



Seasonal Temperature Dynamics of the Inner Southern California Bight

CalCOFI Conference
December 7, 2005

Issues and Analysis



- Simple vertical diffusion model with one free parameter accounts for both the amplitude and phase of the seasonal temperature modulation with depth.
- How about lateral advection? Advection previously proposed to account for seasonal variation.
- Are the surface waters of the Inner Southern California Bight sufficiently isolated to permit a 1-D treatment of the dynamics?
 - Entrainment in eddy (dynamic height measurements)
 - Small currents
- Examine spatial distribution of seasonal parameters derived from long-duration experiments

Temperature Dynamics Model



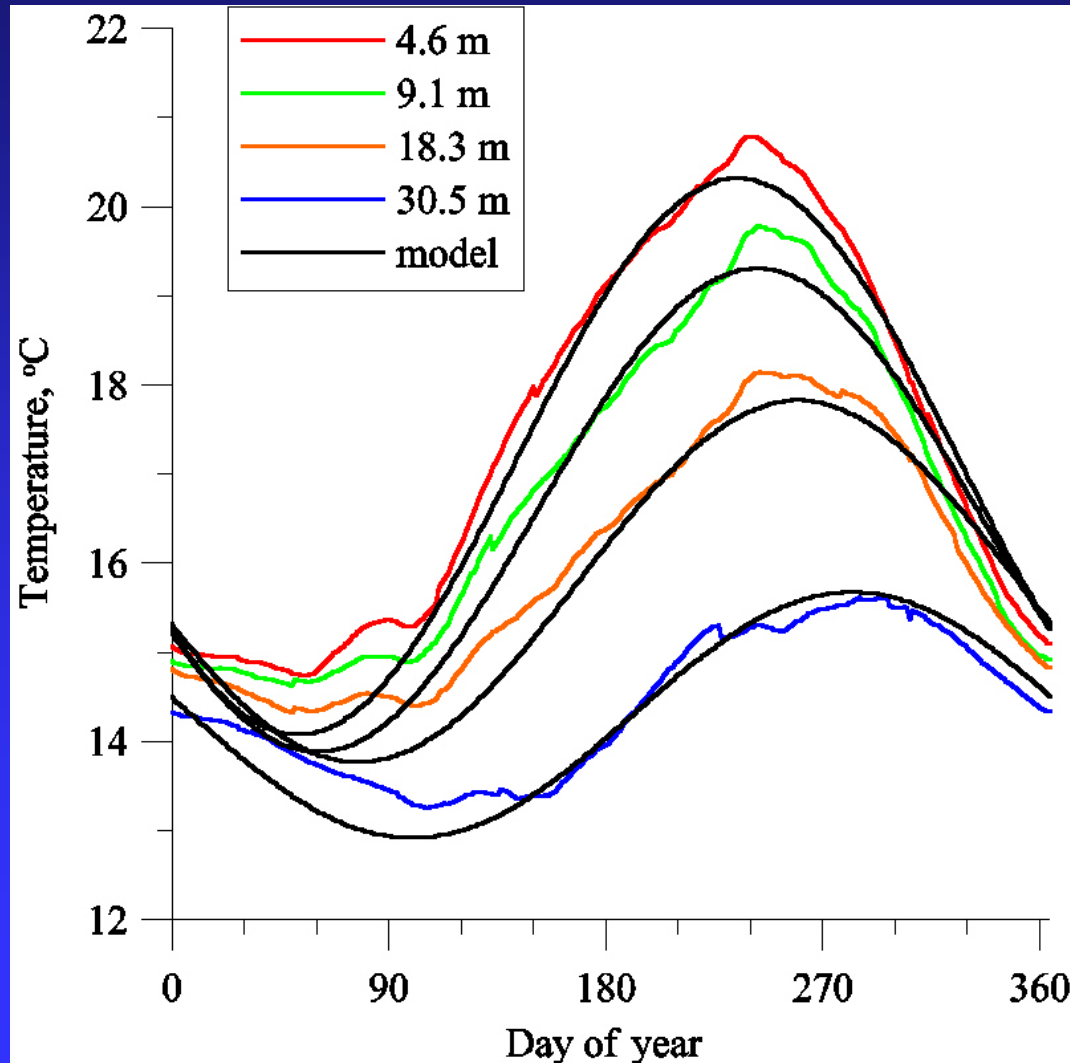
Full temperature dynamics

$$\frac{\partial T}{\partial t} + \vec{u} \cdot \nabla T + \nabla \cdot \frac{\vec{F}^{rad}}{\rho c_p} - \kappa \nabla^2 T = Q_e + Q_c$$

Approximations

$$\frac{\partial T}{\partial t} = \kappa \frac{\partial^2 T}{\partial z^2} + C e^{-\beta z} e^{-i\omega t}$$

