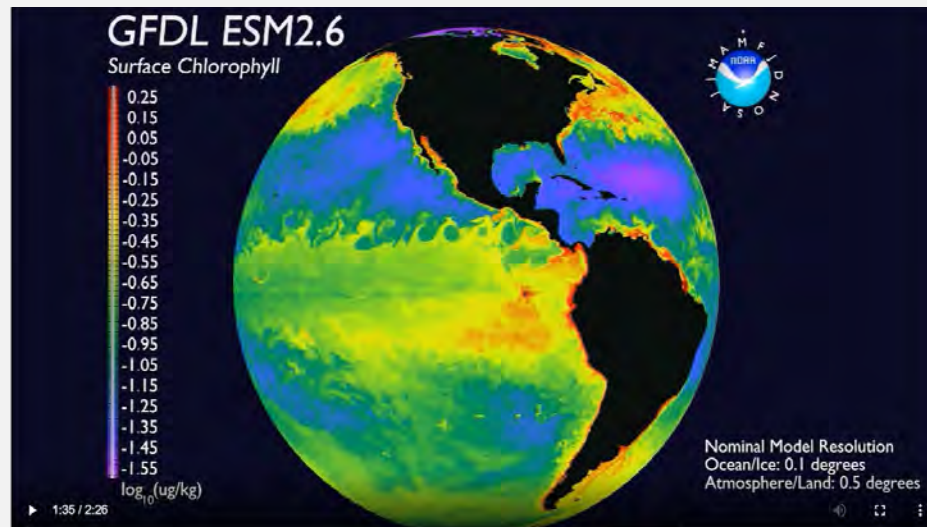
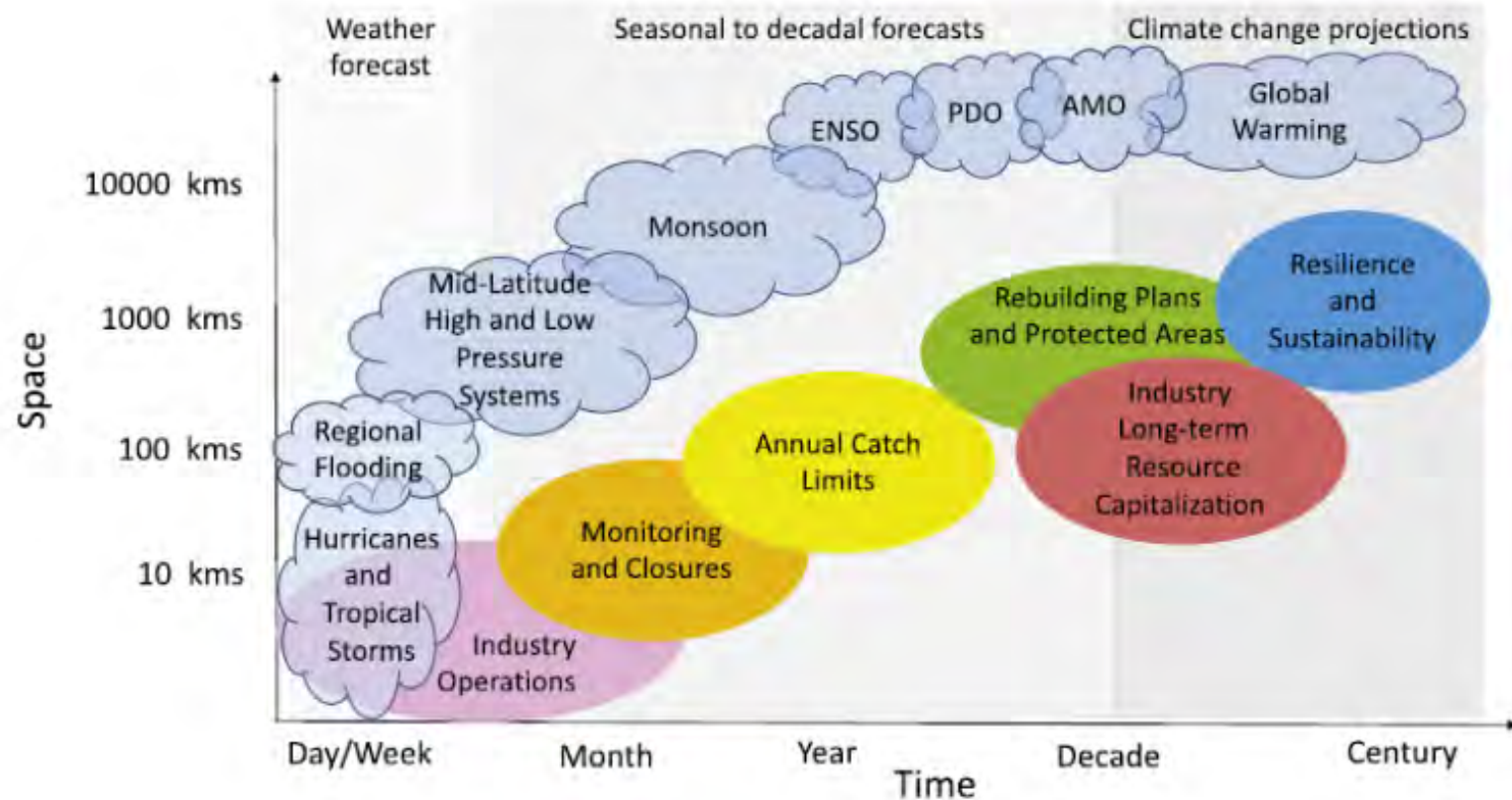


Earth System predictions and projections to support NOAA's Marine Ecosystem Mandates



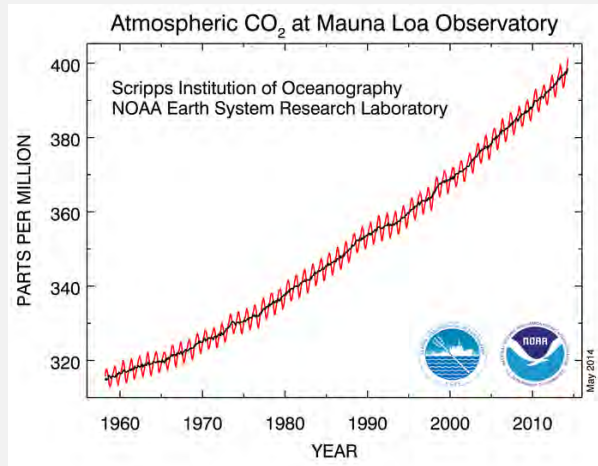
Presented by Charles Stock
(on behalf of many at GFDL and diverse research partners)
NOAA Eastern Region Climate Services Monthly Meeting
September 29, 2020

Broad range of ocean predictions and projections needed for marine resource mandates

