Using Cross-Networked Coastal Ocean Observations to Characterize a Marine Heat Wave

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5 Aug Satellite SST anomalies

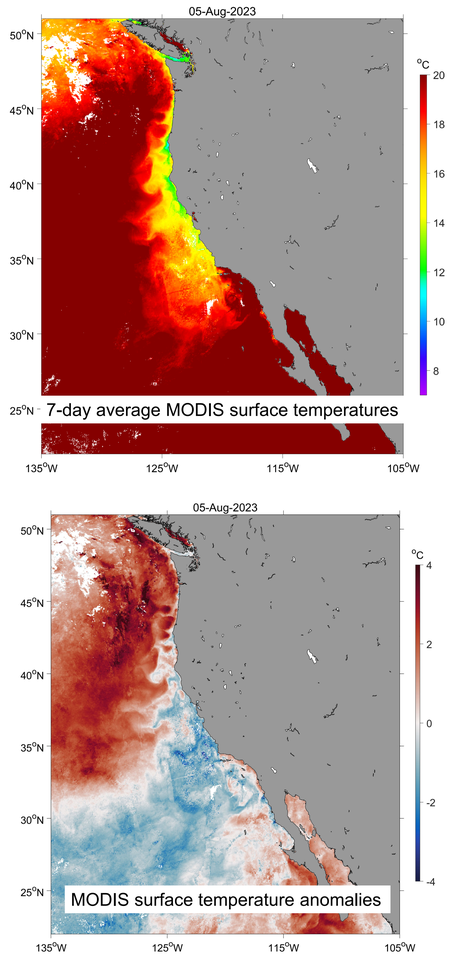

Fig 1 Strong SST anomalies in the NE Pacific meet marine heatwave (MHW) threshold (see time series)

Background

In early August 2023, anomalously warm surface water was observed in the northeast Pacific. This was well prior to the El Niño arrival in December.

We examine temperatures during that time using satellite imagery, in situ time series, and glider transects from several regional observing networks.

- How deep is the anomaly?
- How does it stack up against existing climatologies and models?
- What are the next steps?

In Situ Observations

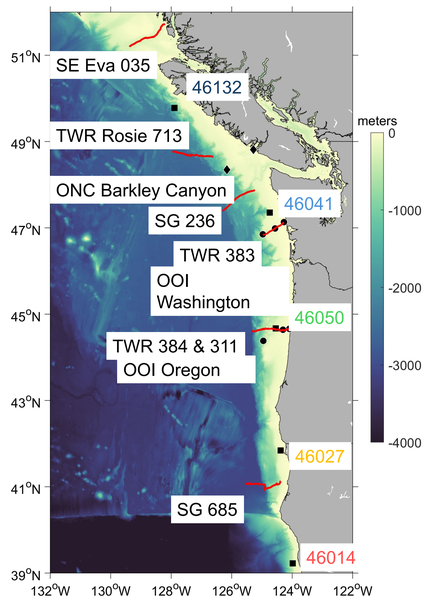

Fig 2. Regional data include glider transects (—); a Sea Explorer (DFO Eva 035), TWR Slocums (DFO Rosie 713 and OOI gliders), and Seagliders (UW/NANOOS SG 236 and OSU/NANOOS SG 685). Time series include NSF OOI (●) temperatures and NDBC (■) winds.

