IMPACT OF A DOWNSCALING METHOD FOR FUTURE PROJECTIONS ON THE CALIFORNIA CURRENT SYSTEM

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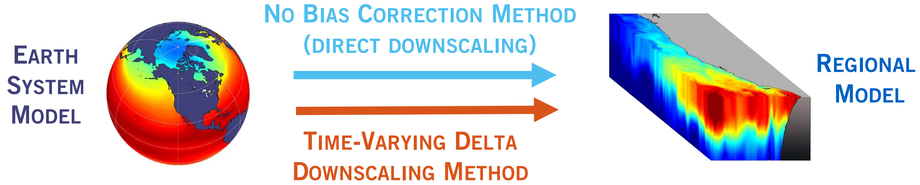
Objective

Compare future changes in the California Current System (CCS), using the Regional Model (ROMS) and dynamically downscaling the GFDL-ESM2M output applying two methods: a "time-varying delta" method to debias the model forcing, and a no bias correction method



Time-Varying Delta Method

Control run (REGIONAL)

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

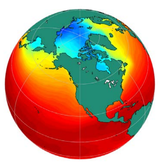
Atmospheric forcing: ERA5, CCMP
Open boundaries: SODA, WOA

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

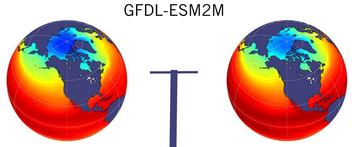
REANALYSIS



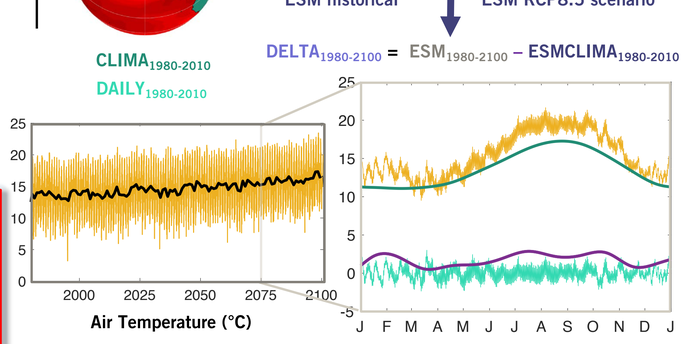
$CLIMA_{1980\text{-}2010}$
$DAILY_{1980\text{-}2010}$

EARTH SYSTEM MODEL

GFDL-ESM2M



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



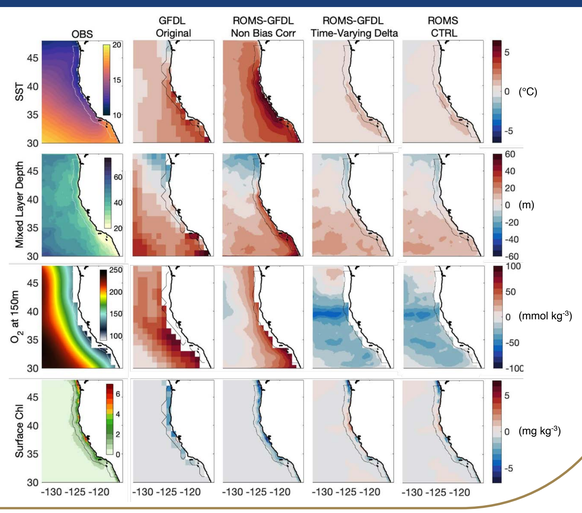
$FINAL\ FORCING_{1980\text{-}2100} = CLIMA_{1980\text{-}2010} + DAILY_{1980\text{-}2010} + DELTA_{1980\text{-}2100}$

Historical Period Validation

Climatological mean bias relative to observations

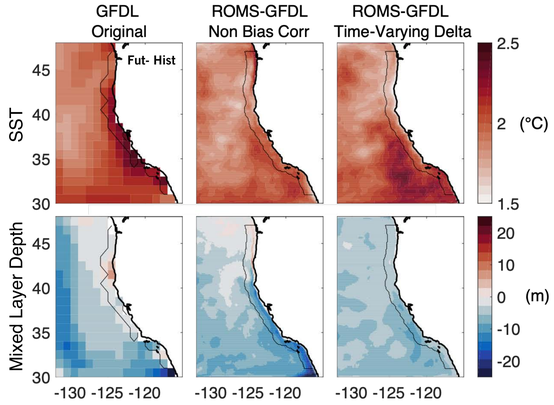
SST (NOAA OISSTv2, 1982-2010)
MLD (CCS ROMS reanalysis,1980-2010)
Subsurface O_2 (WOA, 1981-2010)
Surface Chl (Seawifs 2000-2010)

