Marine heat waves in the Chile-Peru Eastern Boundary Upwelling System: rates of change in sea-surface temperature anomalies near a major upwelling center

Kylene Cooley, College of Earth, Ocean, and Atmospheric Sciences, Oregon State University
Melanie R. Fewings, College of Earth, Ocean, and Atmospheric Sciences, Oregon State University
James Lerczak, College of Earth, Ocean, and Atmospheric Sciences, Oregon State University

During 2014-2016 and 2019-2020, marine heat waves dramatically affected the biota and dependent fisheries in the northeast Pacific Ocean, but the effects of marine heat waves are not isolated to the North Pacific. In the Chile-Peru eastern boundary upwelling system (EBUS), scientists do not yet understand which forcing mechanisms dominate the surface ocean heat budget during marine heat waves. Although primary contributing processes and extent of warming may vary, worldwide EBUS are sensitive to prolonged periods of extreme warming, which may affect their ability to serve as important biological and economic centers. In the California Current System (CCS), there are apparent dipole patterns in SST anomalies and in surface wind stress measurements during wind relaxations. Flynn et al. (2017) determined that during wind relaxation events in the poleward (northern) half of the CCS, the net surface heat flux, especially latent heat flux, was the dominant contributor to the high sea-surface temperature (SST) anomalies. In the equatorward (southern) half of the CCS, SST anomalies during wind relaxation events were preconditioned to be colder than average, but still showed heating during the relaxation via advection of SST gradients from farther south, decreased entrainment and Ekman pumping at the base of the mixed layer, and some combination of cloudiness and SST feedback. We analyzed SST anomalies surrounding the Punta Lavapié upwelling center for time periods of extreme ocean warming during 1979-2020. These were defined as times where the SST anomaly relative to an annual climatology exceeded two standard deviations, and included analysis of annual distributions by season and month. We used the fifth generation European Centre for Medium-Range Weather Forecasts reanalysis (ERA5) hourly SST and filtered the signal to obtain a record of anomalies that occur on time scales of a week to 30 days. This analysis is leading into approaching the sea surface mixed layer heat budget from the perspective of rate of change of SST anomalies preceding the warmest periods. We will combine this with satellite ocean vector wind data and ERA5 and satellite-derived air-sea heat fluxes to determine the most important forcing mechanisms during these times. Through this method we will identify how marine heat waves in the Chile-Peru System compare to those observed and better understood in the CCS.