N-S Glider Transects

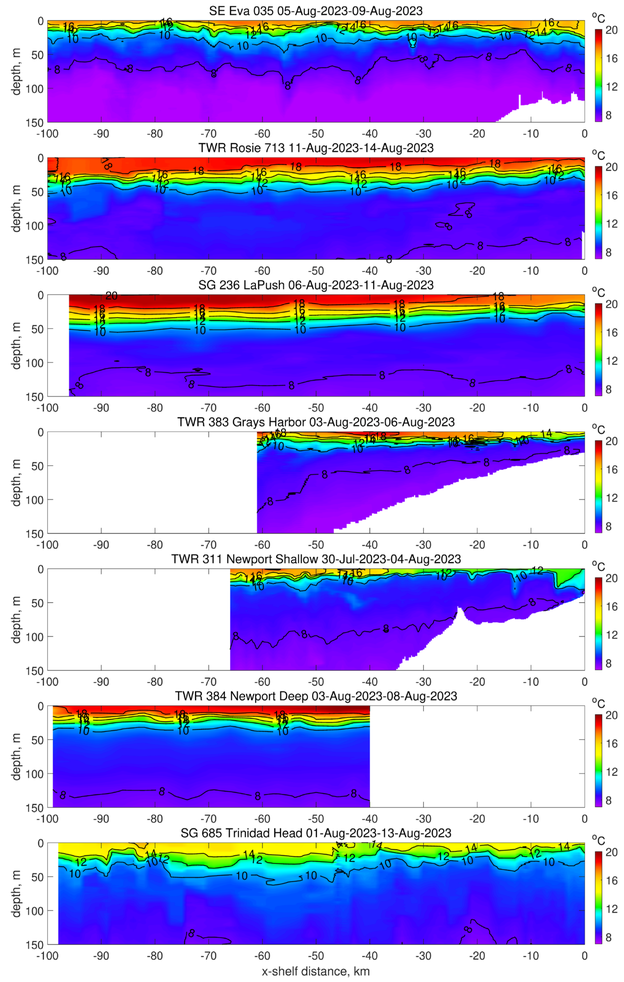

Fig 3. The temperature scale is the same as used on the upper panel of Fig 1. The Oregon Shallow and Deep transects are combined on Fig. 2 but separated here to indicate the impact of temporal variability.

Comparison to CTD Climatology

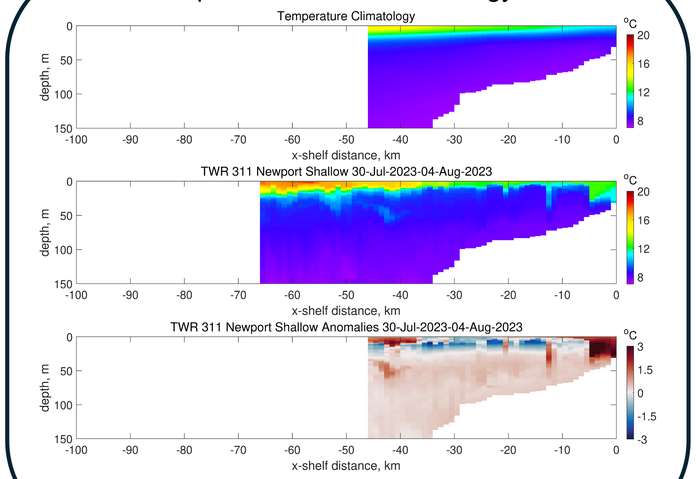

Fig 4. Comparison to 1997-2021 CTD climatology (Risien *et al.* 2022)

Comparison to Model Output

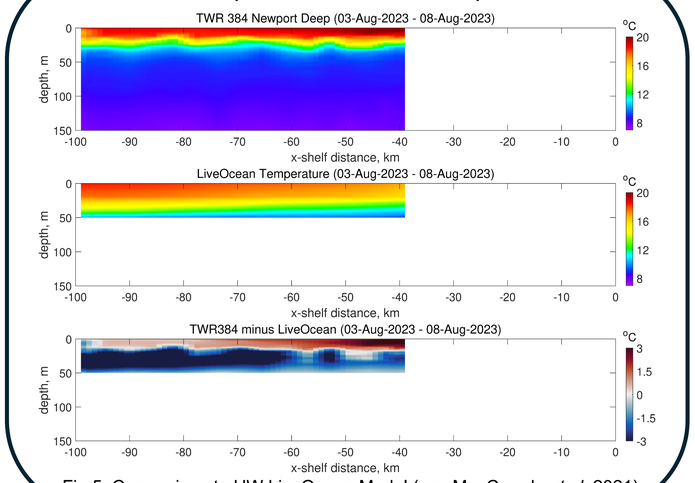

Fig 5. Comparison to UW LiveOcean Model (see MacCready *et al.* 2021)

