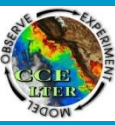




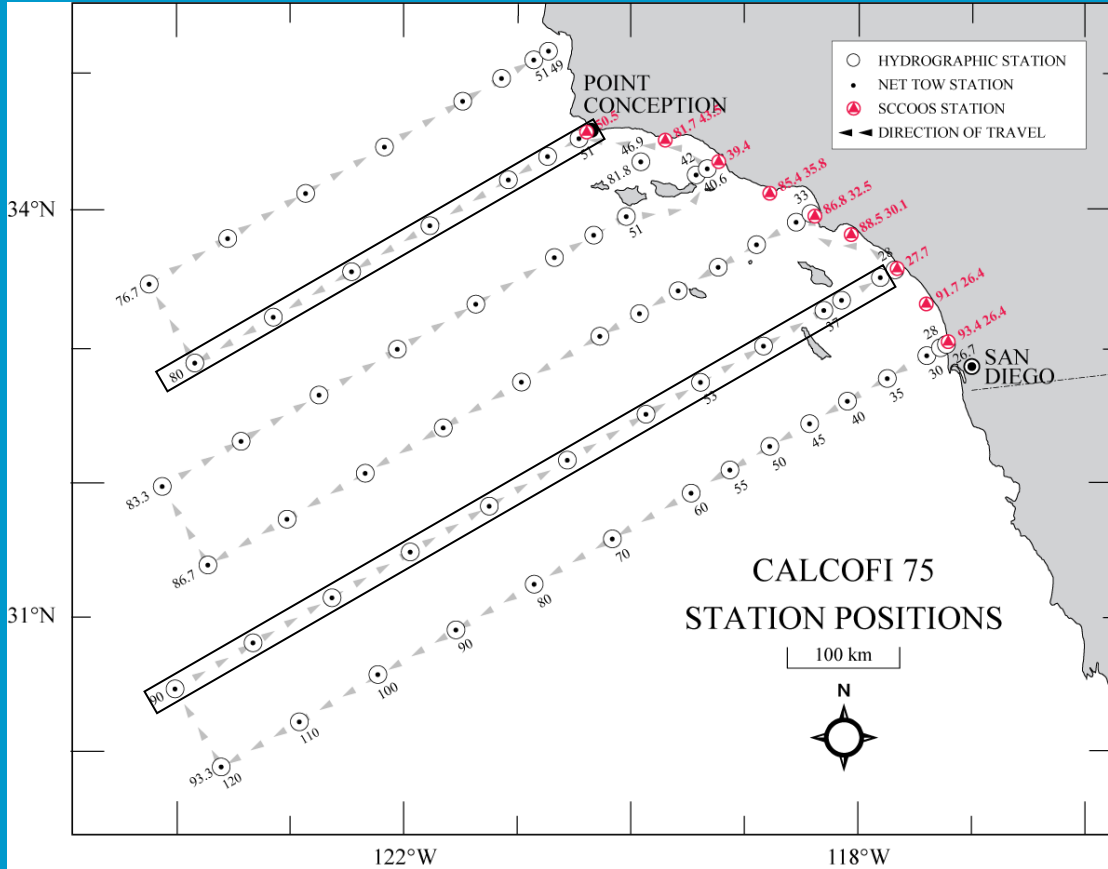
# CalCOFI – The 2014/15 Warm Anomaly



## The 2014/15 Warm Anomaly in the Southern California Current

Ralf Goericke & CalCOFI Tech. Group

Scripps Inst. of Oceanography  
La Jolla, May 2015



New Horizon, LOA 52 m

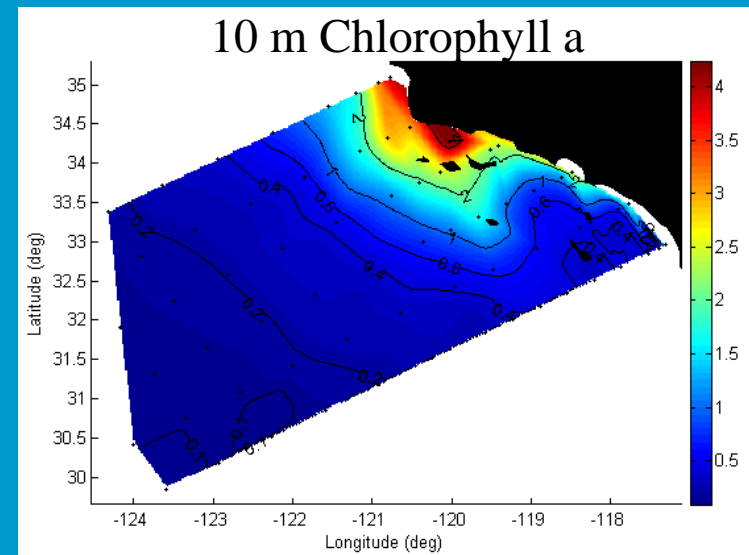
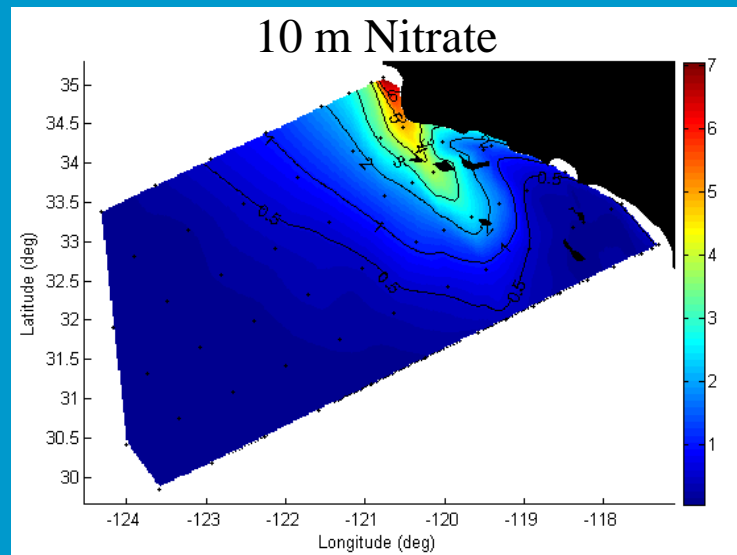
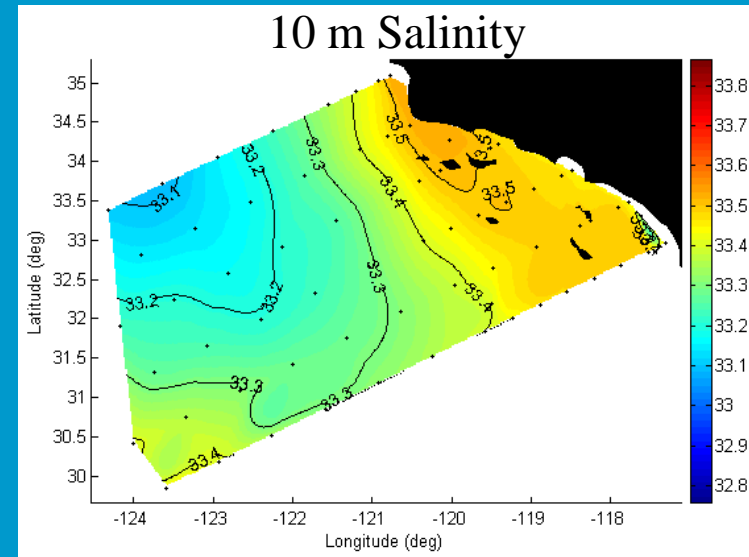
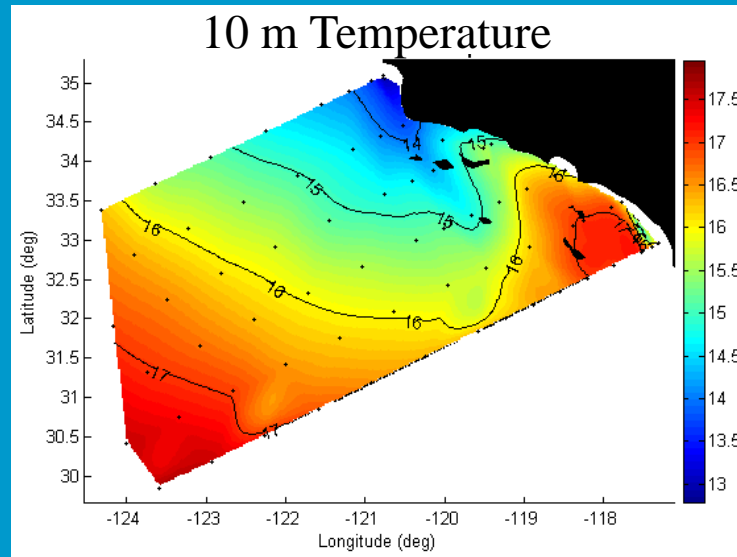