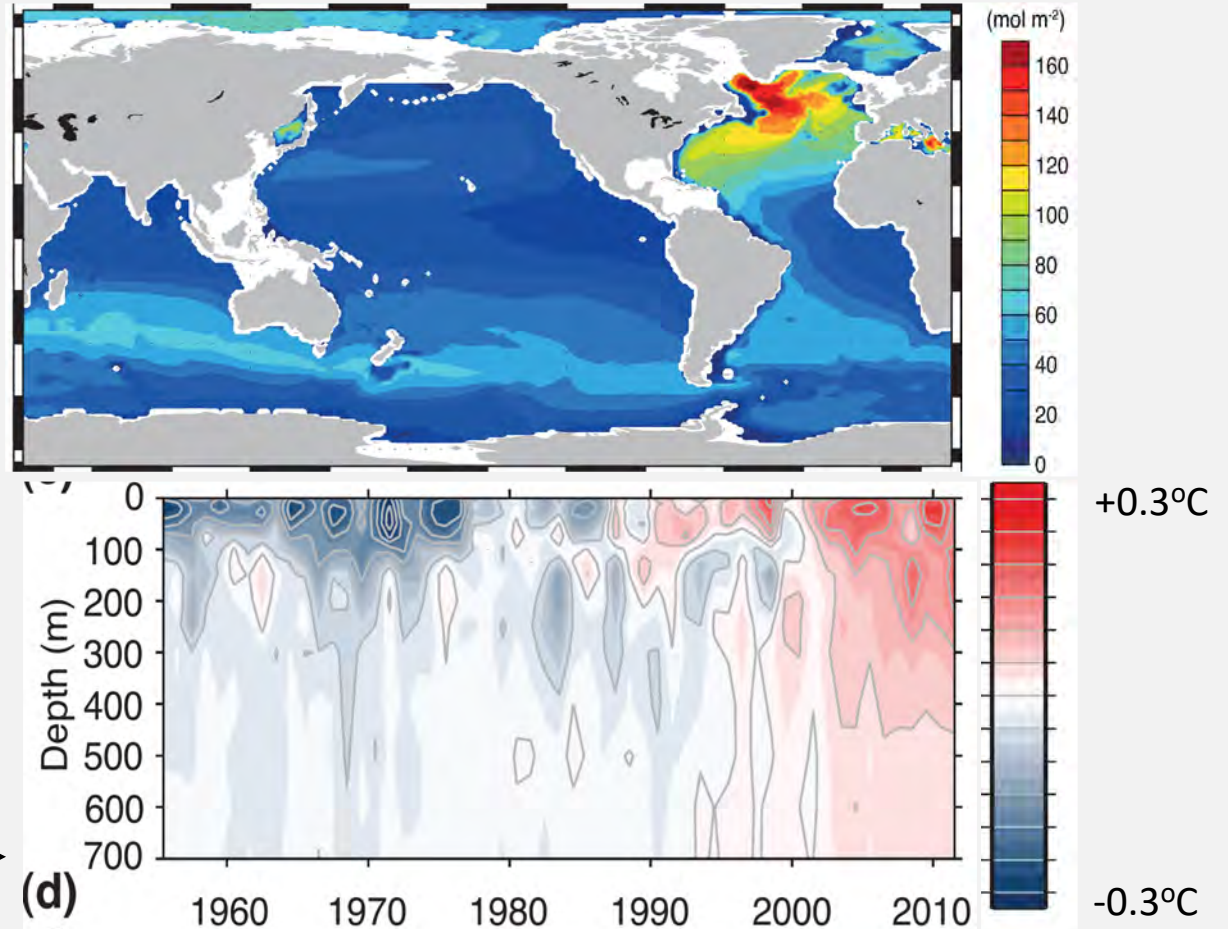


Thank your local ocean. It has provided humankind a great climate service

The ocean has absorbed $\sim 1/3$ of our carbon emissions since the industrial revolution

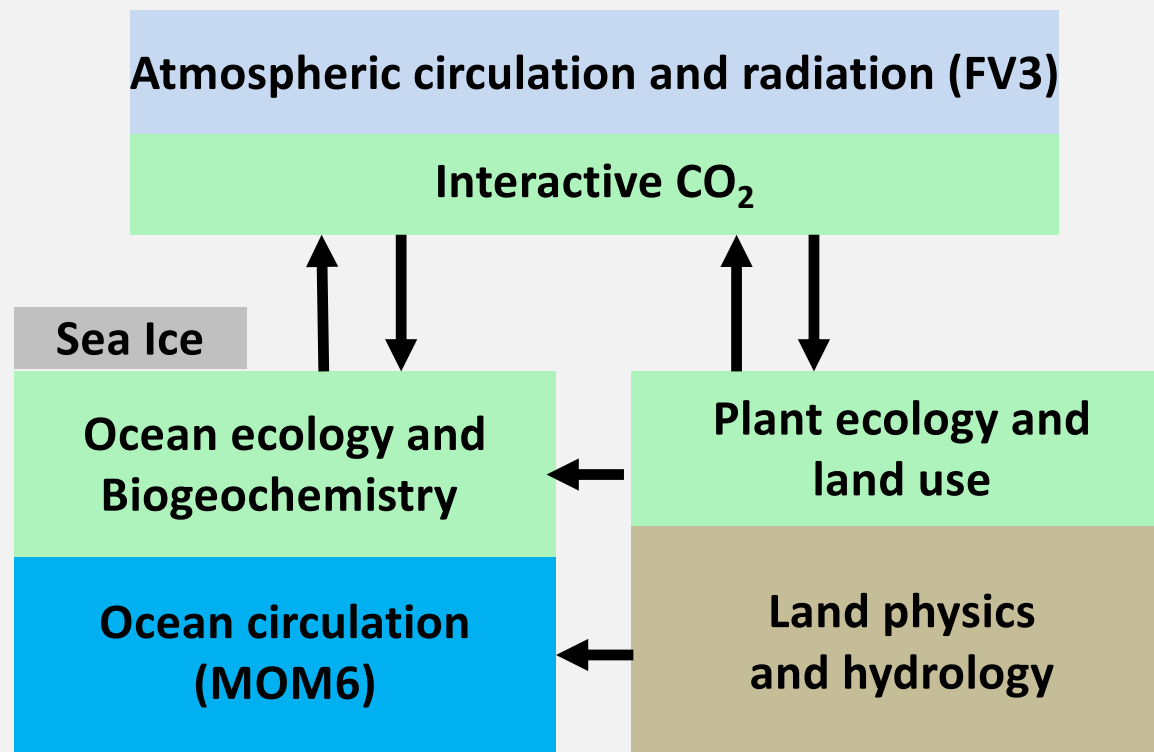
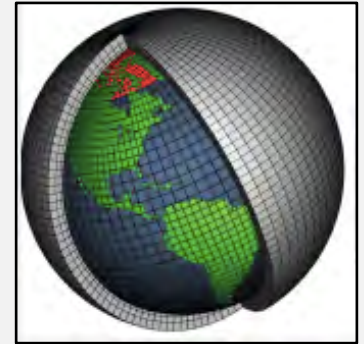