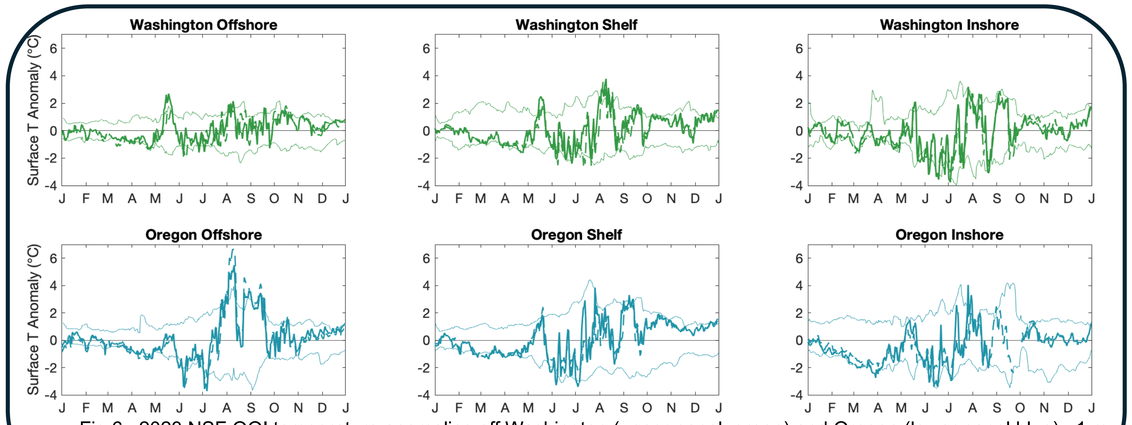

Fig 6. 2023 NSF OOI temperature anomalies off Washington (upper panel, green) and Oregon (lower panel blue). 1 m temperatures are solid lines, 7 m temperatures are dashed lines. Thin lines indicate the envelope of 90th percentile levels (MHW threshold) for 1 m temperature anomalies during 2015-2023.

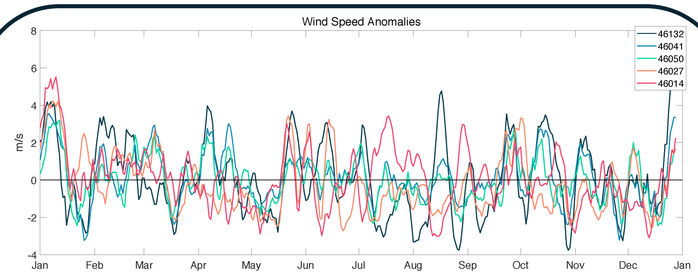

Fig 7. Scalar wind speed anomalies from Northern California (NDBC 46014) to Vancouver Island (Environment Canada South Brooks, here identified using NDBC 46132). In July 2023, there was an extended period of low wind speed anomalies off Vancouver Island and high wind speed anomalies off northern California (NDBC 46014) with somewhat lower than average anomalies in between. Low winds in the north may have contributed to the near surface warming observed in early August. In mid August, stronger winds in the northern part of the study area coincided with a decrease in surface temperatures there.

Discussion

- Satellite, glider and time series data were readily available in near real time (data were accessed in Sep 2023).
- A near surface warm anomaly developed in August. It was associated with weaker than average winds in June-July.
- Glider profile transects suggest the strongest and deepest anomalies in August 2023 occurred off Vancouver Island and the Olympic peninsula.
- Off Oregon, comparison to a CTD-based climatology shows the anomaly is shallow and not well developed over the shelf except inshore of the 50 m isobath.
- Further offshore, comparison to the UW LiveOcean model shows the anomaly in both the data and model. The model, which does not assimilate data, mixes heat deeper than the glider transect.
- Development of glider-based climatologies and assimilation into operational models would enhance our ability to characterize MHW's as they occur.