1. Introduction

- Most NE Pacific marine heat wave (MHW) studies focus on surface expression, but this dataset allows a subsurface characterization of temperature anomalies from 2014-present with focus on MHW events of 2014-16 and 2019-20
- Long time series allow us to address gaps in knowledge regarding the subsurface response on the shelf to recent temperature anomalies and create a climatology that approaches the standard of 30 years
- Six programs contributed to T, S and velocity data at NH
- Approaches the standard of 30 years

2. Data: Temperature Climatologies and Anomalies

- OISST near NH agrees well with the NH-10 surface data and has a correlation of 0.74 for 2014-16 and 0.94 for 2019-21, both significant at 95%, so we use it to fill gaps in the NH-10 surface temperature time series
- Sustained anomalous warming at all locations during 1st MHW, which first appears in the westernmost OISST region at the end of 2015
- Weaker and shorter warming during the 2nd MHW but anomalous warm temperatures at near surface locations in the summer of 2019 and further offshore in 2020

3. Results: Marine heat wave events are increasing over time on central Oregon shelf

- Cumulative Intensity (°C-days) = 
- Hobday et al. 2016 MHW criteria applied to NH-10 time series at surface, near surface, and bottom
- MHW occurs if T anomalies greater than 90°C percentile of climatology persist for 5 days
- Shift occurred with the 2014-2016 MHWs and the mean cumulative intensity before and after 2014 shows an increase at all depths (also in gradient)
- From 1999-2021, frequency and duration have increased at all depths with steps significantly different from 1999, while cumulative intensity has increased at all depths but with an insignificant slope at the near surface, and maximum temperature has only increased at the bottom

4. Results: Seasonal Timing and vertical structure of warming differs in two MHWs

- Stronger MHWs occur when the maximum temperature exceeds multiples of the 90°C percentile difference from the mean (Category 1 or Moderate > 3X, Category II or Strong > 2X, Category III or Severe > 3.5X, and Category IV or Extreme > 4X, depicted by gray lines)
- Anomalous warming events at NH-10 that qualify as MHWs typically fall within the moderate or strong categories at all depths. During September 2014 – May 2015, the 1st MHW intermittently reaches the moderate category at the surface and bottom and the extreme category at the near surface

5. Results: Upwelling winds interrupt MHWs and warming shortens upwelling season

- Weaker upwelling favorable winds in 2021, yet more cold water at surface after July than in 2015 due to MHW

6. Results: Variation in spring transition date relates to timing and severity of MHW

- Spring transition 21 days after the mean, just outside ±2SD days
- Delayed warming continues in the spring of 2014 after the spring transition, but in May cooling is observed
- Spring transition case close to climatological mean of April 15th
- Winter and early spring warming is interrupted by spring transition
- Cumulative upwelling increases in time would decrease from the 1st MHW to the 2nd MHW
- In 2020, no MHWs at the NH-10 surface and temperature resembles a warmer version of the non-MHW year 2000 with alternating warm and cold anomalies lasting 7-10 days