The ocean has absorbed 90% of the heat energy added from GHGs Between 1971-present

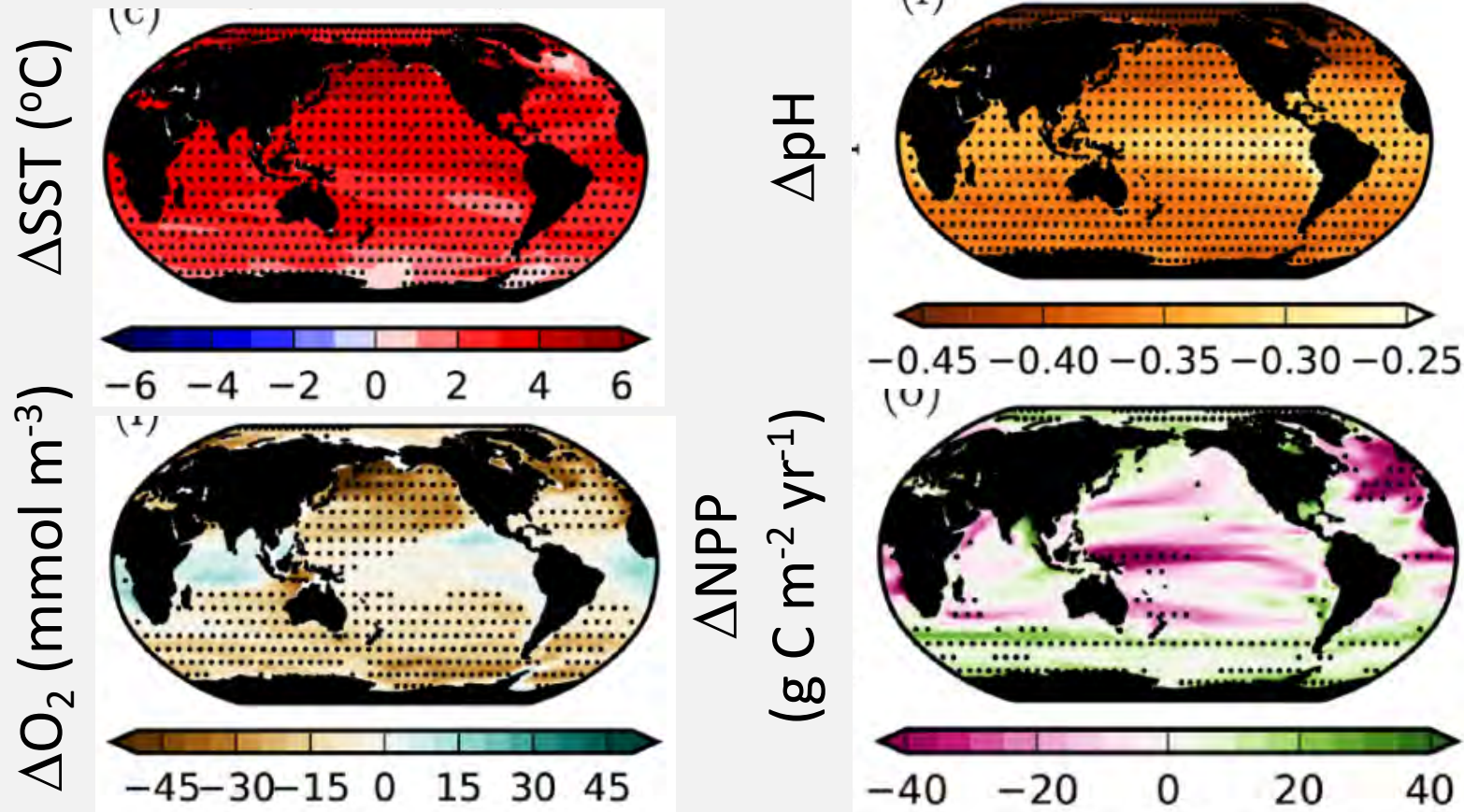


Source: IPCC AR5 report working group 1 report, Sabine et al., 2004

What is a global earth system model?



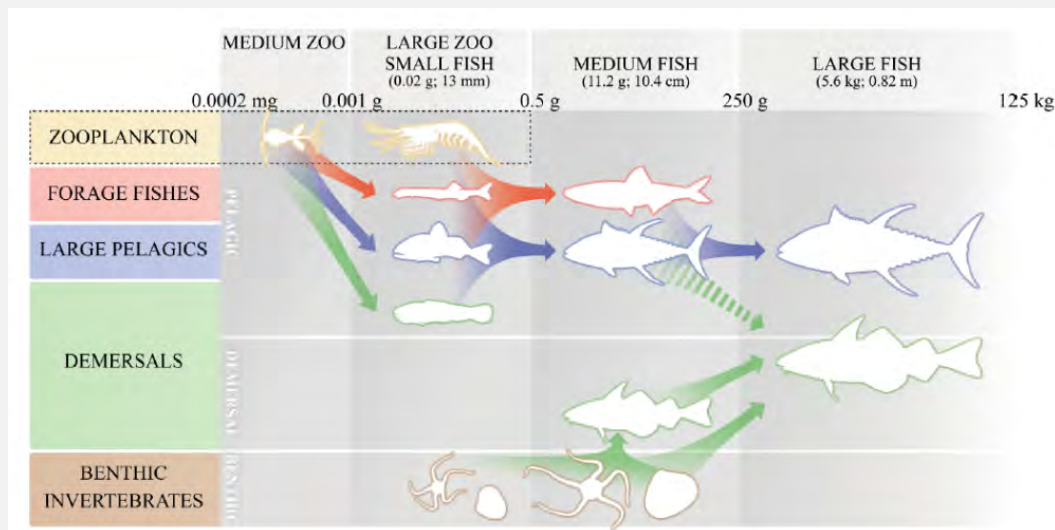
The climate services that the ocean provides come with a price