David Star Jordan, LOA 52 m

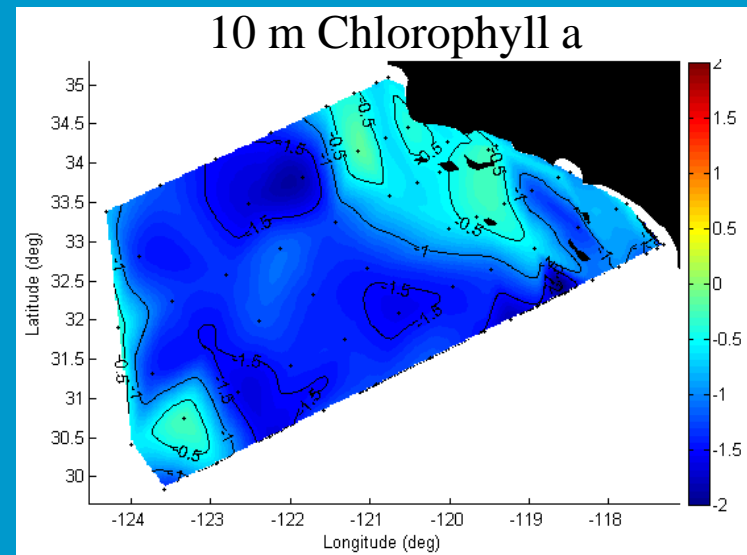
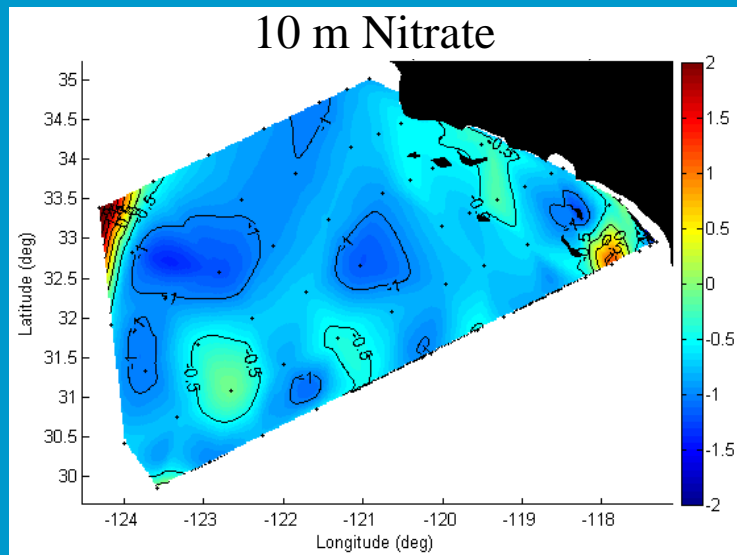
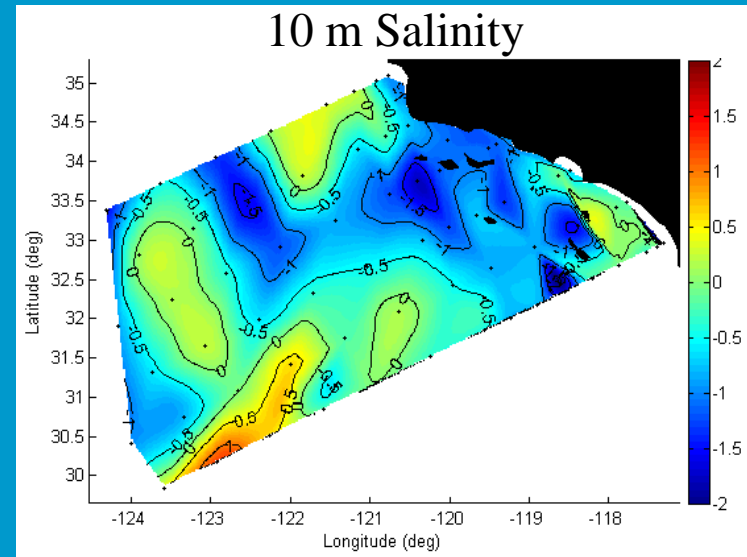
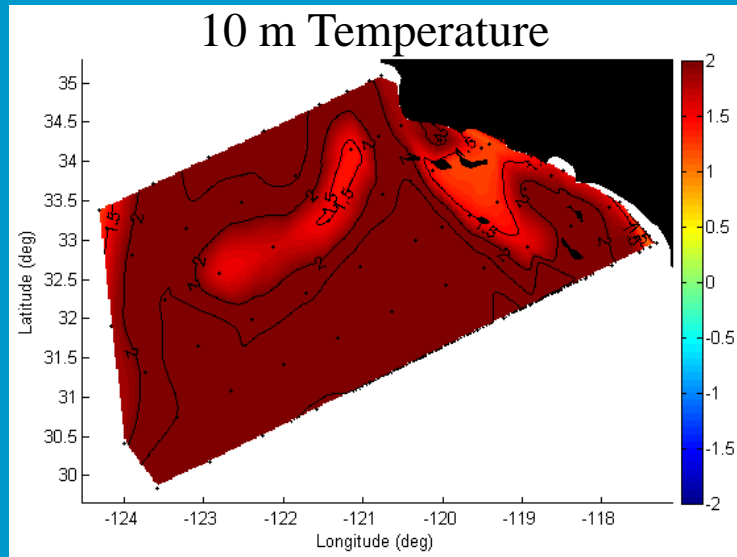
Cruises: four times a year covering the above 75 station pattern during summer & fall or a 113 station pattern during winter and spring.