Seasonal Temperatures at Santa Catalina Island



Model:
NCEP/NCAR net surface
1-D vertical diffusion
near-surface absorption, β

$\kappa \sim 10^{-4} \text{ m}^2/\text{s}$

Long-duration temperature measurements in the SCB



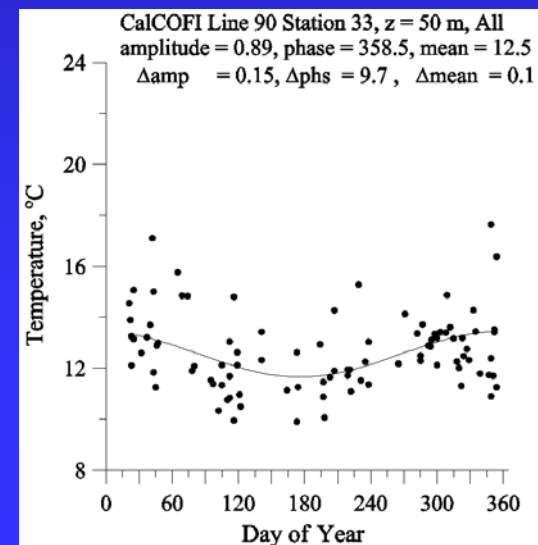
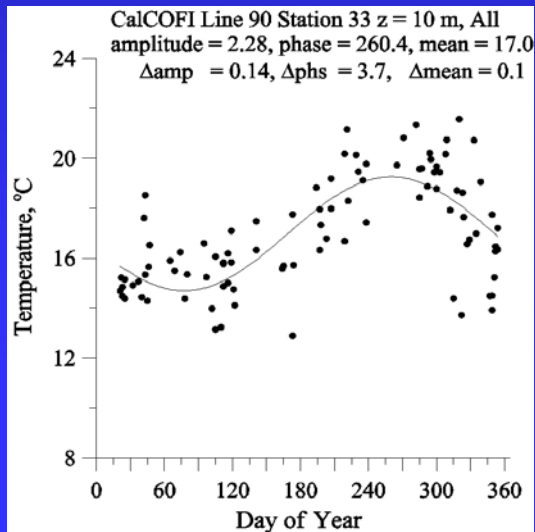
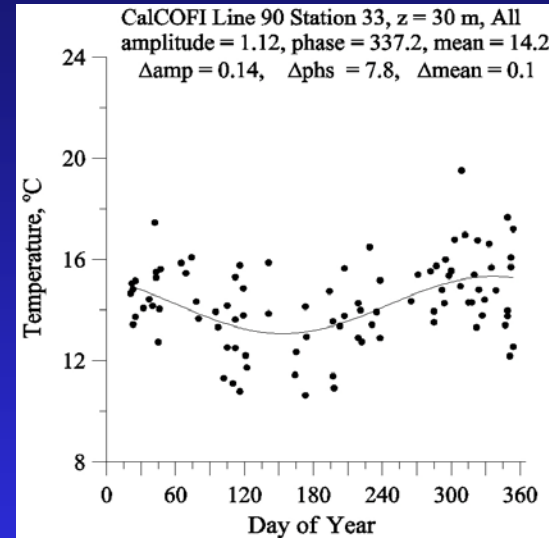
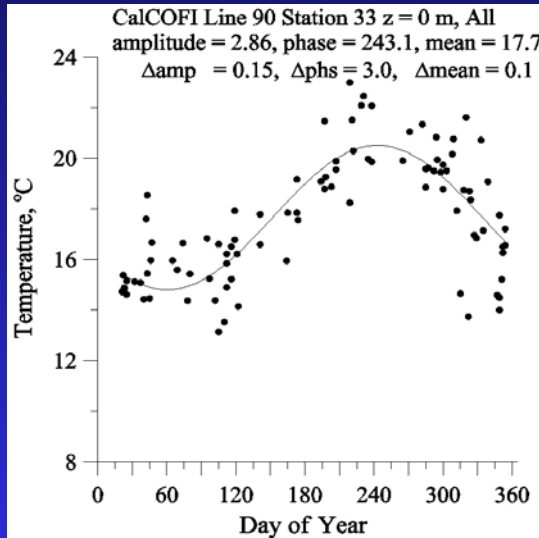
- Long-term measurements needed to isolate seasonal characteristics and diminish the influence of episodic events and turbulence
- There are few long-duration experiments
 - Bucket drops - surface measurements, near shore
 - Scripps Pier - surface measurements
 - Southern Cal. Coastal Water Research Project
 - Santa Monica Bay only, seasonal parameters available
 - NOAA Buoys
 - Surface measurements, laterally distributed
 - Channel Islands National Park
 - Scattered sites and depths
 - Catalina Conservancy Divers (CCD)
 - Upper column depth coverage around Catalina
 - **CalCOFI**
 - Horizontally distributed with depth coverage