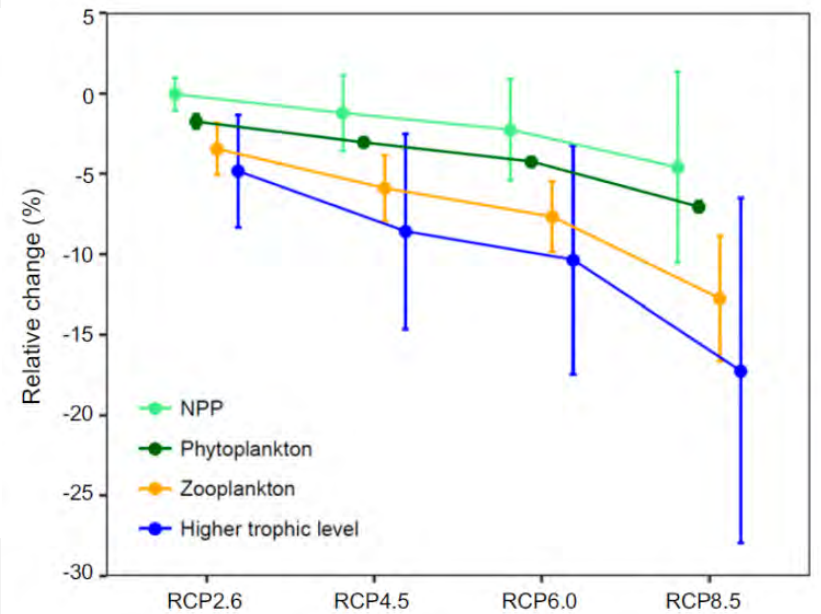
Oceans are “warming up, turning sour and losing breath” by the end of the century under high CO₂ emissions

(Gruber, Royal Society A; 2011; Kwiatkowski et al., Biogeosciences, 2020)

Connecting potential ecosystem stressors to marine resource change

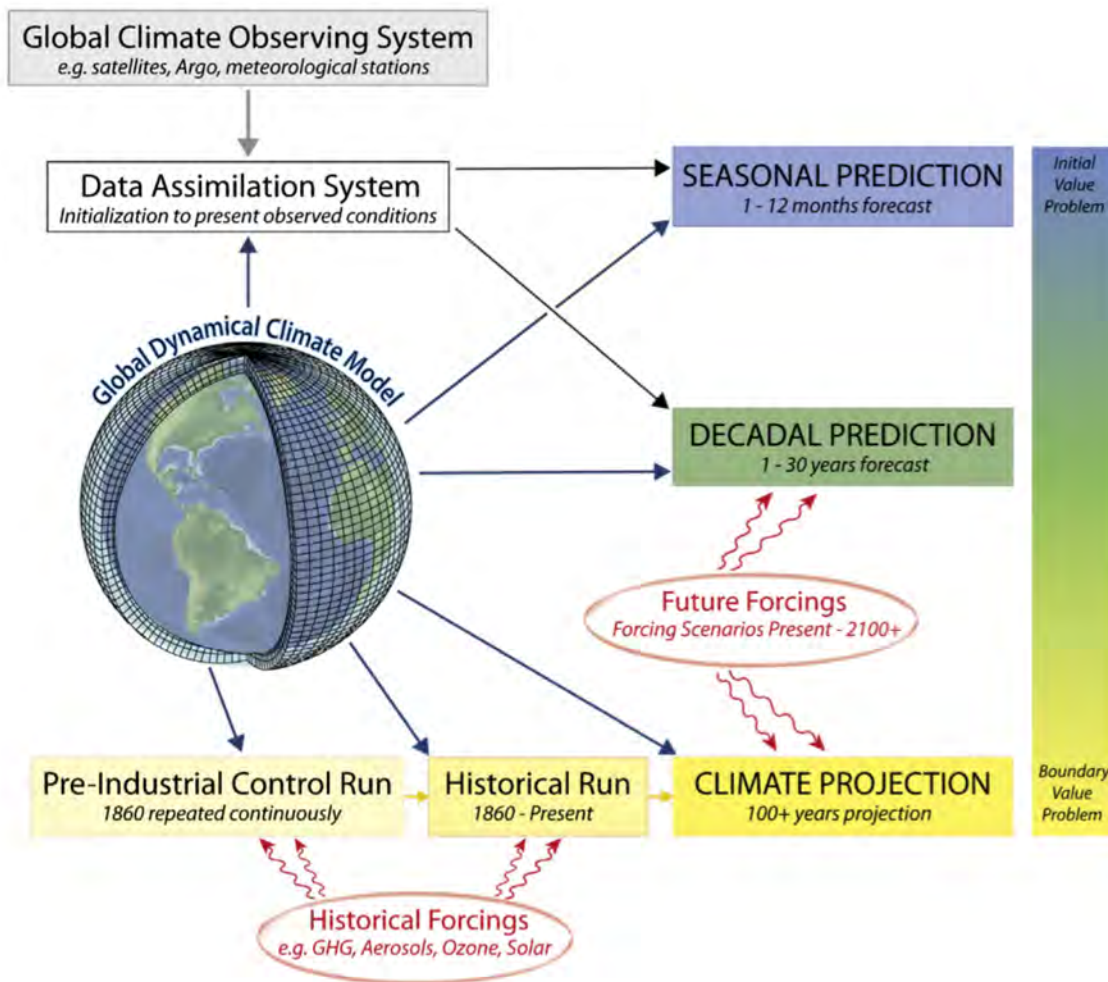


Petrik et al., PinO, 2019



Lotze et al., PNAS, 2019

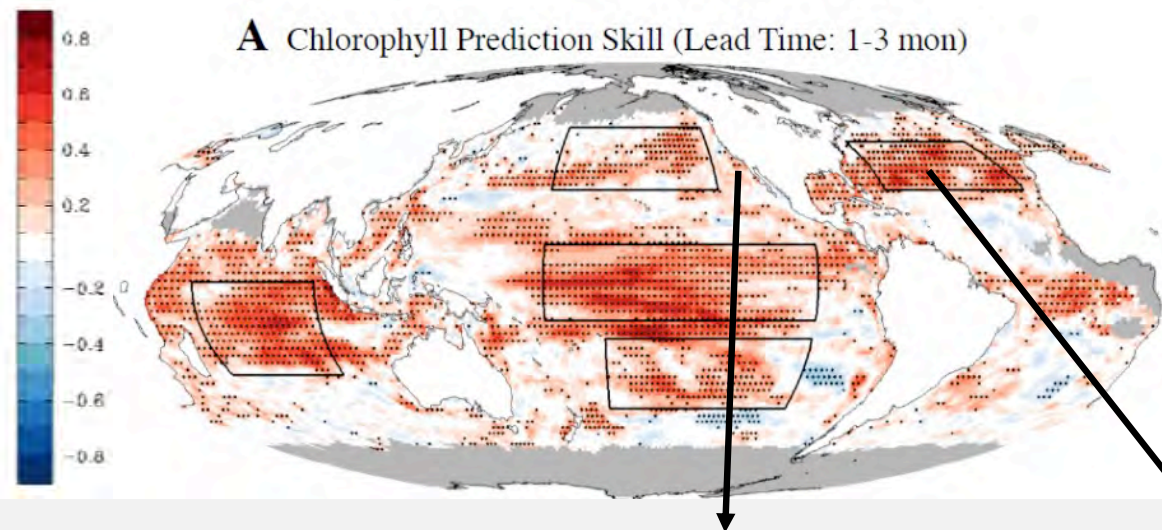
ESMs can also inform decisions on shorter time horizons