Time-Varying delta method significantly **reduces the historical bias** of the GFDL with respect to observations

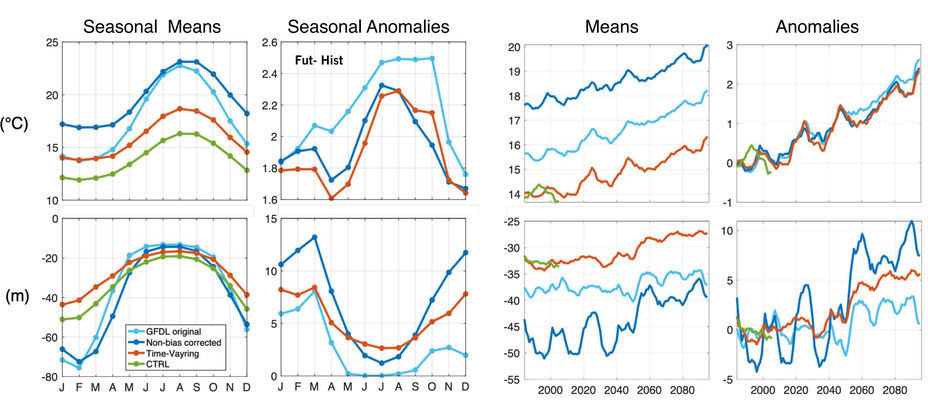


Spatial & Temporal Differences in Future Changes

Future Mean State



Future Variability



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

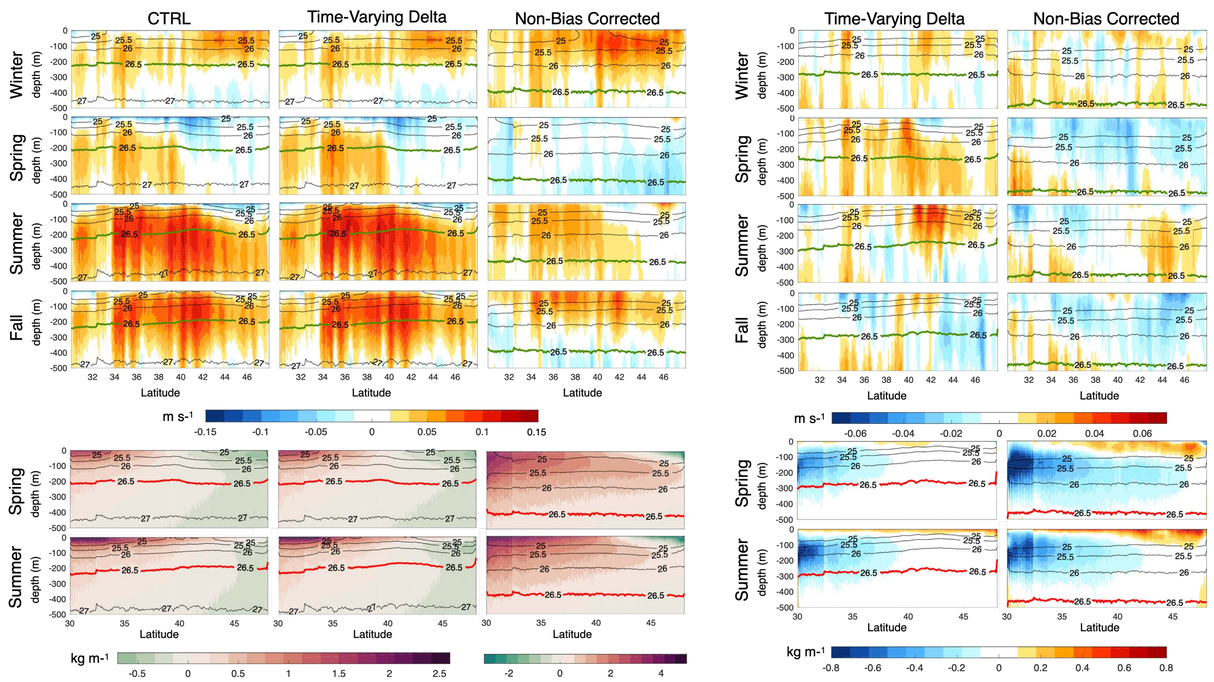
California Undercurrent & Water Mass Properties

Historical Period

Future - Historical

Alongslope velocity & Potential density

Spiciness & Potential density



Take-Home Messages

- Global model outputs can be **bias corrected** and **downscaled** to remove the systematic error and improve spatial resolution
- Bias correction methods are needed when global model outputs do not **resolve key physical processes**, like the California Undercurrent and water properties in the CCS