1. Introduction
The Pt. Sal Inner Shelf Experiment (PSIEX) was a 43-day field experiment aimed at measuring the temporal and spatial variability near the Pt. Sal headland on the central California coast during the summer of 2015. The flow was wind-driven with periods of upwelling favorable winds and episodes of wind relaxations. During upwelling favorable conditions:

- Cold upwelled water was transported to the edge of the surf zone by a weakly stratified water column.

- The temperature gradient is set up by warmer temperatures north of Mussel Pt, a small coastal promontory and colder temperatures south of Pt. Sal.

- During wind relaxations:
  - Warm water was advected north to Pt. Sal.

This study expands upon the flow around large headlands and shows that small coastal irregularities like Mussel Pt. can modify the local upwelling response. This hypothesis is supported with results from numerical simulations where Mussel Pt. was removed from the system.

2. PSIEX and Model Set-up

**PISEX**
- Measured with 32 Tiggings and 6 ADCPs
- Cross-shore (X) array: 12 moorings from 5 to 50 m water depth
- Alongshore array: Y1, Y2, PS, and PSS array
- 4 km alongshore and 9 km cross-shore

**Model**
- ROMS module of COAMPS model system
- COAMPS atmospheric forcing
- Tidal forcing from ADCIRC tidal model

3. Results

- Principal axes of depth-mean subtidal flow are oriented along isobaths.
- Time-mean cross-shore gradient in lee of Mussel Pt.
- Time-mean north-south surface temperature gradient Equation 1, extending favorable winds day: year 173.5 – 175.5
- Wind relaxation: year 175.5 – 178.5

- During upwelling period, the mean isotherm slopes from deep h = 15 m to shallow h = 5 m water and from offshore to coast.

- During wind relaxation, the mean isotherm shoaled to h = 5 m.

- The experimental mean cross-shore isostasy followed the change of the isobaths, surface temperature of the combined PSI and Y1 array from the time-mean surface temperature at each mooring.

Cross-shore Temperature Response

- The temperature anomaly is calculated by subtracting the 1σ cross-shore and spatial mean alongshore, surface temperature of the combined PSI and Y1 array from the time-mean surface temperature at each mooring.

**Alongshore Temperature Response**

\[ \text{Alongshore temperature anomaly} = \text{Alongshore (Observed)} - \text{Alongshore (Modelled)} \]

4. Analysis

**Hypothesis**
- Cross-shore transport of water transported on-shore.
- Cross-shore component of the wind decreases upwelling north of Pt. Sal.

**Ekman Surface Boundary Layer**

- The primary momentum balance in both the alongshore and cross-shore direction.
- Coriolis (COR) & vertical mixing (VM) alongshore wind (y-direction):
  - The cross-shore velocity is directed offshore.
  - The alongshore velocity is 6-10 in the top layer balanced by a return flow below.
- Alongshore wind (x-direction):
  - Net offshore transport with a small onshore alongshore flow in the top layer.
  - Strong alongshore velocity in y-direction with only a weak return flow below.

**Model Dynamics**

- Model without Mussel Pt.
- Model with Mussel Pt.

5. Conclusion

Temperature and current observations were used to test the flow structure around the Pt. Sal headland and a smaller promontory, Mussel Pt. The water column was continuously stratified, and upwelling occurred over the inner shelf to the edge of the surf zone. The wind-driven flow westward past Mussel Pt. and Pt. Sal creates a 15 km alongshore gradient over 3 km. During upwelling favorable winds, temperatures are colder north of Mussel Pt. and colder south of Pt. Sal, and intermediate along the bath near the two regions. Additionally, there are anomalously cold temperatures in the lee of Mussel Pt. at these times. The measurements show that small-scale (i.e., O(1 meter)) promontories modify local upwelling.

A modeling study was used to remove Mussel Pt. from the Pt. Sal system. The modeled kinematics and dynamics show the cross-shore component of the wind is generally decreasing the upwelling north of Pt. Sal. The orientation of the isobaths south of Mussel Pt. leads to a stronger alongshore component of the wind and stronger upwelling. This supports the hypothesis that small-scale coastal irregularities impact local upwelling.

**Model Kinematics**

- Temperature
- Cross-shore component
- Cross-shore current

**Model Parameters**

- Mussel Pt.
- W Mussel Pt.
- Without Mussel Pt.

**Model Metrics**

- Temperature
- Cross-shore component
- Cross-shore current

- Mussel Pt.
- W Mussel Pt.

**Model Assumptions**

- Kelvin Haas: Kevin Haas
- Thomas Freimuth:

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