Offshore Stations since 1984: 66 Stations, ~ 2 to 400 km from shore, depth 50 to 4000m  
 Nearshore Stations since 2004: 9 Stations, ~ 2 to 10 km from shore, depth ~20 m

# Average Hydrography



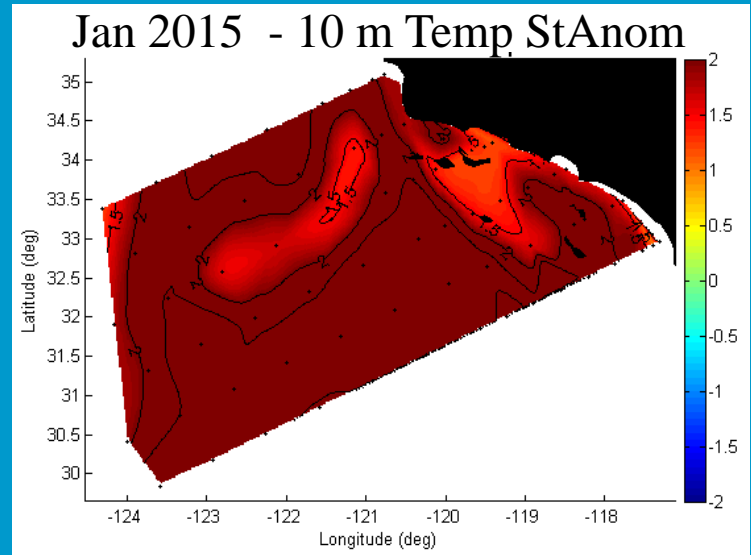
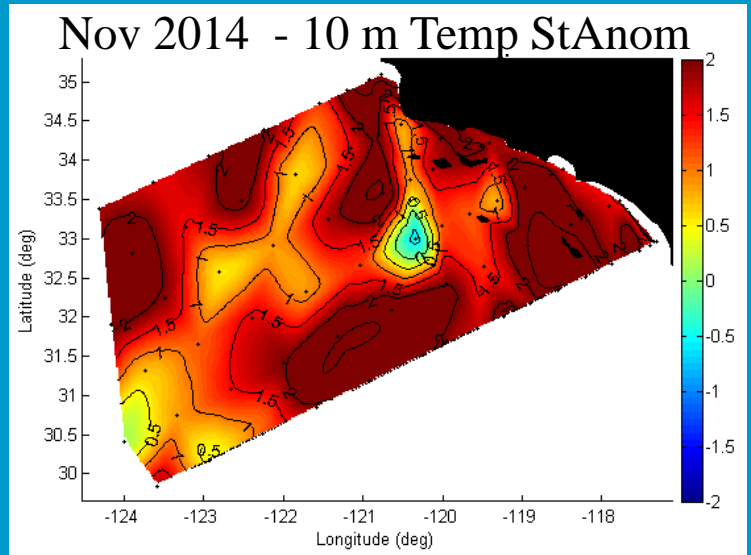
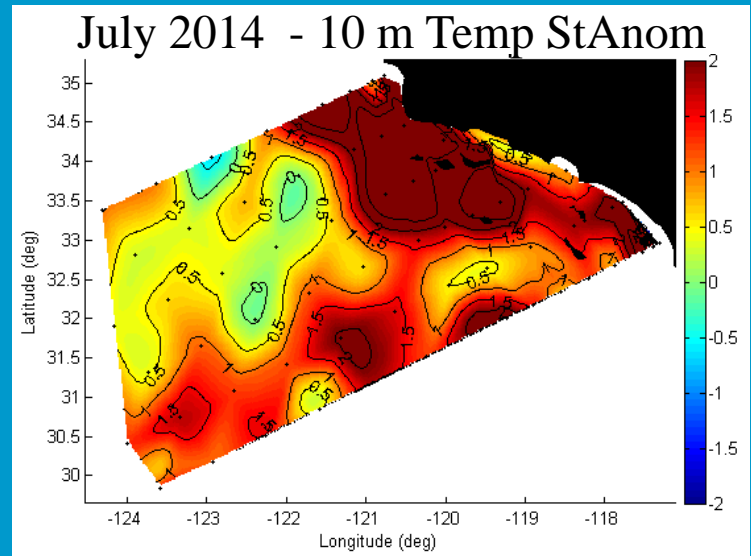
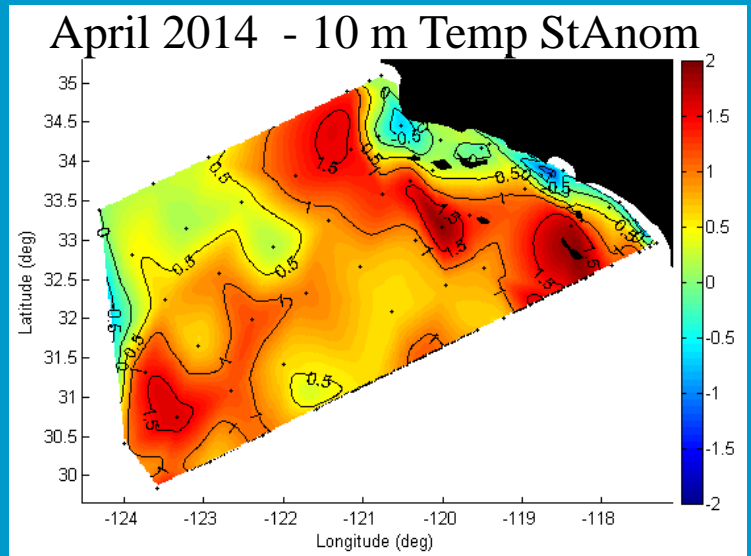
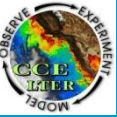
1984 to 2014 Distributions of 10 m Temperature, Salinity, Nitrate and Chl *a*.