Earth system predictions predict the next months/years by initializing forecasts with current conditions, hoping that this initial “state”, combined with high quality model dynamics, will yield skillful predictions on seasonal time scales

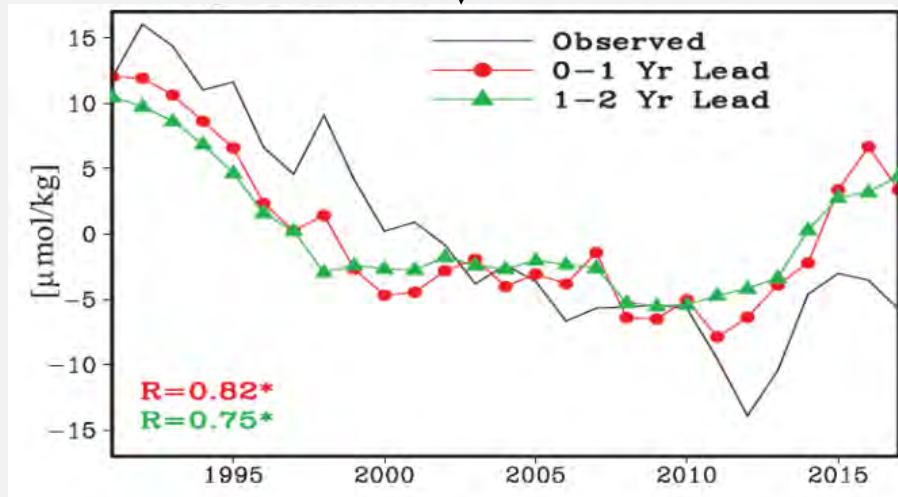
Earth system projections project the evolution of the climate (defined by statistics of atmosphere and ocean conditions over ~30 year windows) as it responds over centuries to different scenarios for greenhouse gases and other climate drivers.

Tommasi et al., Progress in Oceanography, 2017



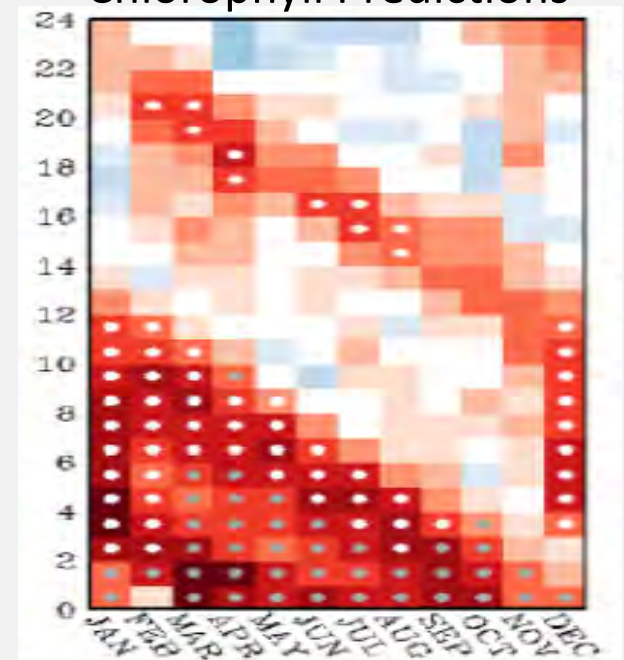
Earth system predictions
to support marine
resource mandates

Oxygen
Predictions
off California



North Atlantic
Chlorophyll Predictions

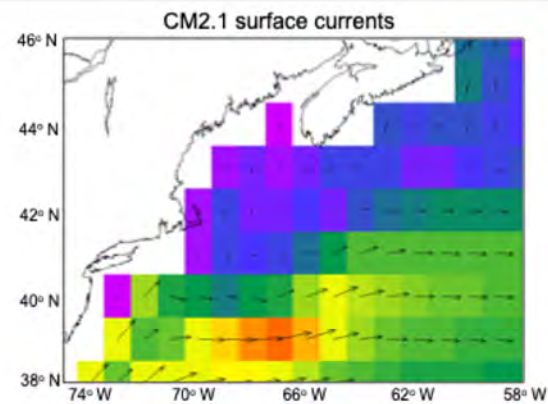
Forecast Lead (months)



