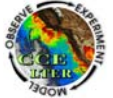




# How anomalous was spring 2005? The California Current System in context



Mark D. Ohman<sup>1</sup>, Bertha E. Lavaniegos<sup>1,2</sup>, Mati Kahru<sup>1</sup>

<sup>1</sup> Scripps Institution of Oceanography, University of California, San Diego  
<sup>2</sup> Centro de Investigación Científica y Educación Superior de Ensenada, Mexico

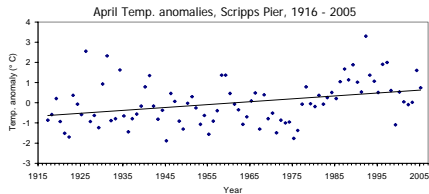
## Introduction

Considerable attention has been focused on the oceanographic conditions and plankton availability prevailing in different parts of the California Current in spring 2005, catalyzed in part by the observation of breeding failure of Cassin's Auklet, *Ptychoramphus aleuticus*, a planktivorous seabird, off the Farallon Islands (W. Sydeman et al. pers. comm.). Our NE Pacific GLOBEC retrospective analysis provides context for interpreting the conditions in early 2005 in light of the ecosystem variations experienced in the past half century, drawing on the extensive CalCOFI time series that was initiated in 1949. Our GLOBEC analysis is supplemented by recent developments in the new CCE (California Current Ecosystem) LTER site. We sought to address the questions:

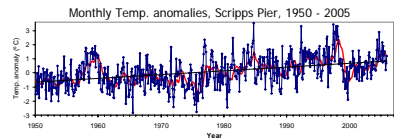
- Are ocean conditions in spring-summer 2005 unprecedented?
- Are observed anomalies geographically restricted or part of a larger system-wide response?
- At what levels of the pelagic ecosystem were responses detected?
- Are such changes part of a longer-term climate pattern or a manifestation of interannual variability?

We provide some partial answers to these questions in this poster presentation.

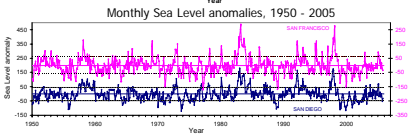
## Temperature and Sea Level



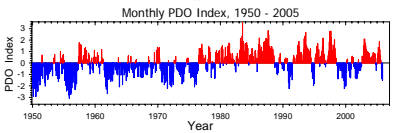
Springtime (April) temperature anomalies measured at the SIO Pier since 1916 show a secular increase. The monthly averaged anomalies measured in April, 2005, were well above the long-term mean, but lower than those in April 2004 and several other non-El Niño years.



Continuous temperature records (anomalies from monthly averages) shown here from the SIO Pier since 1950 illustrate that long-term warming has occurred at all times of year. It continued after the rapid, deep cooling following the 1997-98 El Niño.



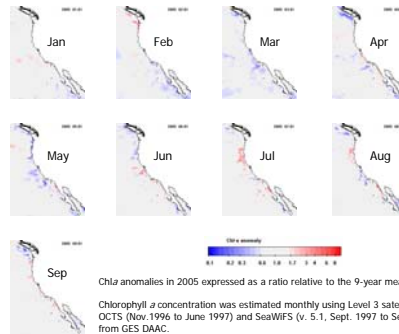
Detrended sea level anomalies can be used to approximate El Niño effects in mid-latitudes. This index shows no clear evidence for Niño conditions off either San Francisco or San Diego in spring 2005 (approximated as sustained values > 1 s.d. above the detrended mean).



The index of the Pacific Decadal Oscillation devised by Mantua et al. (1997) indicates a warm phase across much of the NE Pacific in early 2005, but not of exceptional magnitude or duration. In fall, 2005, the index turned negative.

## Satellite-derived Chlorophyll a

Beginning in March, negative anomalies of Chl a appeared off coastal central and southern California. In April, these became weak positive anomalies. By May relatively strong negative anomalies were detected in many regions between Washington and southern CA. In June these negative anomalies persisted only in the northern region, while turning positive in the southern region. From July onward the pattern was of generally positive Chl a anomalies.