Processing



- CalCOFI standard depths data set
 - 1949 - 2002
 - retrieve all temperature data from lines encompassing the SCB, 70-110, assign day of year to observations
- Assume stationarity and perform fits to mean, annual amplitude and phase
 - temperature and salinity
 - assume regime change insignificant
 - compute errors to fit
- Plot retrieved values spatially

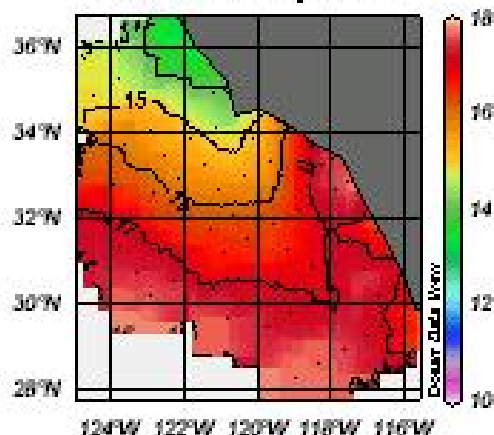
Example Scatter Plots and Fits



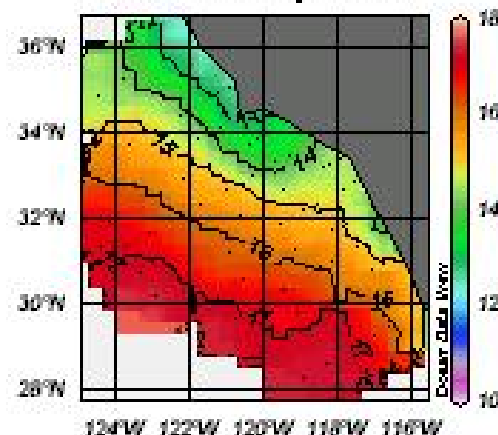


Mean Temperature, CalCOFI

