Using longterm observations to verify the regional ocean circulation model with focus on interannual shelf and slope variability

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Model: ROMS, 2-km horizontal resolution / 40 vertical levels, atm forcing: ECMWF ERA5, boundary conditions: HYCOM (non-tidal), TPXO (tides), terrestrial discharges: Columbia R., Fraser R., small rivers around Puget Sound

No data assimilation, 10-year simulation (2009-2018)

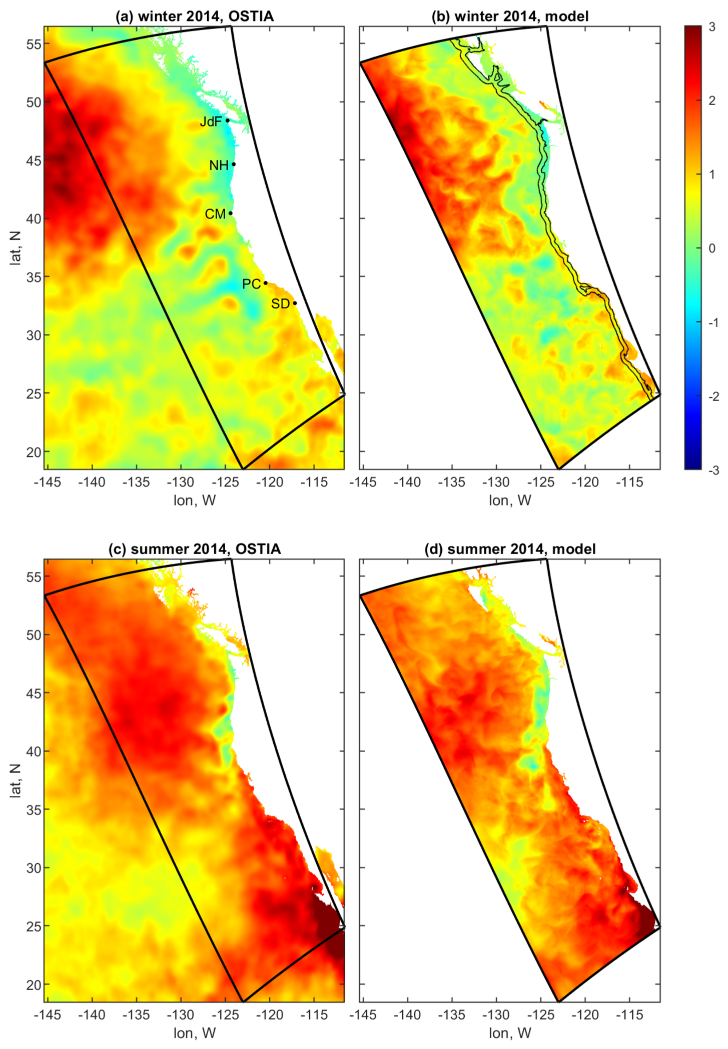
Goals:
- Assess the regional model performance over scales from several days to seasonal and interannual
- Understand the effects of the 2014-16 El Niño on the shelf and slope variability

The "warm blob" and El Niño emerge in 2014:

Shown: (LEFT) satellite SST, (RIGHT) model SST

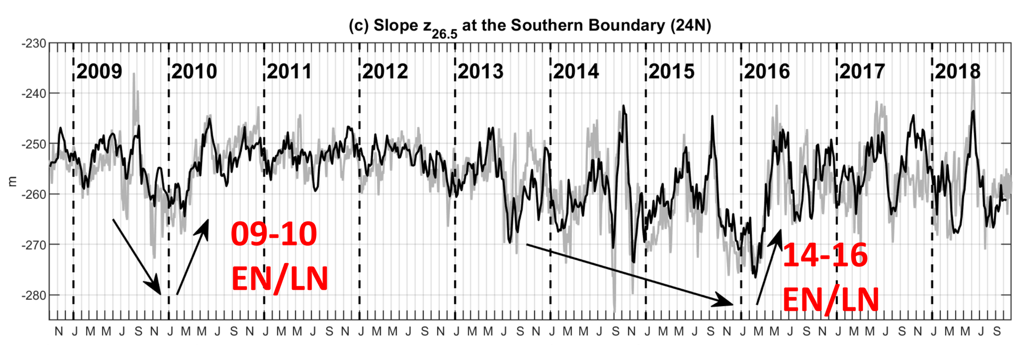
Winter 2013-14

Summer 2014



The El Niño oceanic signal propagates in the regional model through the southern boundary conditions:

The depth of σ_θ=26.5 kg/m^3 isopycnal surface ($z_{26.5}$) over the continental slope at the south boundary (24N)

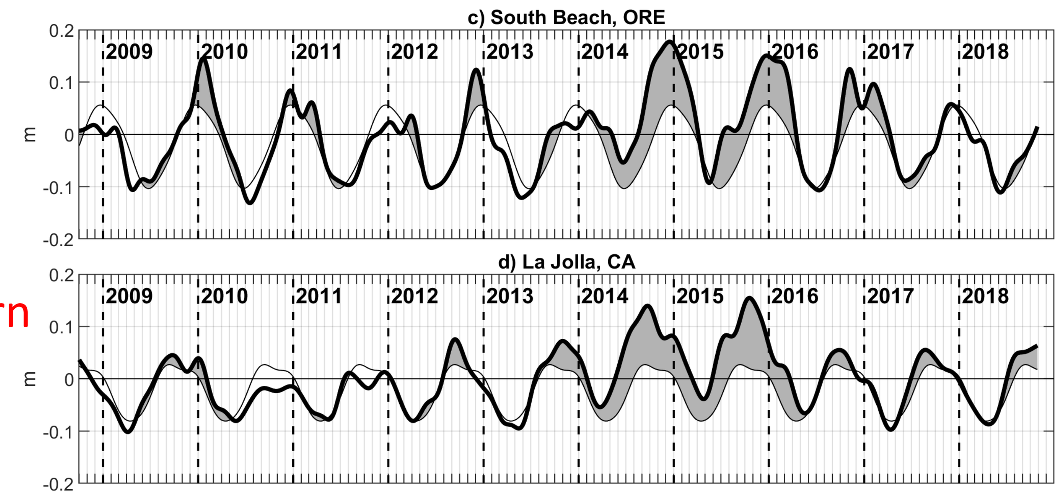


(Half-tone) boundary conditions, (Black) interior model solution

Model coastal sea level [**total**, seasonal cycle (thin line), anomaly], 90-day low-pass filter applied

Oregon

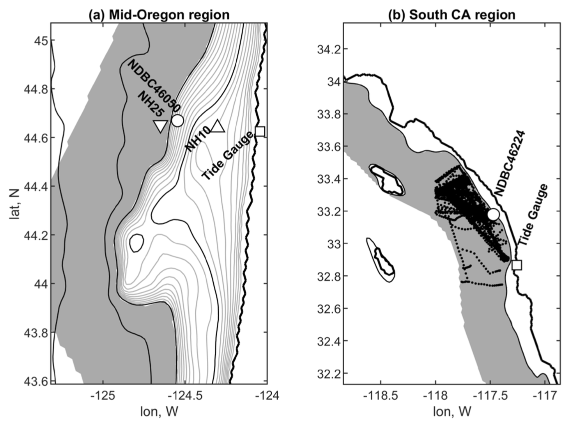
Southern CA



The EN anomalies are forced in part by the southern boundary conditions. Do they propagate to ORE w/ coastally trapped waves (CTW)?