January 2015, 10 m Depth Anomalies: Temperature, Salinity, Nitrate and Chl a.



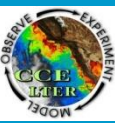
# 2014/15 Temp Anomalies at 10 m



The 2015 Warm Anomaly has intensified

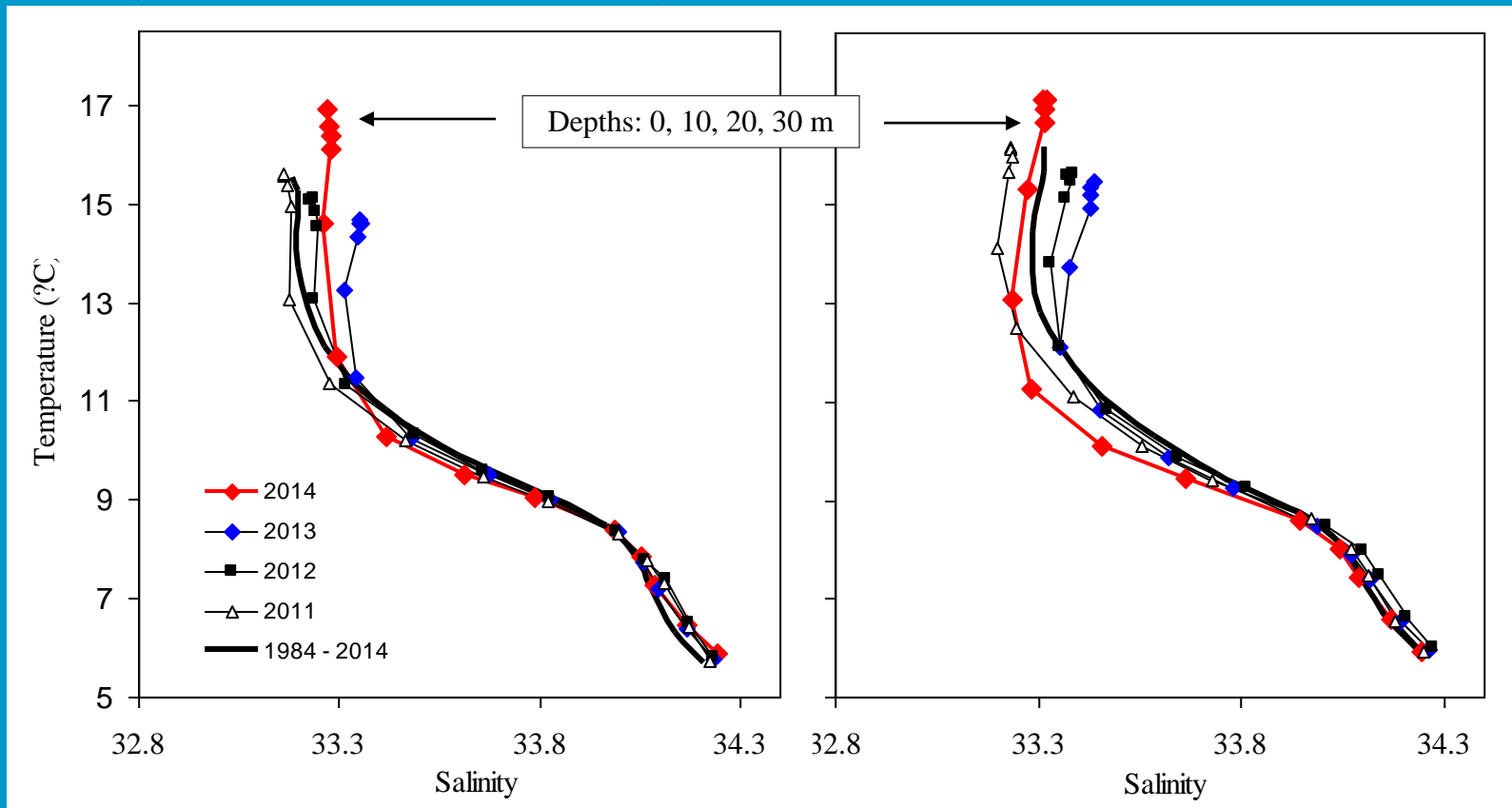


# TS Diagrams – Annual Averages



California Current North  
(Lines 77 - 83 Stations 70 - 90 )

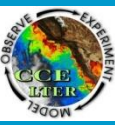
California Current South  
(Lines 87 - 93 Stations 60 - 90 )