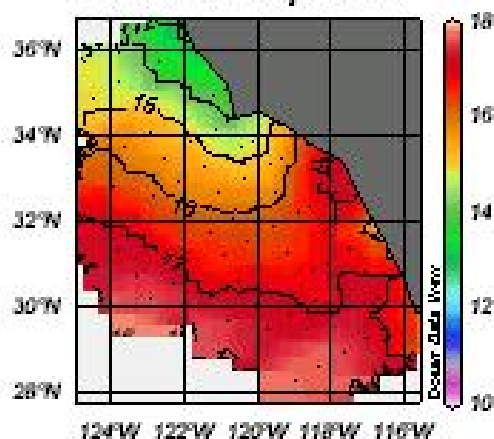
mean on depth=0



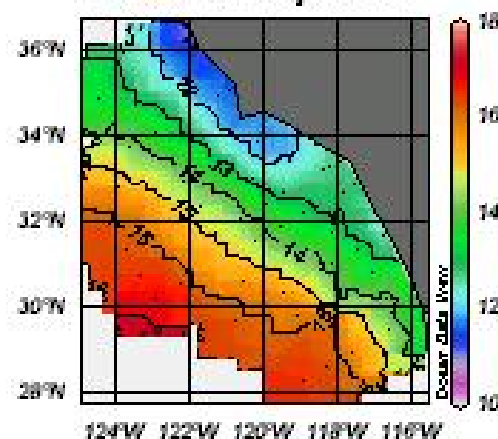
mean on depth=30



mean on depth=10



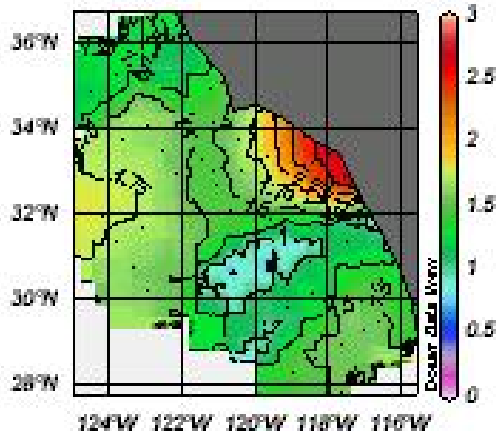
mean on depth=50



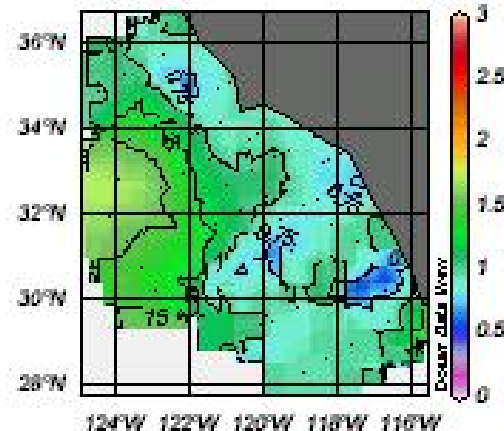
Seasonal Amplitude, CalCOFI



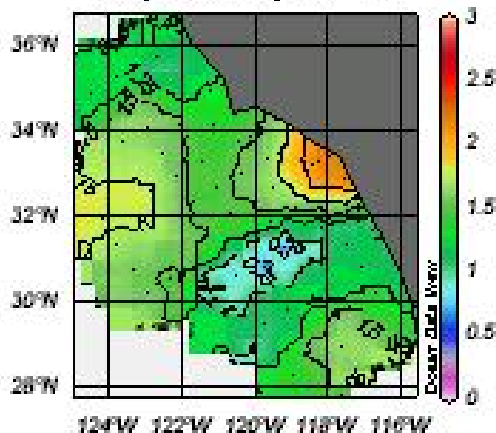
amp on depth=0



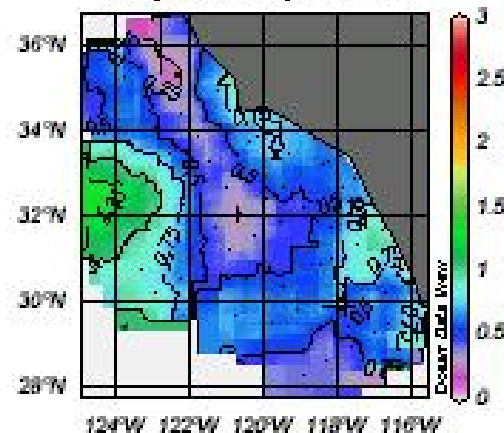
amp on depth=30



amp on depth=10



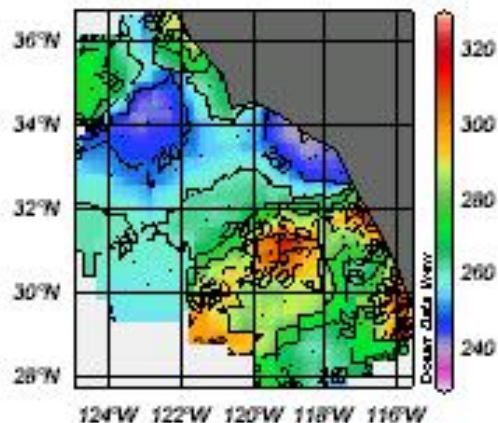
amp on depth=50



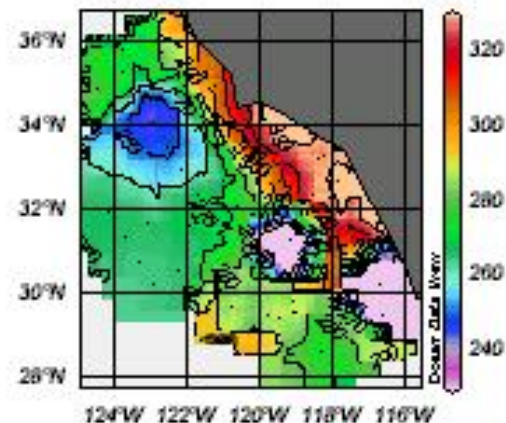
Phase, CalCOFI (day of maximum temperature)