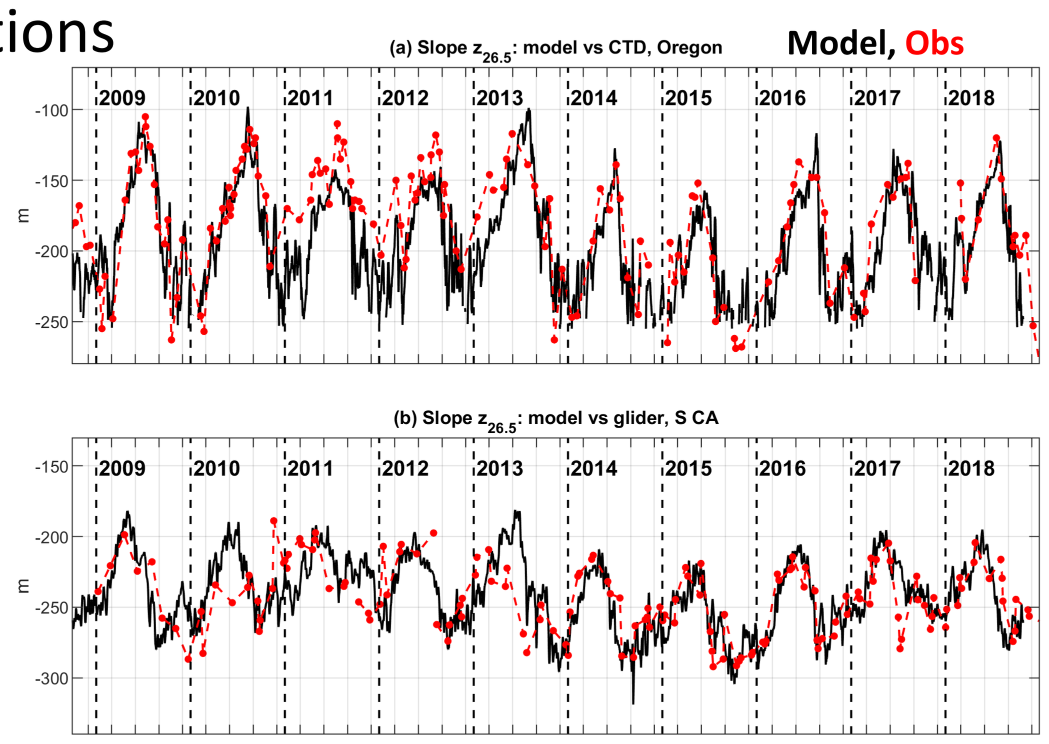
$z_{26.5}$ deepening is found in observations and model over the slope

Data locations:



Oregon (data: NH25 CTD, J. Fisher)

S CA (data: glider, D. Rudnick)

