A DYNAMICALLY DOWNSCALED ENSEMBLE OF FUTURE PROJECTIONS FOR THE CALIFORNIA CURRENT

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FUTURE SEAS
A Physics-to-Fisheries Management Strategy Evaluation for the California Current System

Objective

Build a downscaling framework to produce high-resolution regional climate projections of ecosystem variables for the California Current System (CCS)

Time-Varying Delta Method

Control run (REGIONAL)

Regional Ocean Model System coupled with a biogeochemistry model (**ROMS-NEMUCSC**)

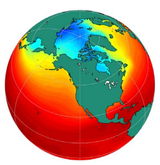
Atmospheric forcing: ERA5, CCMP
Open boundaries: SODA, WOA

Resolutions:
ESM Atmosphere ~ 200Km
ESM Ocean ~100Km
ROMS ~10Km

TIME-VARYING DELTA:

- Changes in **INTER-ANNUAL** variability are captured
- **Full Transient period** (1980-2070) is resolved

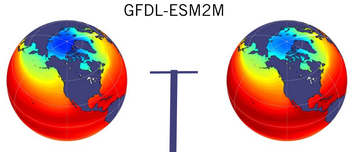
REANALYSIS



$CLIMA_{1980\text{-}2010}$
$DAILY_{1980\text{-}2010}$

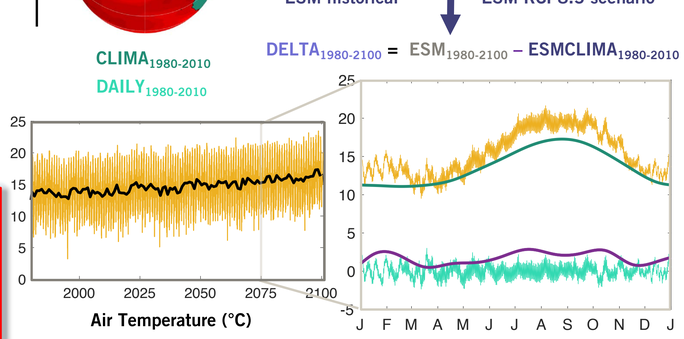
EARTH SYSTEM MODEL

GFDL-ESM2M



ESM historical — ESM RCP8.5 scenario

$DELTA_{1980\text{-}2100} = ESM_{1980\text{-}2100} - ESMCLIMA_{1980\text{-}2010}$

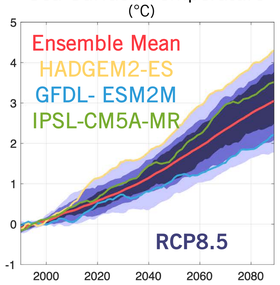


$FINAL\ FORCING_{1980\text{-}2100} = CLIMA_{1980\text{-}2010} + DAILY_{1980\text{-}2010} + DELTA_{1980\text{-}2100}$

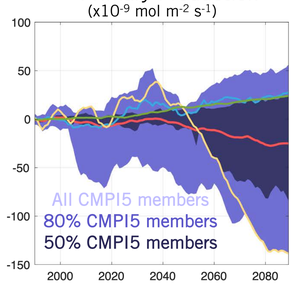
Selecting the ESMs to Downscale

Anomalies relative to the historical climate

Sea Surface Temperature (°C)



Primary Production (x10^{-9} mol m^{-2} s^{-1})

