1. Introduction

The Surface Sea Temperature (SST) intraseasonal variability (40-90 days) along the coasts of Peru (Fig. 1) is commonly attributed to the efficient oceanic connection with the equatorial variability.

- In agreement with Detwiler et al. (2011), the subsurface SST variability off Peru (Fig. 1a) consists in a narrow coastal fringe of SST anomalies with amplitudes decreasing from the coast to the offshore region. It highlights two regimes of variability: the
  - A wind-forced sub-monthly regime (-40 days) that explains 50% of the variability
  - An intraseasonal regime (40-90 days)

Here, we focus on the intraseasonal regime (40-90 days) that it shows a significant peak at ~60 days with a marked seasonal dependence, prominent in Austral Summer.

2. Objectives

What are the forcing mechanisms of the intraseasonal SST variability off central Peru (8°S-16°S) during the 2000-2008 period?

- Locally forced
  - Wind stress, Heat Fluxes
  - Local wind stress forcing shows upwelling favorable pattern that is prominent in Austral Winter and barely significant at intraseasonal timescales.

- Remote forcing
  - Connection with the equator (Ekman drift)
  - Analysis of Intraseasonal Equatorial Kelvin Wave (IEKW) activity at 100°W shows that the remote equatorial forcing shares the temporal characteristics of the intraseasonal SST variability off Peru.

3. Methodology

Our approach is based on the experimentation with the regional ocean model ROMS.

Model Configuration:
- Domain: 40°S-15°N, 110°W-30°W
- Vertical resolution: 27 levels
- 32 (sigma) vertical levels
- Bathymetry GECO-UB

Model Forcing:
- Wind stress: QuickSCAT daily (CERSAT)
- Heat/Water Fluxes: bulk formula with daily ERA-I
- Boundary Condition: SIDAS (5 days)
- Spin-up: 3 years (2000)
- Simulation over 2000-2008 with daily outputs

Model Validation:
- Our confidence in the model result configurations is realized as evidenced by the detailed validation of the model control run experiment (ROMS)
- It indicates that it is skillful in simulating most aspects of the mean state and intraseasonal variability.

The model has a good mean SST, with averaged bias <0.5°C.

Comparison of the model experiments reveals that the intraseasonal SSTA variability off central Peru is accounted for by almost the sole equatorial forcing.

The ratio of variance between ROMS (ROMS) and ROMS estimated for the 40-90 days scale for central Peru coastal SSTA (averaged between 16°S-8°S within the 0.5° coastal fringe) is 95% (24%).

Conversely, the local forcing explains most of the intraseasonal SST variability along the coast of central Peru, since the spectrum for ROMS and ROMS is comparable (ratio=94%) for the 93% for the 93% of the intraseasonal SST variability off Peru (2000-2008) (Fig. 1a).

Since the seasonal dependence of the intraseasonal wind stress activity is different from one of the SST (Fig. 1a), the model results are counter-intuitive. This calls for investigating the mixed-layer processes associated with the local atmospheric forcing.

4. Local equatorial forcing quantification

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5. Local forcing and processes

To filter out the internal model variability and provide an overview of the time sequence of intraseasonal cold events:
- We used a composite analysis of stronger intra-seasonal events
- Of latitudinal averages (16°S-8°S)
- Results are displayed as a function of the distance to the coast (Fig. 1b)

- Black horizontal lines (---) = Mature phase of the event @lag=0day
- Green dashed lines (-----) = characteristic of the wind stress activity @lag=-8day
- White dashed line (*) = Max. of the upwelling favorable wind (>0.8 dyn.cm)

- Vector wind: arrows pointing towards coastal region are upwelling favorable winds.

6. Summary and conclusions

Despite evidences of clear propagations of coastal trapped waves of equatorial origin observed in the thermocline fluctuations until 30°S (Fig. 2), the compared marked seasonal cycle in the intraseasonal Kelvin wave and coastal SST variability (i.e. peak in Austral summer) off central Peru, the remote equatorial forcing only accounts for ~20% of the intraseasonal SST regime, which is instead mainly forced by the local winds and heat fluxes.

A heat budget analysis further reveals that during the Austral summer, despite the weak along-shore upwelling (downwelling) favourable wind stress anomalies, significant cool (warm) SST anomalies along the coast are to a large extent driven by Ekman-induced advection.

This is shown to be due to the shallow mixed layer that increases the efficiency by which wind stress anomalies relate to SST through advection.

Thus, the SST intraseasonal regime during the Austral summer is mostly wind-driven despite the very weak wind stress variability (~6 times weaker in Austral winter).

Diabatic processes also contribute to the SST intraseasonal regime, which tends to shorten the lag between peak SST and wind stress anomalies compared to what is predicted from a simple advective mixed-layer model.

7. References and Acknowledgements


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