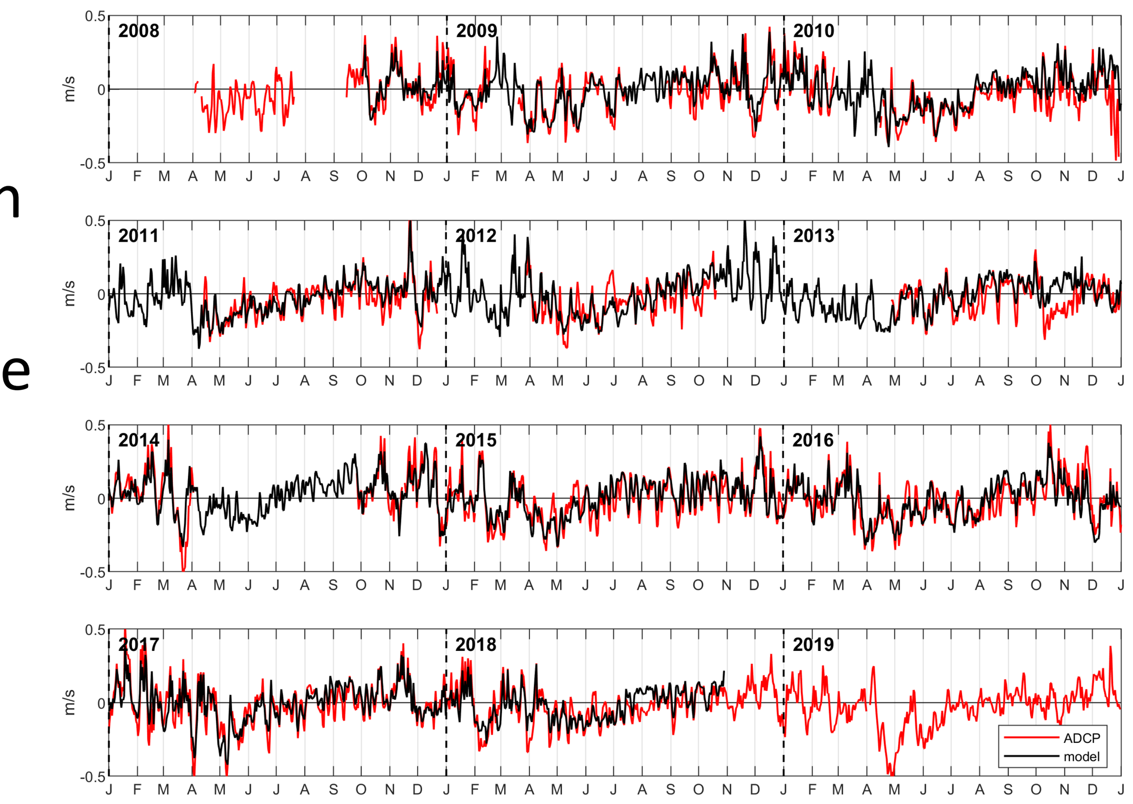


Skill assessment over the shelf:

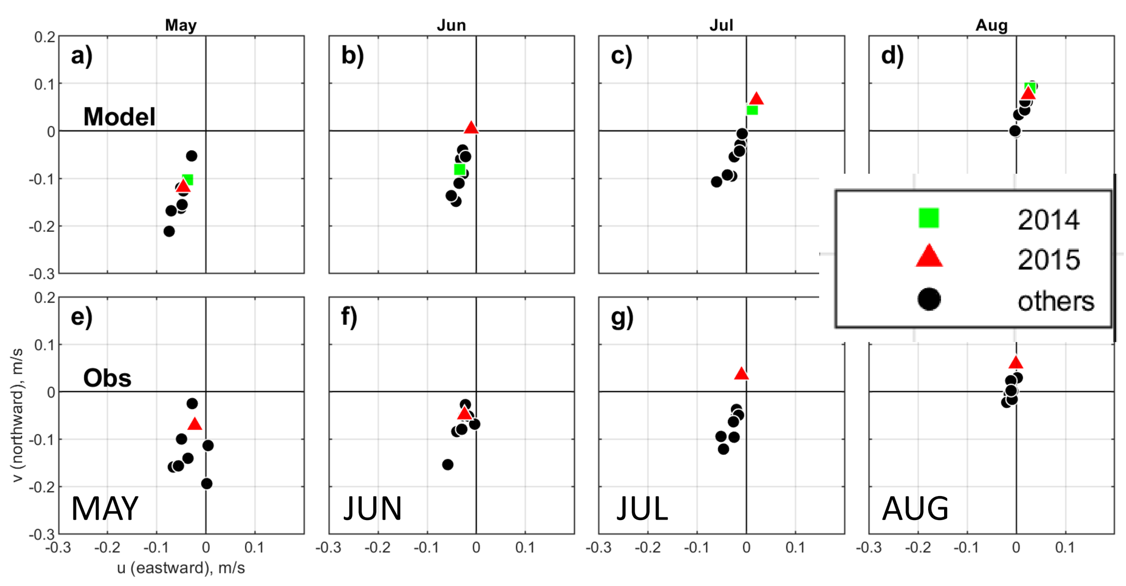
near-bottom meridional current, NH10 ADCP and model (water depth h=81 m)

The 10-year model time-series of the daily-averaged current between 60-70 m below surface is close to observations

Summer 2014: Data gap (OUCH)