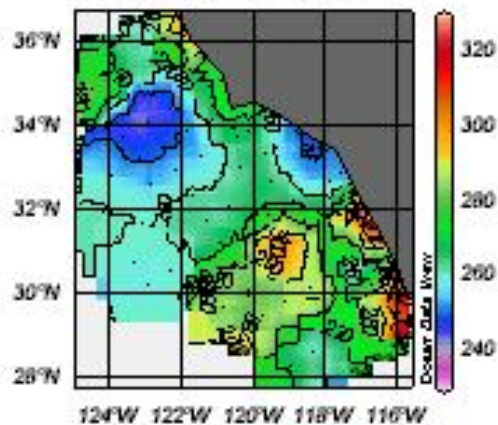
phase on depth=0



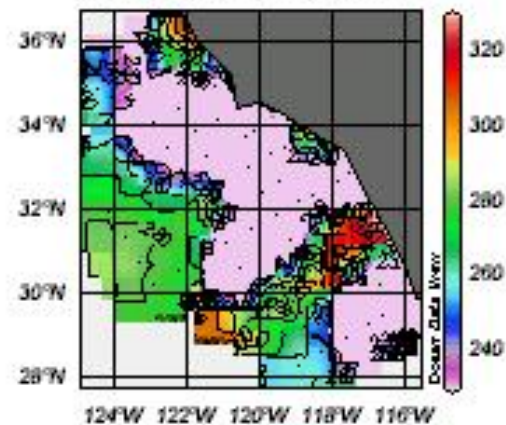
phase on depth=30



phase on depth=10



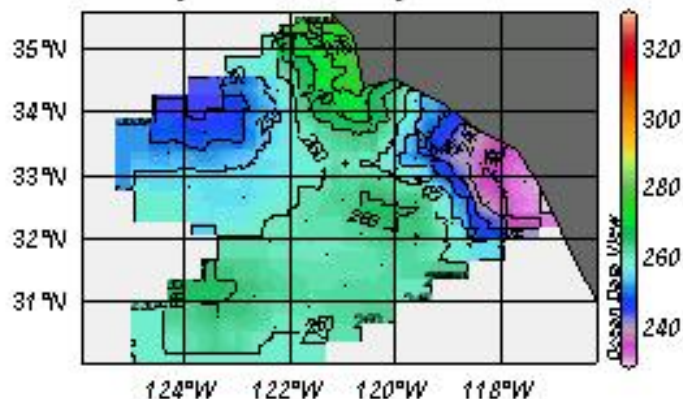
phase on depth=50



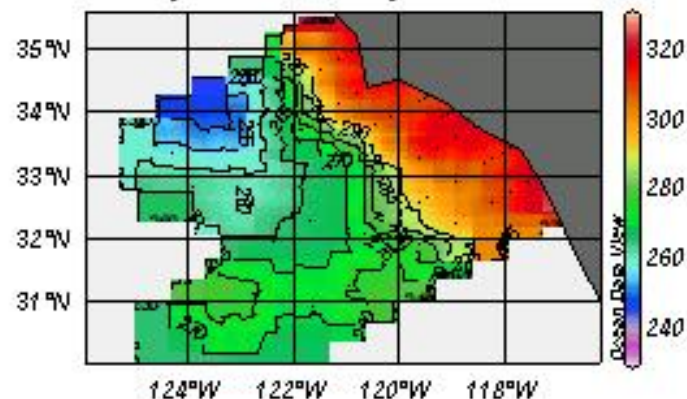
Comparison with CalCOFI-web calculations - Phase