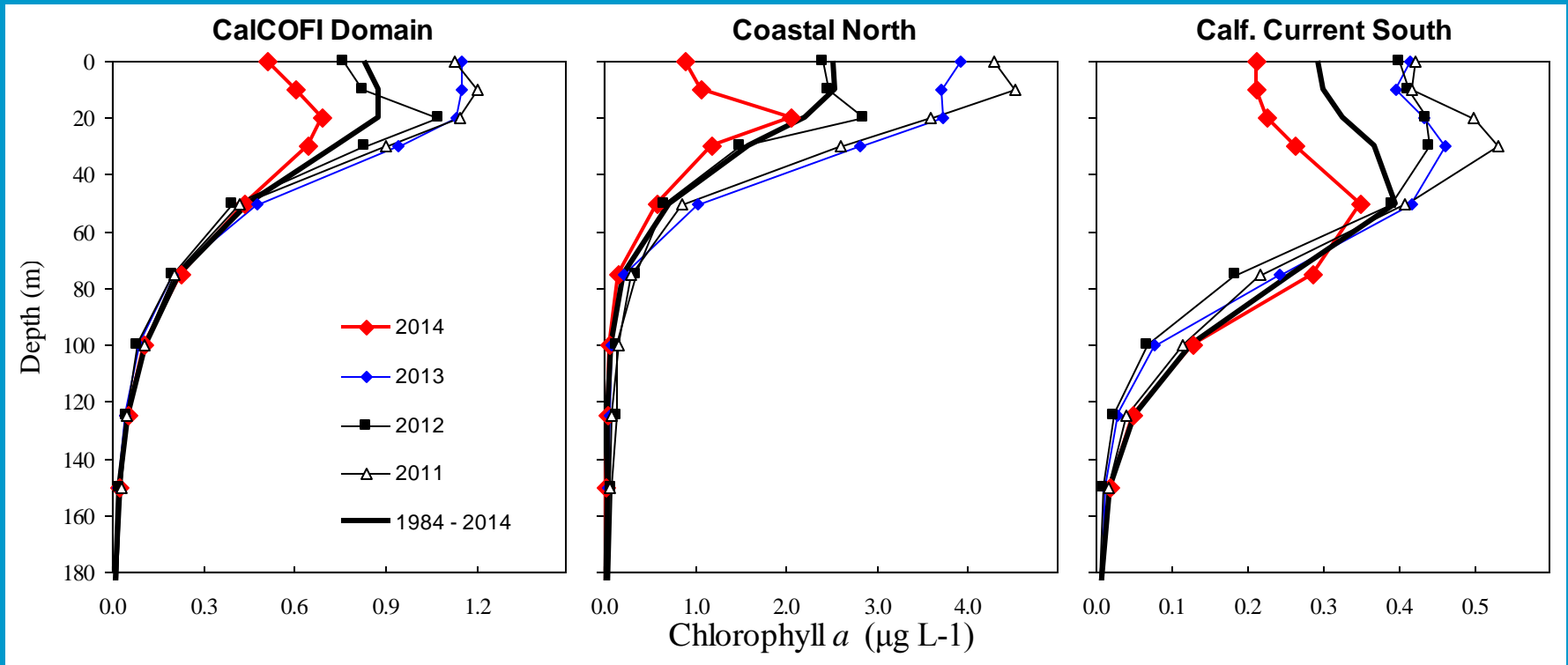
TS Changes: In the north only a strong warming of the surface layer; in the south the same plus a decrease in spiciness at depth.



# Chlorophyll – Annual Averages



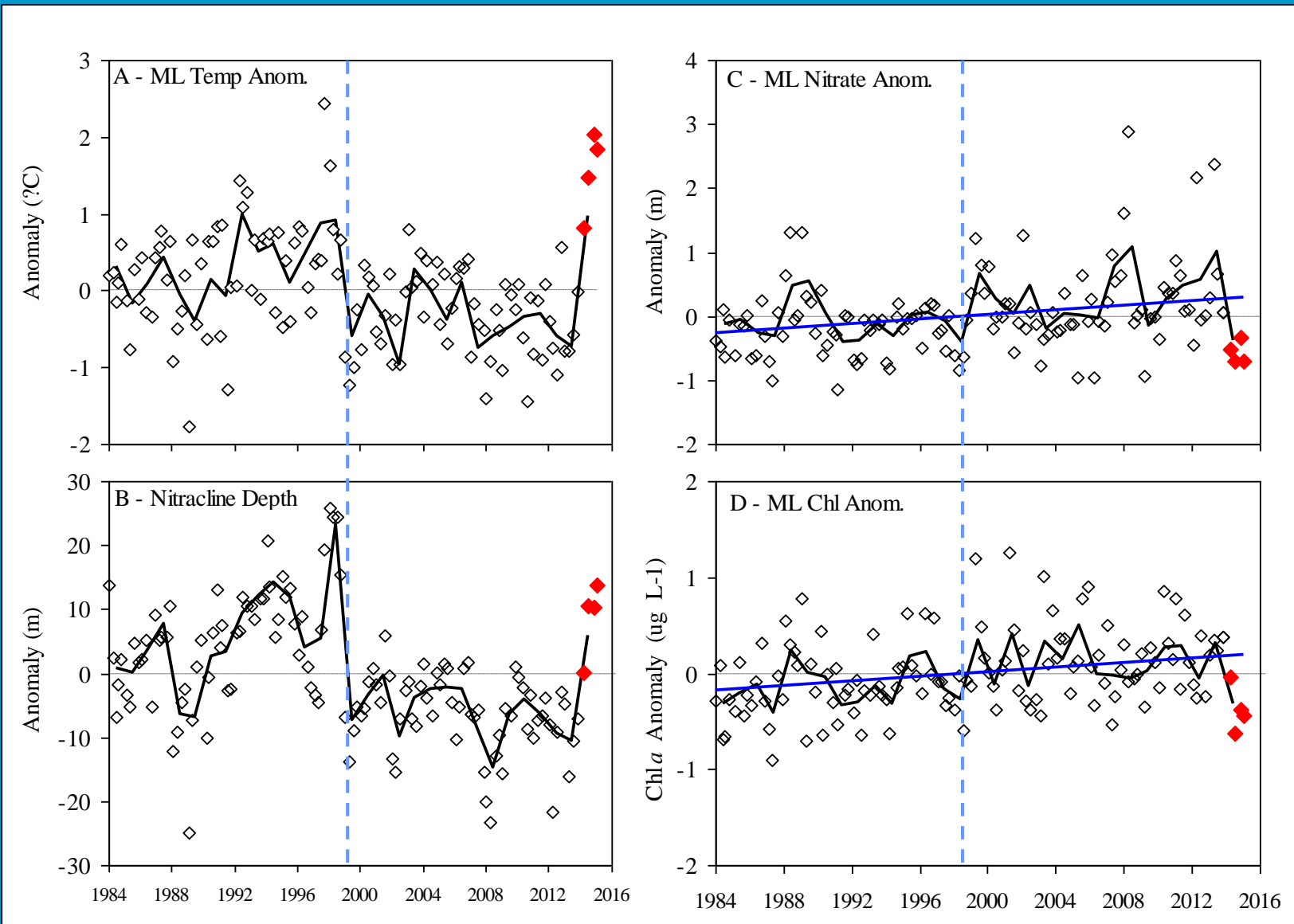
Chl a vs. Depth for the CalCOFI region and the northern coastal and southern Calif. Current areas.