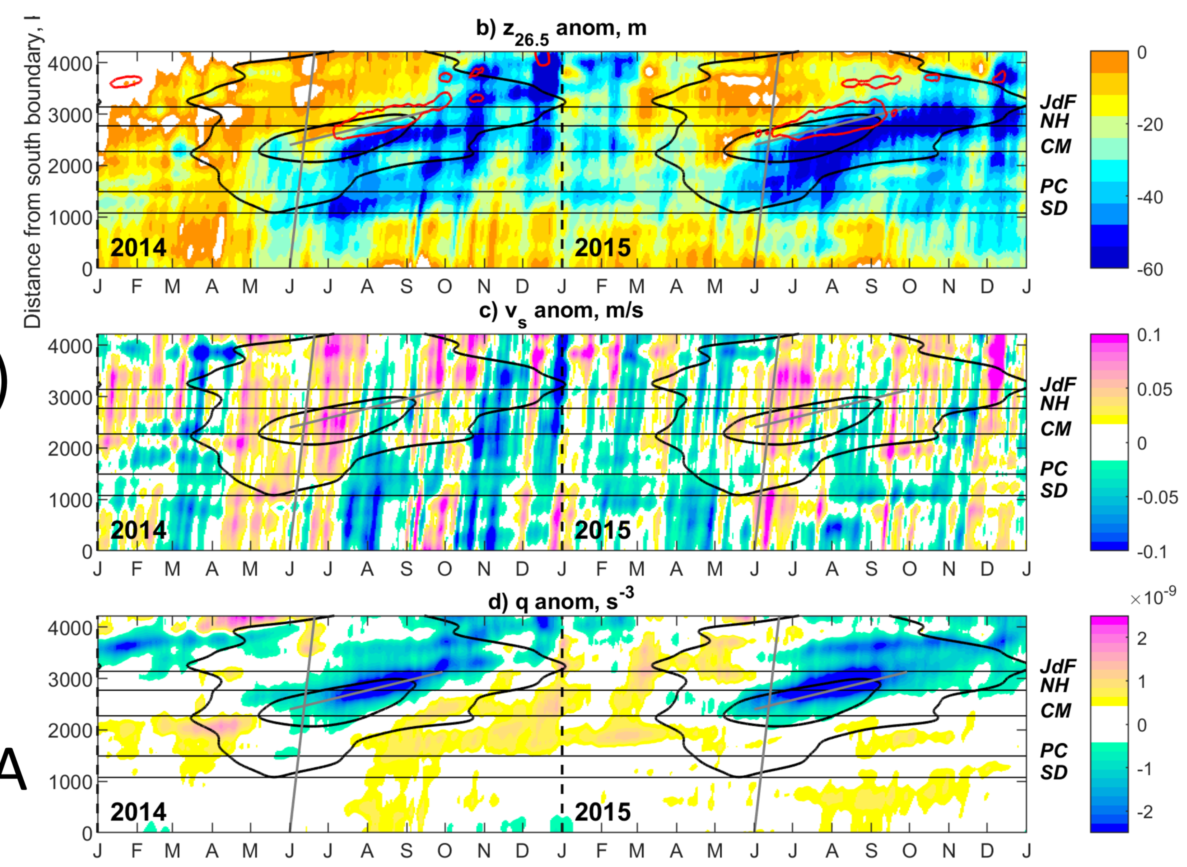
EN effect: early transition to weaker currents already from June to July in 2014 and 2015, despite the winds are not anomalously weak (shown: monthly ave u,v current for each year)



Alongslope vs. time anomalies

show CTW and connection to the southern boundary in $z_{26.5}$ and alongslope v_s (average: depths of 125-300 m, 0-40 km from h=200 m)

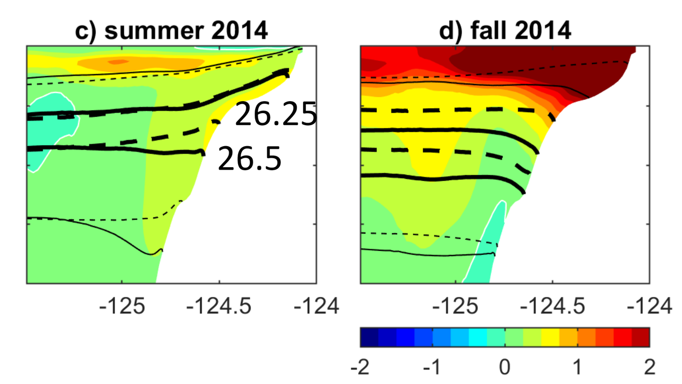
Anomalously strong positive v_s advects the seasonal **potential vorticity (*q*)** => negative *q* anomaly in summer 2014 and 2015 in OR-WA



$$q = f \frac{g}{\rho} \frac{\Delta\sigma_\theta}{\Delta z}$$

$$\Delta z = z_{26.25} - z_{26.5}$$

q↓ ≡ isopyc. surfaces spread over slope in summer 2014. *Shown: (contours) 3-mo ave and clim σ_θ (clim is dashed), (color) T anom.*



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