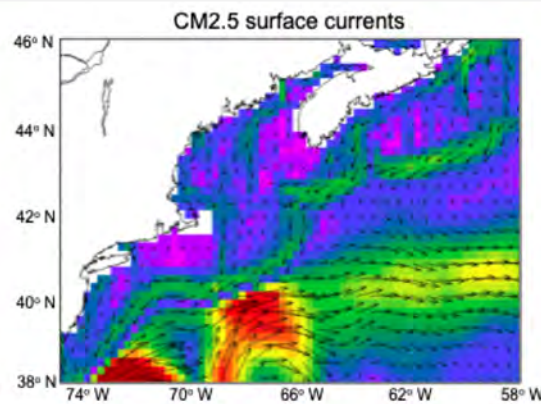
Forecast initialization month

Limited global model resolution hinders applications in coastal waters

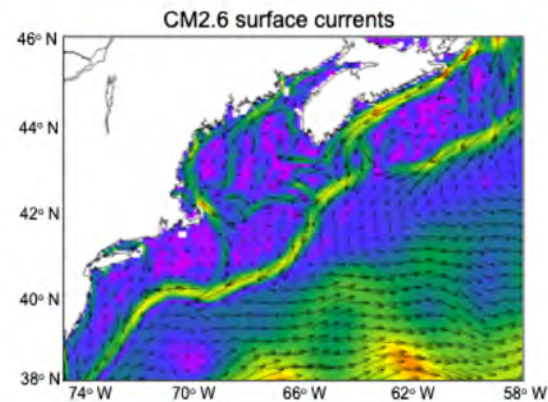
100 km
Horizontal
Resolution



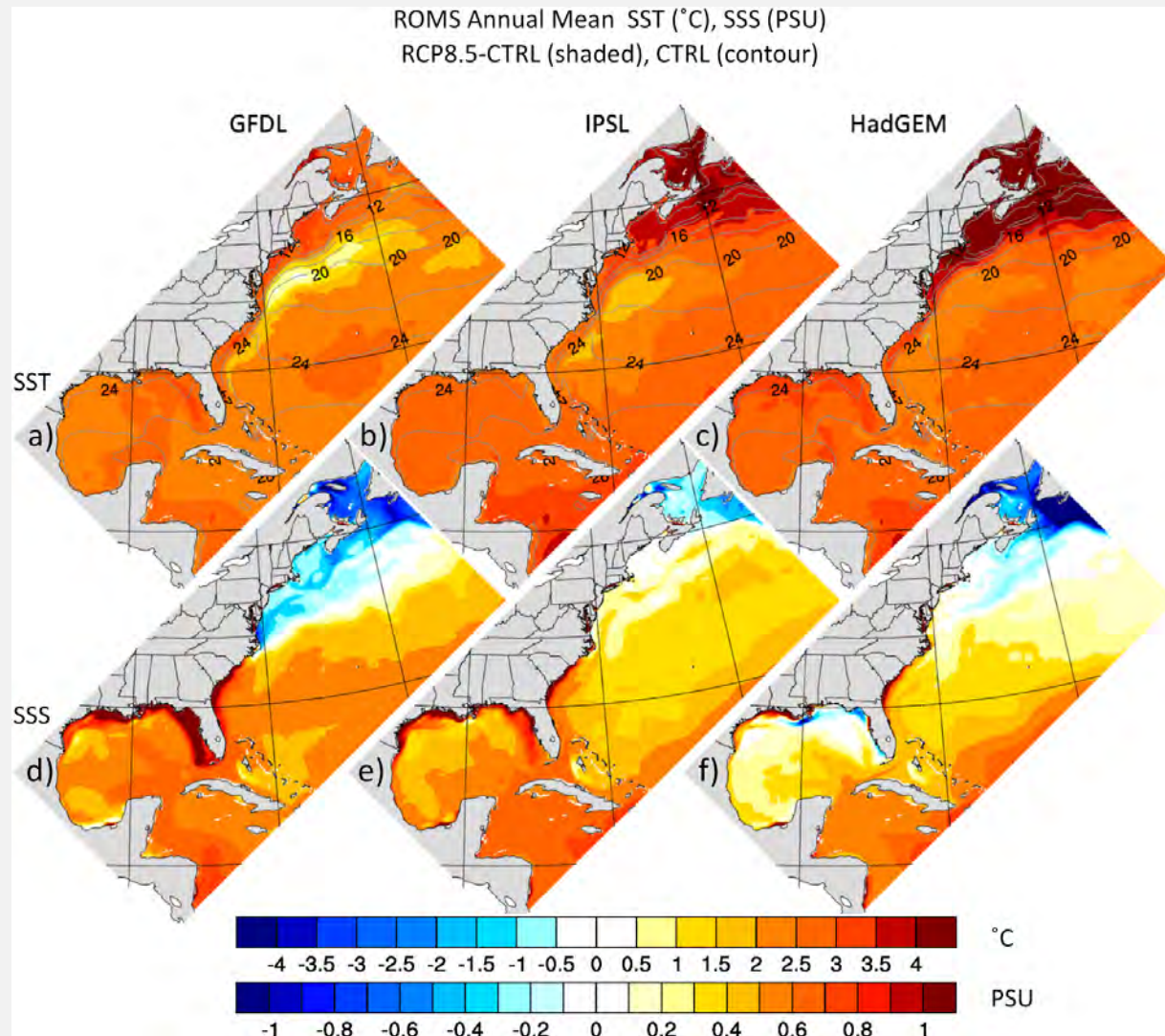
25 km
Horizontal
Resolution



10 km
Horizontal
Resolution



Drenkard et al., submitted



Dynamically-downscaled
climate projections for the US
east coast (led by Mike
Alexander; OAR/PSL)

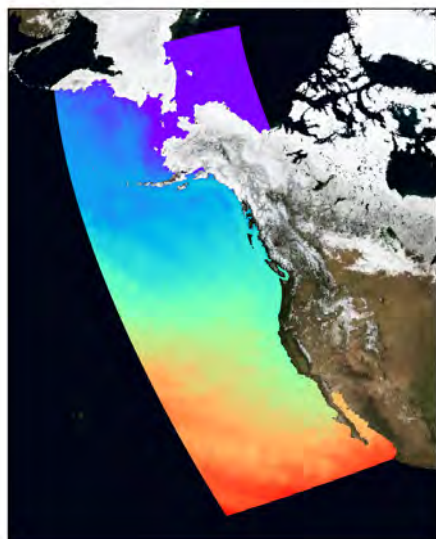
<https://psl.noaa.gov/ipcc/>

(a data portal for both global
models and these regionally
downscaled solutions)

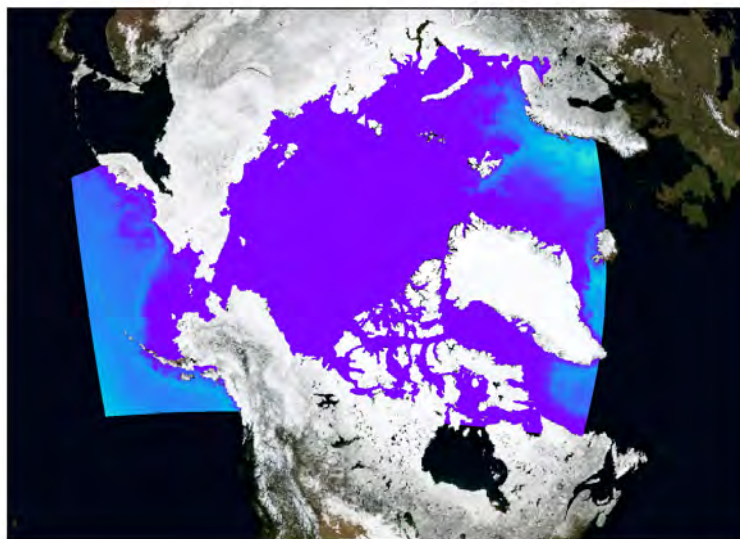
Alexander et al., (2020) Journal
of Climate

Toward a nationally-integrated regional earth system modeling and prediction system to support marine resource decisions

