**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

**Historical Period Validation**

- Climatological mean bias relative to observations:
  - SST (NOAA OISSTv2, 1982-2010)
  - MLD (CCS ROMS reanalysis, 1980-2010)
  - Subsurface O2 (WOA, 1981-2010)
  - Surface Chl (Seawifs 2000-2010)

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

**California Undercurrent & Water Mass Properties**

- 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.