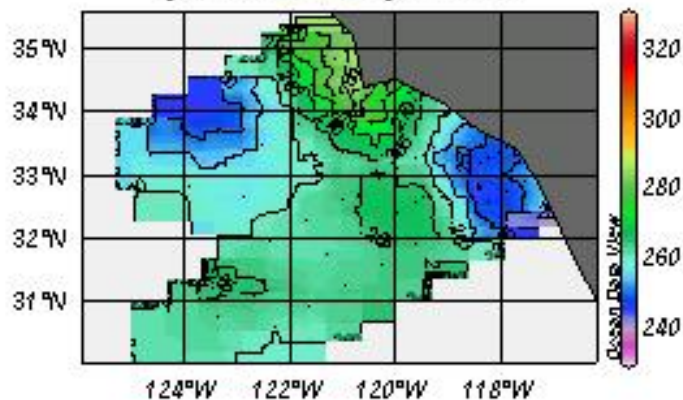
phase on depth=0



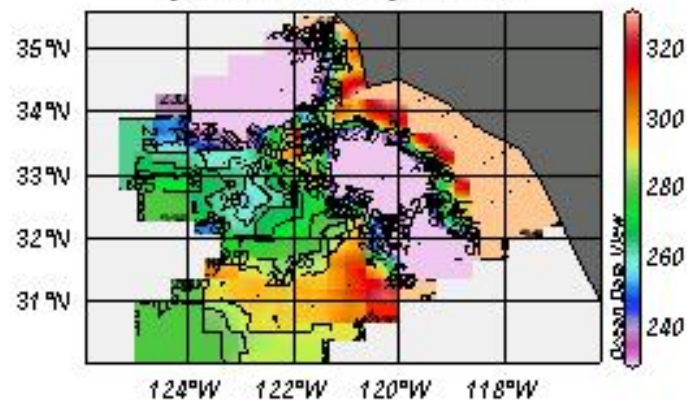
phase on depth=30



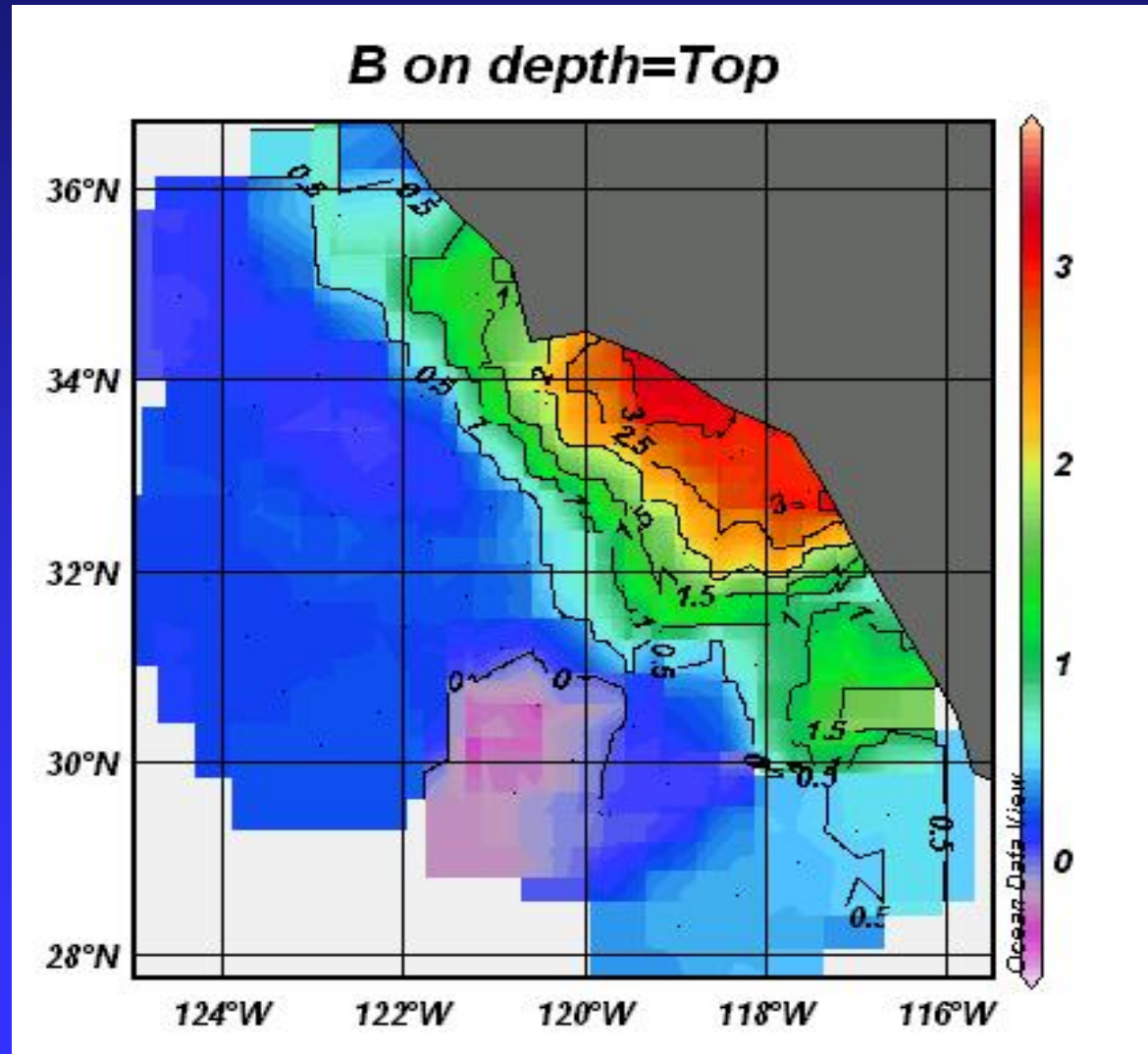
phase on depth=10



phase on depth=50



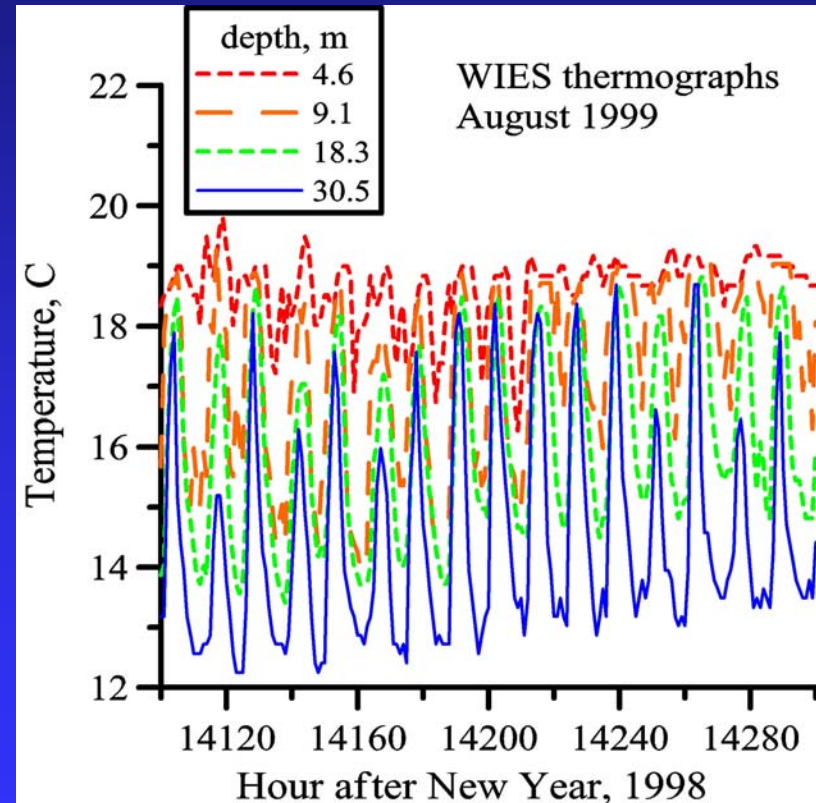
Vertical gradient of Phase days/meter (depth 0-30 m)



New Issues



- Island phase leads CalCOFI
 - interpolations
 - internal waves
 - near shore internal waves rectification.
 - Island effect
 - increased diffusion near shore (internal waves?)
- Regime change
 - maximum temperature now occurs earlier
- Net energy flow requires small current outflow, what are the dynamics?



Summary and Implications



- CalCOFI data indicate that temperature dynamics are different in the inner SCB.
 - Significant phase gradient with depth
- Solar heating is a significant part of the seasonal dynamics, which cannot be produced by advection alone.
- A 1-D vertical diffusion model suggests that near-surface waters are entrained within the inner Bight for at least 9 months of the year. Permits computation of the upper ocean diffusion coefficient