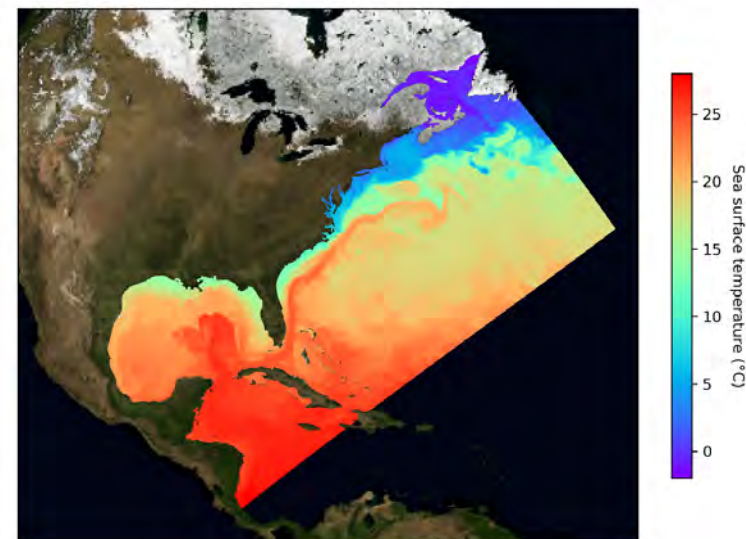
MOM6-NEP



MOM6-Arctic



MOM6-NWA



Visualizations by Andrew Ross



PRINCETON
UNIVERSITY

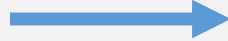


RUTGERS

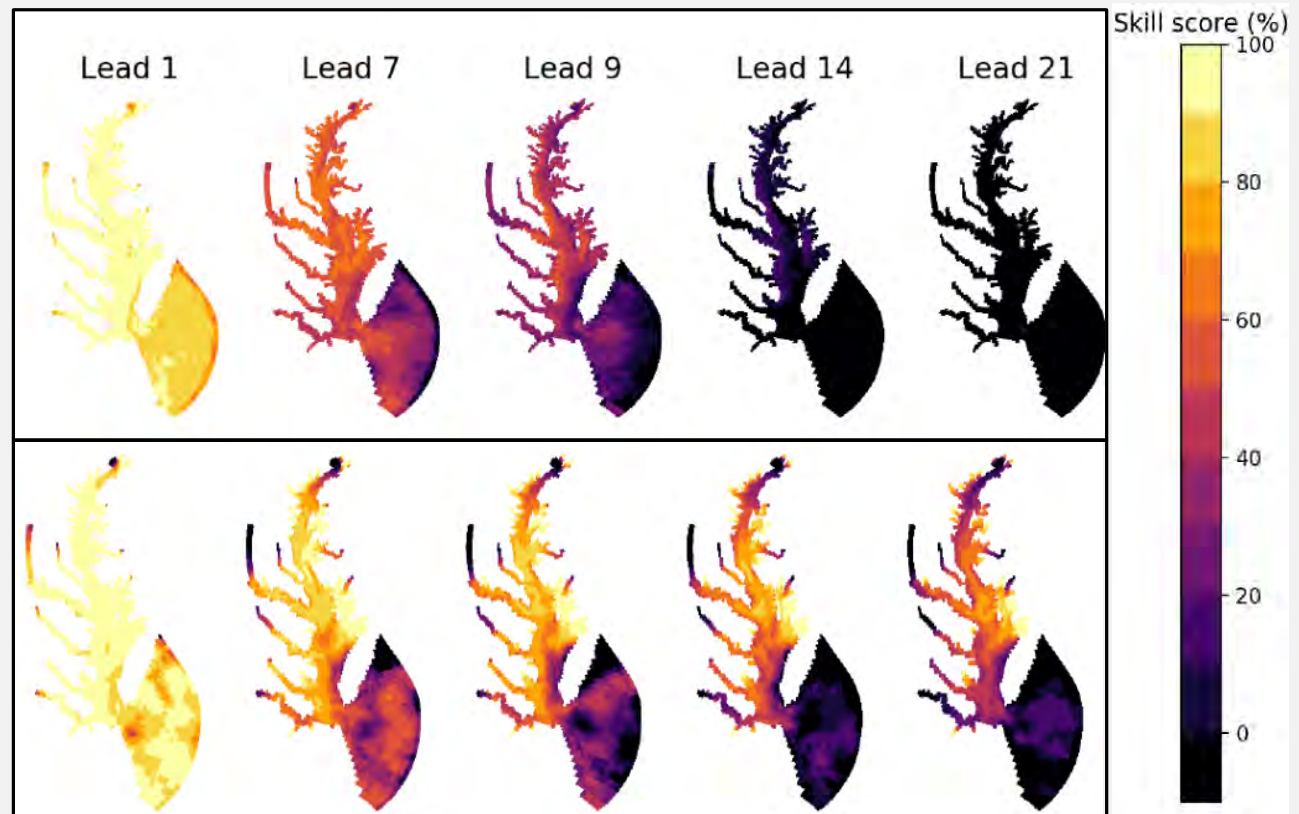
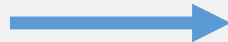