Surface layer phytoplankton biomass has decreased by a factor of two or more depending on region.



# Phytoplankton and Nutrients

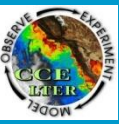


Phytoplankton biomass was controlled by the availability of inorganic nitrogen





# What is the Context? What are the Drivers?



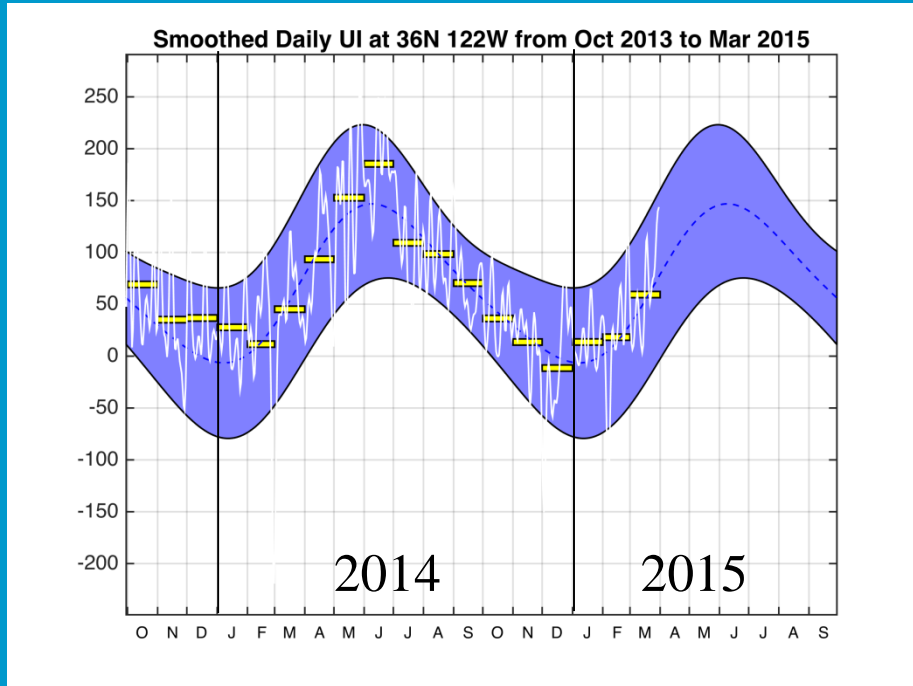
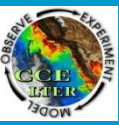
## Questions:

- Winds and upwelling
- Comparison to the 1998/99 ENSO event
- Changes on isopycnals