Chl a anomalies in 2005 expressed as a ratio relative to the 9-year mean for each month.

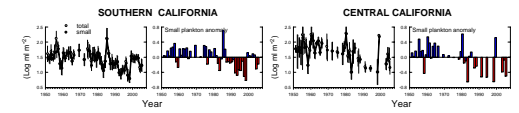
Chlorophyll a concentration was estimated monthly using Level 3 satellite data from OCTS (Nov. 1996 to June 1997) and SeaWiFS (v. 5.1, Sept. 1997 to Sept. 2005) obtained from GES DAAC.

## Preliminary Conclusions

- Temperature, sea level, and zooplankton conditions in the California Current in spring 2005 were unusual, but not unprecedented, at least for the regions that have been sampled for sufficiently long to provide a multi-decadal context.
- Monthly averaged Chl a from satellites suggest a geographically widespread coastal region of low values of phytoplankton pigments in May, 2005, but in June this region was restricted to more northern waters. Chl a values increased in many parts of the CCS in July.
- Total zooplankton biomass was relatively low in Southern CA and especially in Central CA in spring, 2005, although only selected species (e.g., the euphausiid *T. spinifera* in Central CA) were negatively affected.
- It is not clear whether these conditions reflect an interannual perturbation or the influence of other time scales of forcing.
- Monthly and regionally averaged data may be too coarse to resolve some event-scale ocean phenomena.

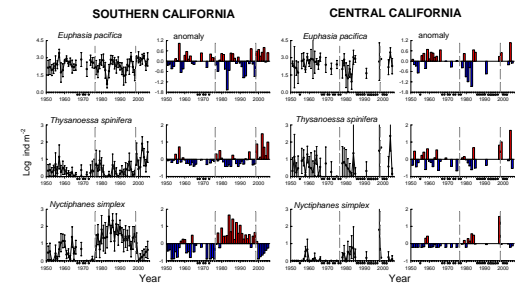
## Zooplankton

### Total macrozooplankton biomass



The total biomass of macrozooplankton (as displacement volume, springtime CalCOFI cruises) was anomalously low in spring 2005 in both Southern CA (S. California Bight and region offshore) and Central California (off Monterey Bay). Comparably low values have occurred in many previous springs off Southern CA, but only during El Niño's off Central CA.

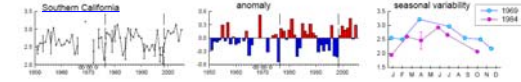
### Individual euphausiid species



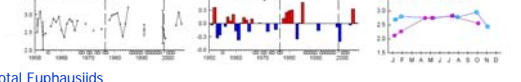
In spring, 2005, the Transition Zone/Subarctic euphausiid *E. pacifica* and the shelf break-associated *T. spinifera* were at or above the long term mean (in Southern CA) or somewhat below the mean (in Central CA). The subtropical species *N. simplex* was similar in abundance to the immediately preceding years, showing no sharp increase in either region in 2005.

### Aggregated Zooplankton Taxa

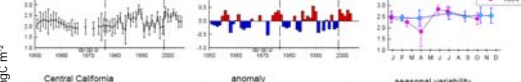
#### Total Copepods



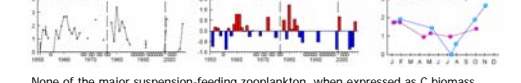
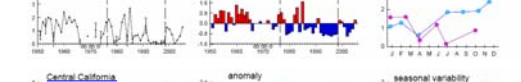
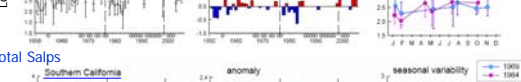
#### Total Euphausiids



#### Total Salps



#### Total Salps



None of the major suspension-feeding zooplankton, when expressed as C biomass aggregated by taxon, showed marked declines in springtime biomass in spring 2005, in either Southern CA or Central CA. The righthand panels illustrate seasonal variations in biomass in two years (1969 and 1984), in order to address the possible seasonal bias in measuring zooplankton variations only in the springtime.

<http://ccelter.sio.ucsd.edu/>