Estuarine forecasts at weather/sub-seasonal scales

Surface water
temperature

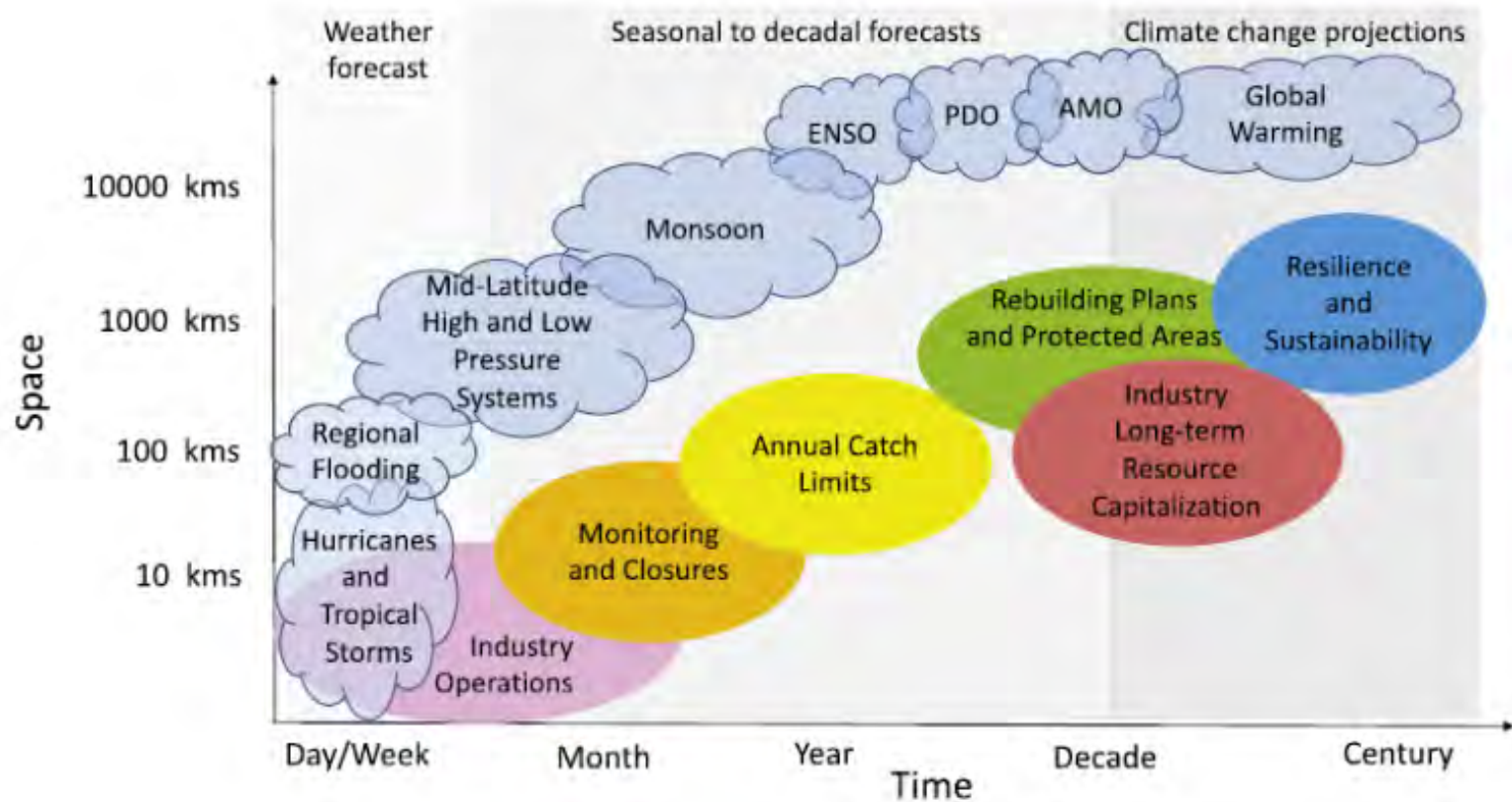


Surface
salinity



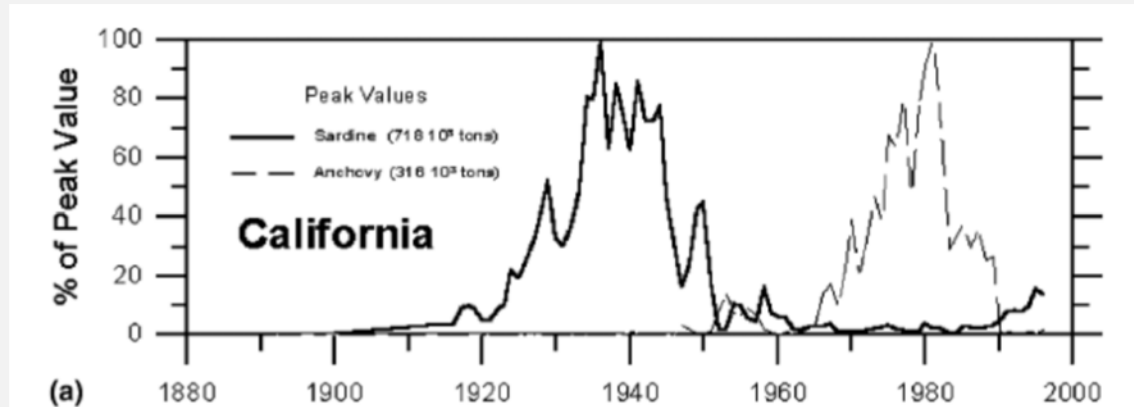
Ross et al., (in press); Earth and Space Science

Harness global & regional approaches to provide information across management-relevant scales



s in Oceanography

A visit to cannery row....



Women cannery workers on the line - 1949



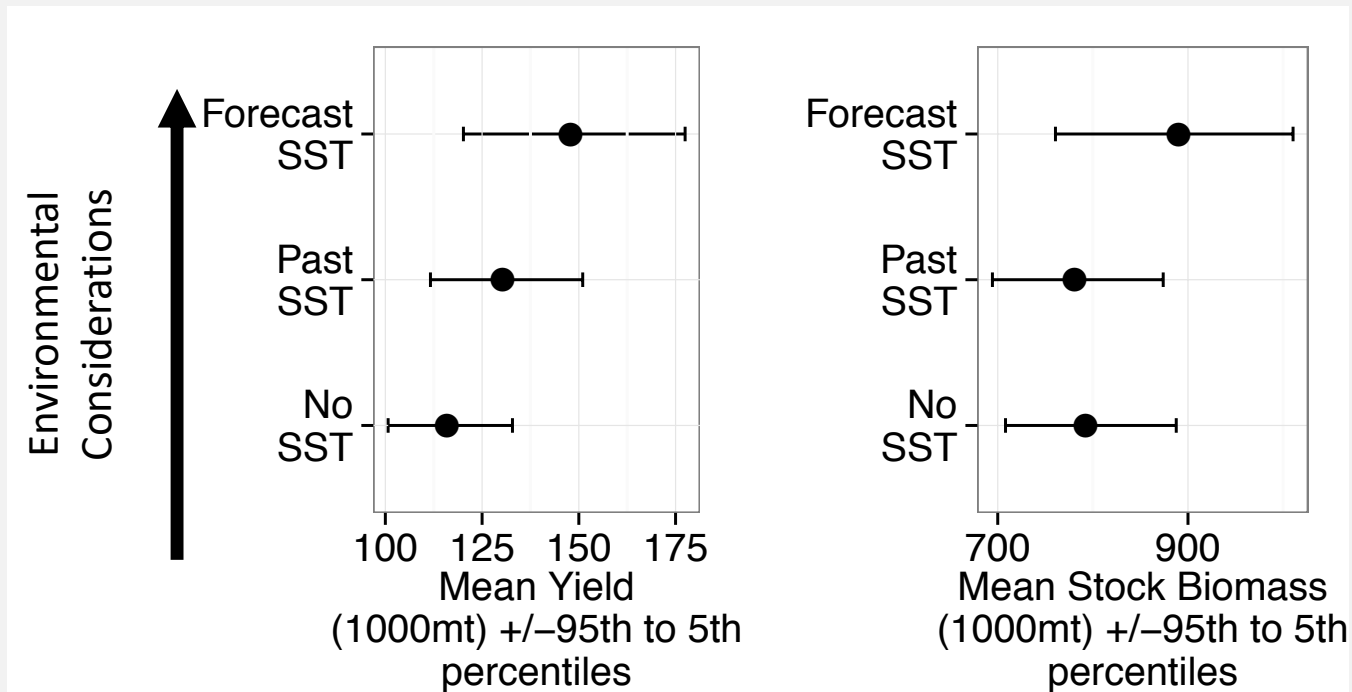
Unloading sardines - 1920s



End of an Era - Cannery Row.1950

Photos courtesy of the city of Monterey,
time series de Young et al., PinO, 2004

Increased expected yield and stock biomass through anticipatory management



Tommasi et al., Improved management of small pelagic fisheries through seasonal predictions, Ecological Applications, 2017