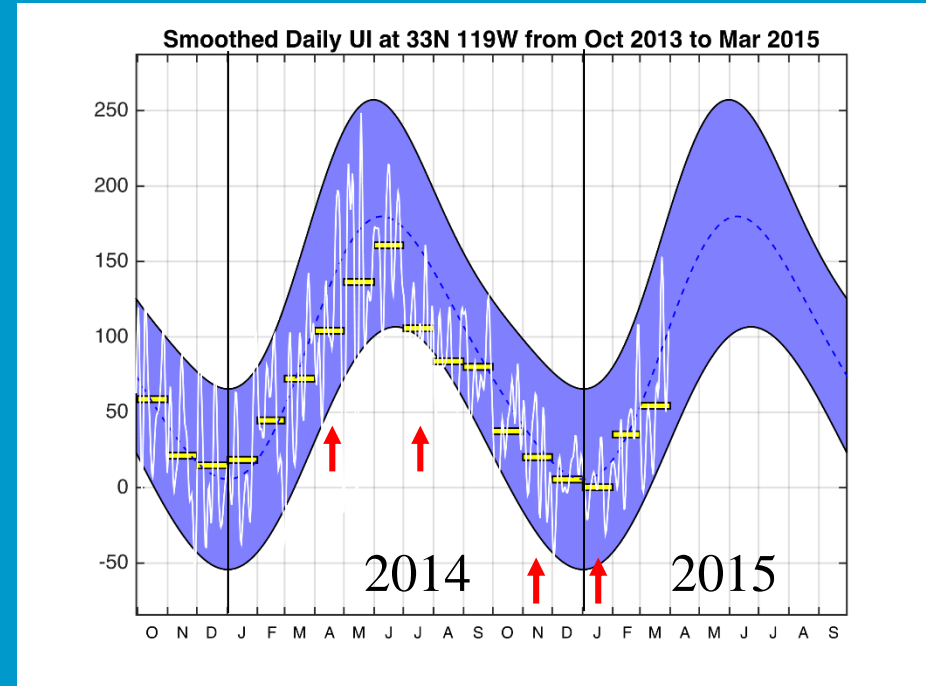




# Upwelling at 33 and 36 °N



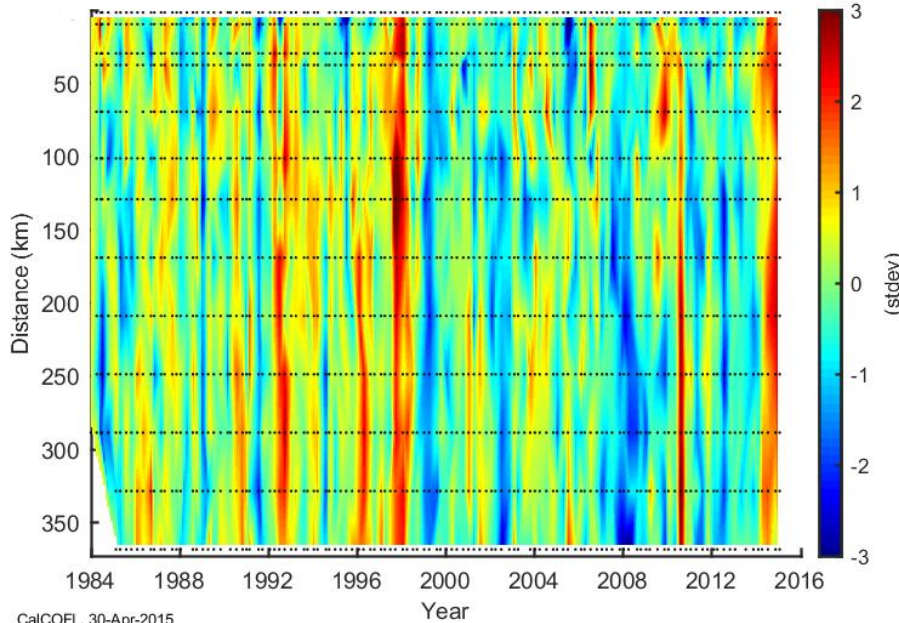
36°N – Central Calif.



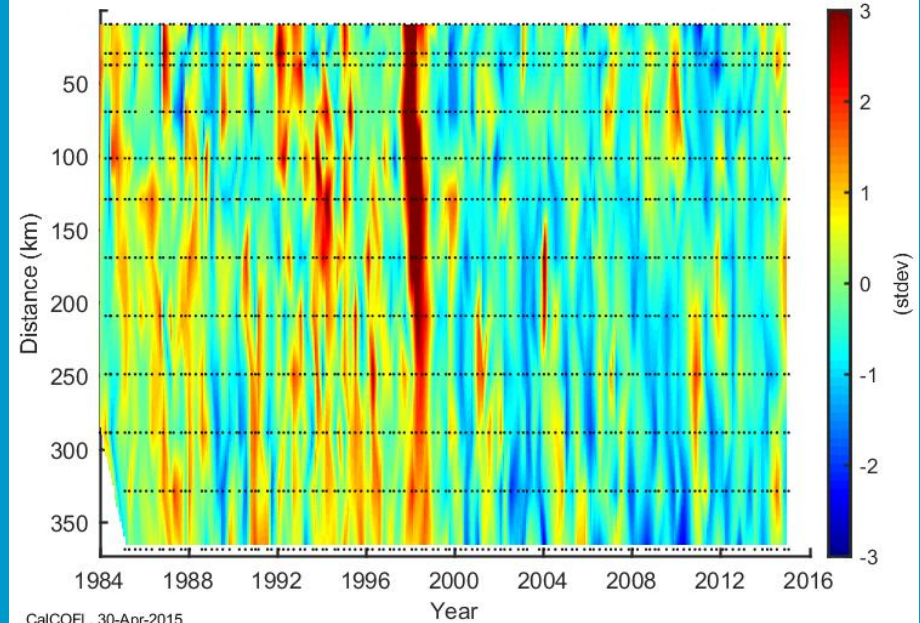
33 °N – South Cal. Bight

Coastal upwelling in the S. Calif. Current was not anomalous during the 2014 and 2015 cruises (except for July 2014)

## Temp StAnom at 10 m – Line 90



## Temp StAnom at 100 m – Line 90



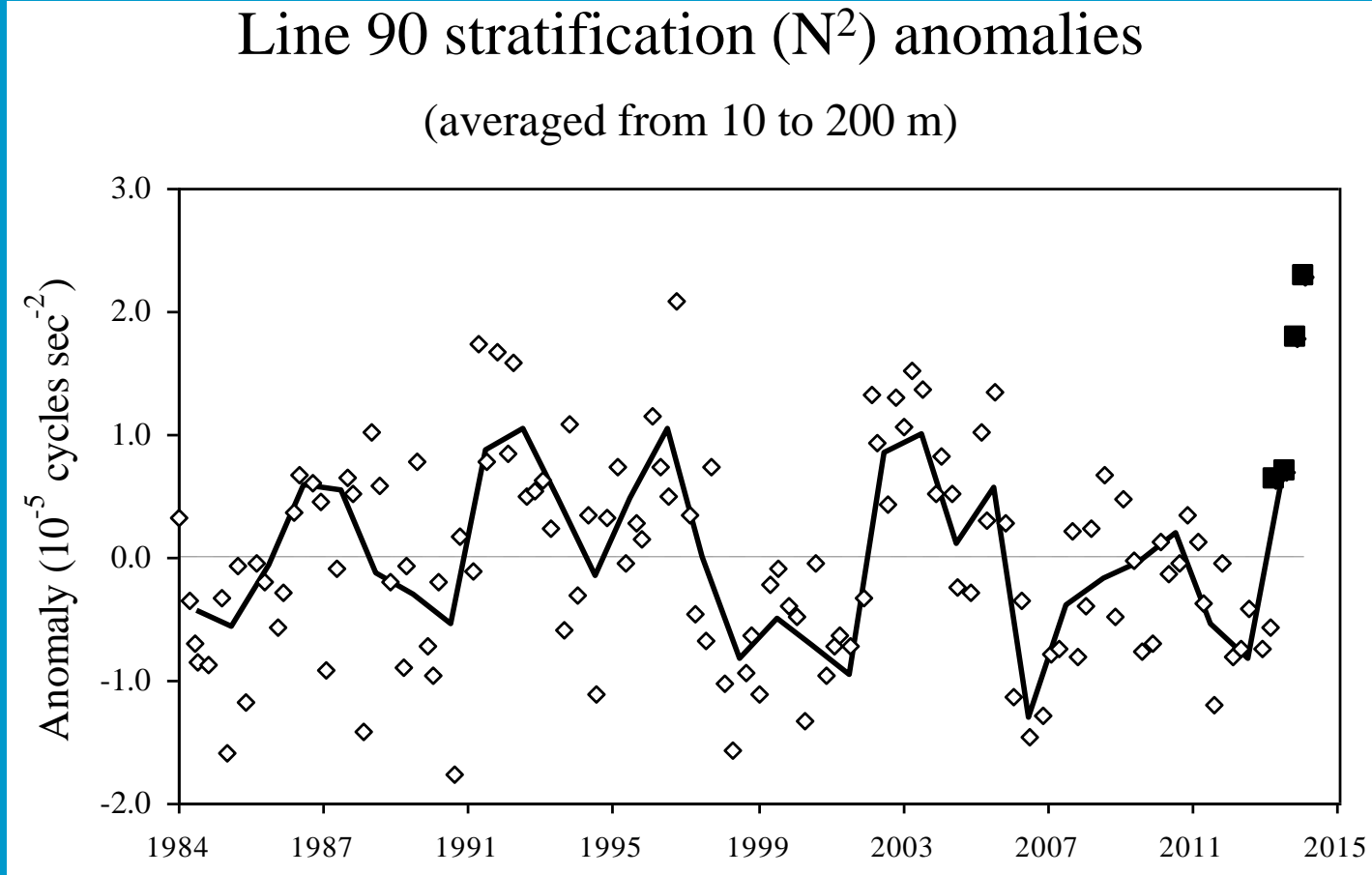
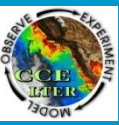
The 2014/15 Warm Anomaly is confined to the Surface Layer!