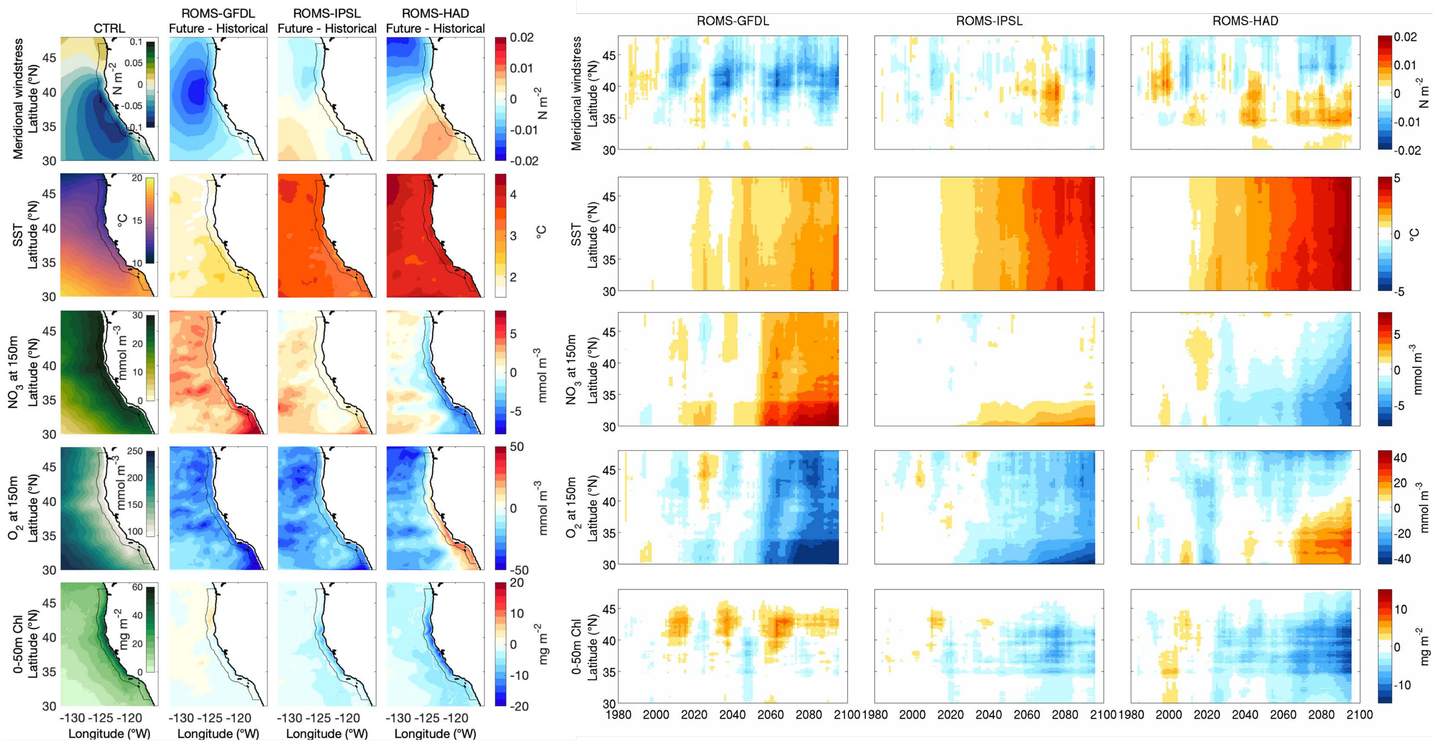


Capturing the **range of physical and biogeochemical** properties in the CCS

3 DOWNSCALING EXPERIMENTS: ROMS-GFDL, ROMS-IPSL, ROMS-HAD

Spatial & Temporal Differences in Future Changes

Future Mean State — **Anomalies relative to the historical climate**

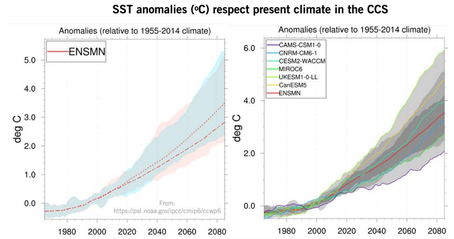


Future period = 2070-2100; Historical period = 1980-2010; Anomalies are relative to the 1980-2010 period

- All models agree in the direction of the future change in offshore waters
- Large **inter-model differences** arise in the coastal region, especially for biogeochemical variables

Future Work & Take-Home Message

SST anomalies (°C) respect present climate in the CCS



FUTURE TASKS:

- Mini-ensemble of CMIP6 models
- Understand and quantify the variability of the **physical mechanisms that drive** changes in the biogeochemistry of the California Current Upwelling System in response to anthropogenic climate change

MAPP
Modeling, Analysis, Predictions, and Projections

Pozo Buil et al, 2020-2023

Until **large ensembles of eddy-resolving global or regional models** are **computationally feasible**, a fruitful approach is to combine coarser resolution **large ensembles with dynamical downscaling** of select runs informed by analyses similar to what we have performed here to assess how representative basin-scale changes are translated to shelf-scale responses