At the surface its magnitude is similar to the 1998 El Nino.

At depth (100 m) the 2014/15 Warm Anomaly is barely expressed.



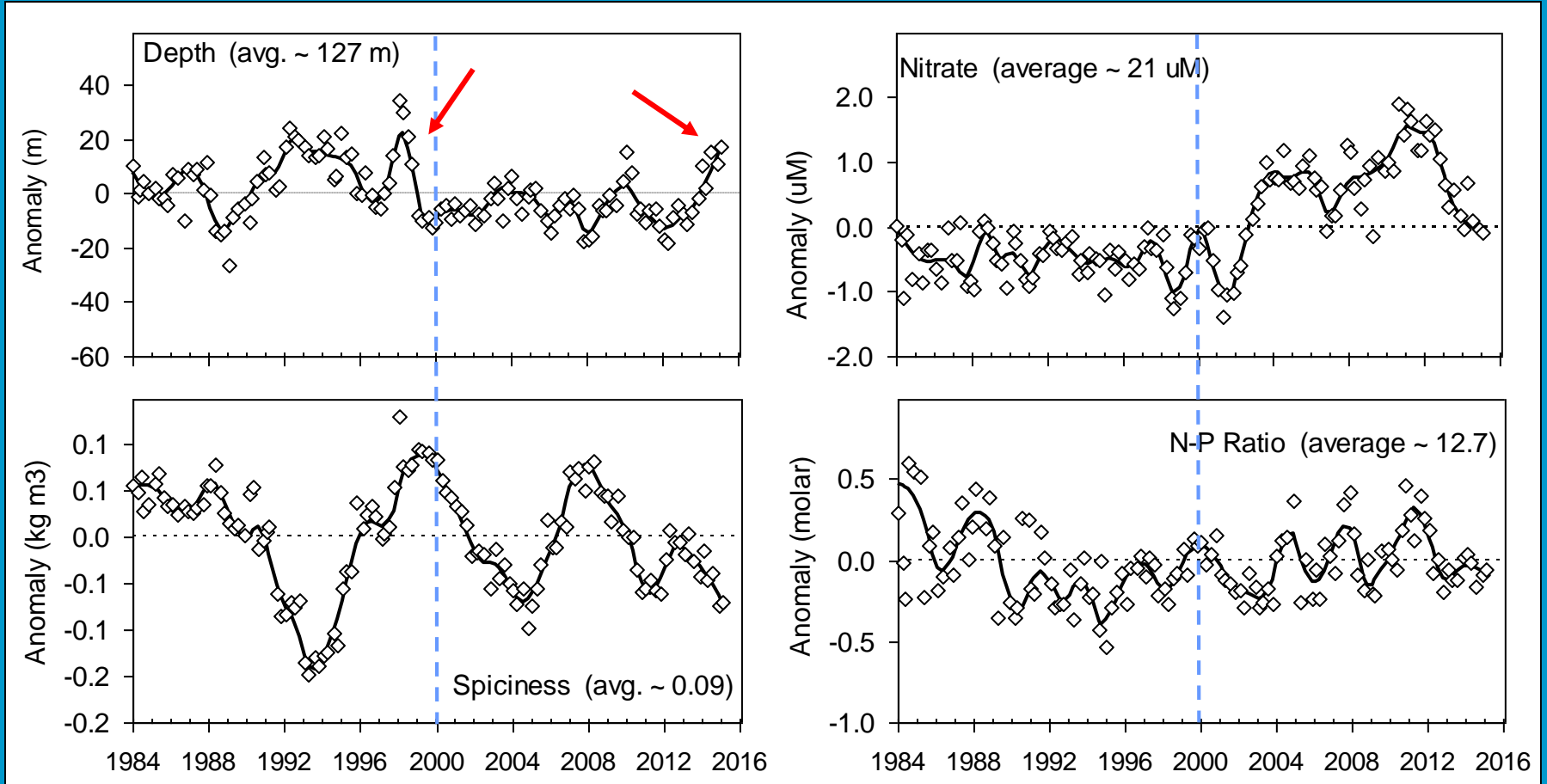
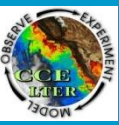
# Stratification along Line 90



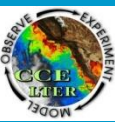
Upper ocean stratification during the warm anomaly was the strongest observed since 1984



# Properties at Depth - Anomalies



At depth, no property changes were observed on isopycnals (shown is  $\sigma_t = 26.0$ ).  
However, the depth of the isopycnal changed significantly!

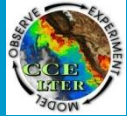


## Summary:

- The warm anomaly is strongly expressed at the surface, with effects similar to those observed during the 1998 El Niño.
- The anomaly has only had weak effects on properties at depth (100 to 400 m).
- Increased stratification caused decreased fluxes of nitrate into the euphotic zone, limiting phytoplankton biomass.
- Phytoplankton biomass was reduced by up to a factor of two in some regions.



# CalCOFI – The 2014/15 Warm Anomaly



Thank You !