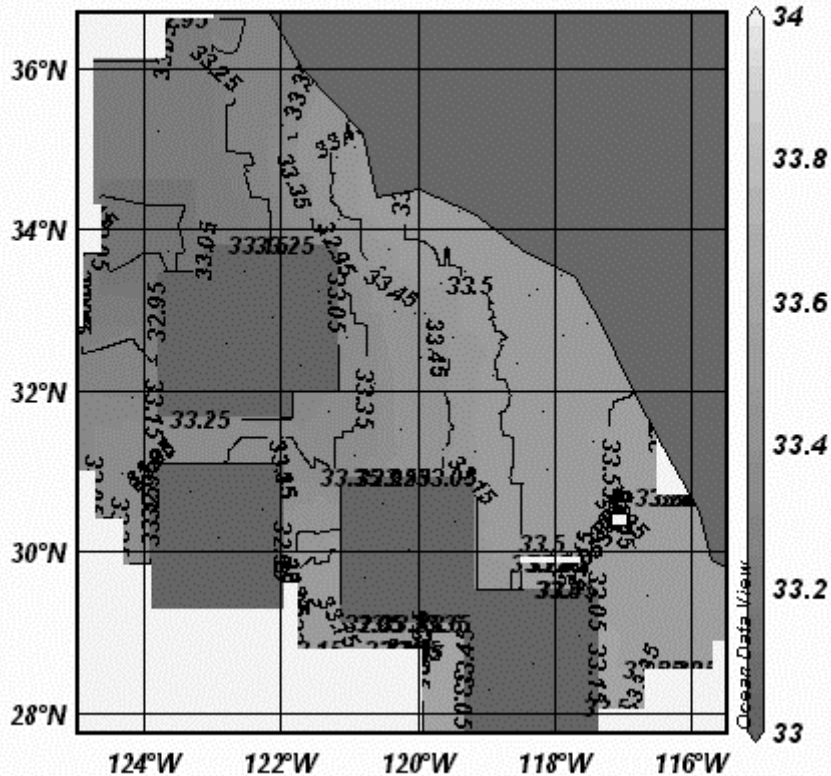


Backups

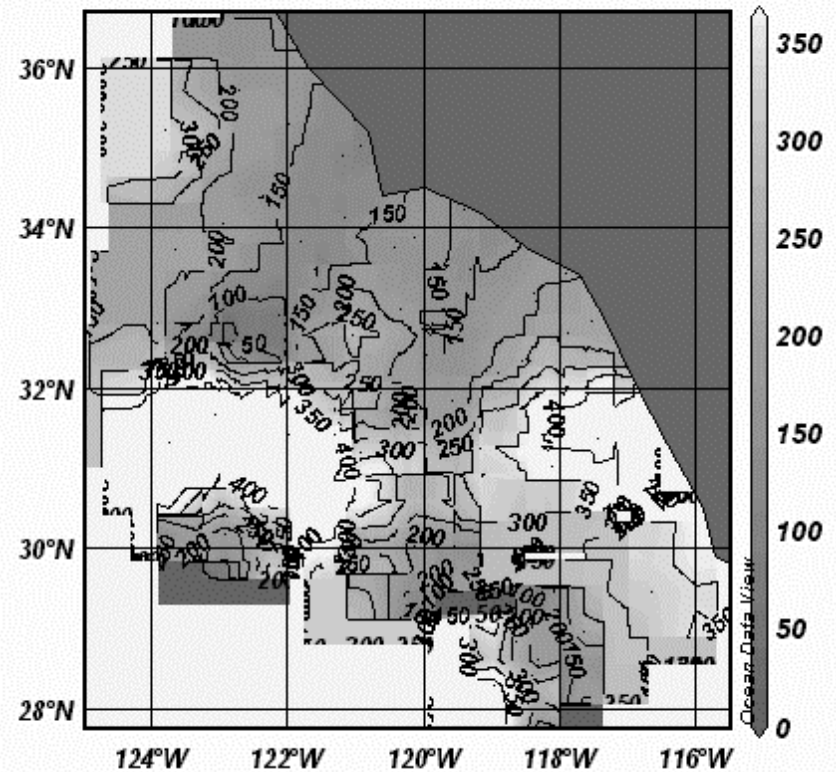
Salinity



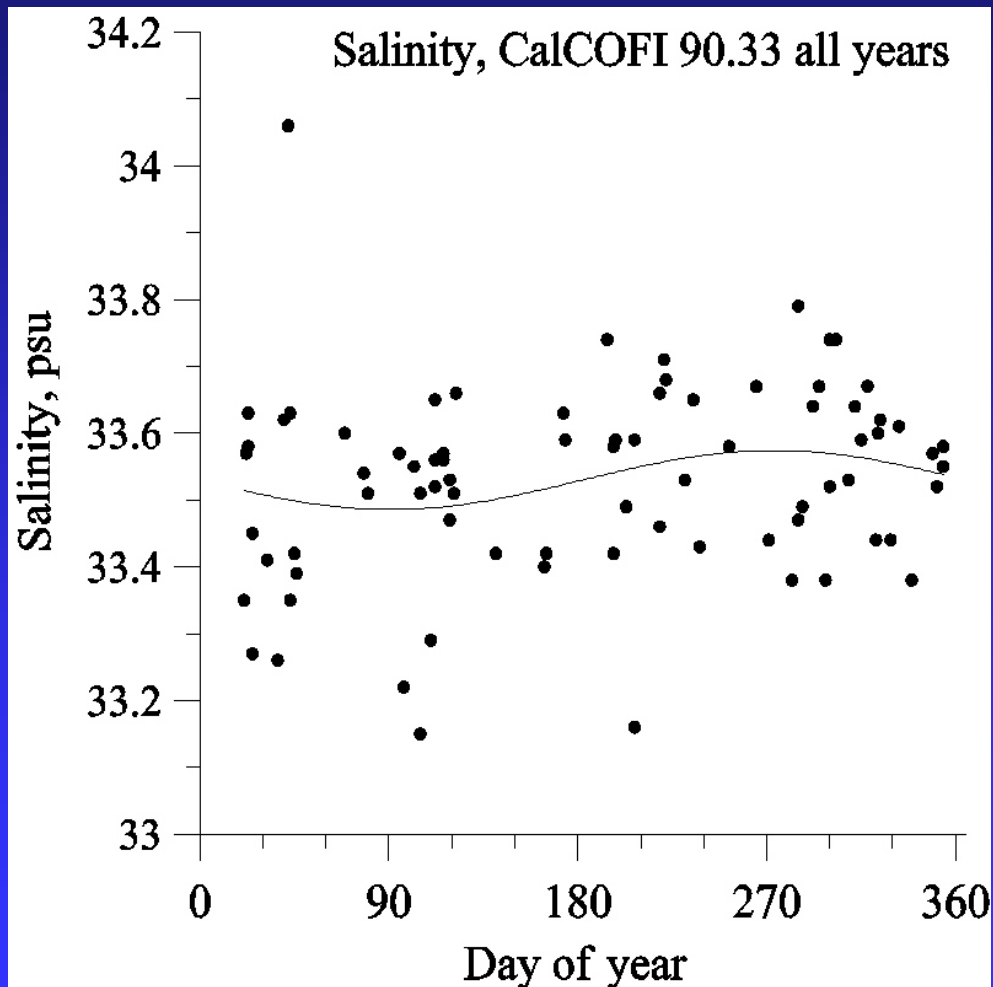
mean on depth=0



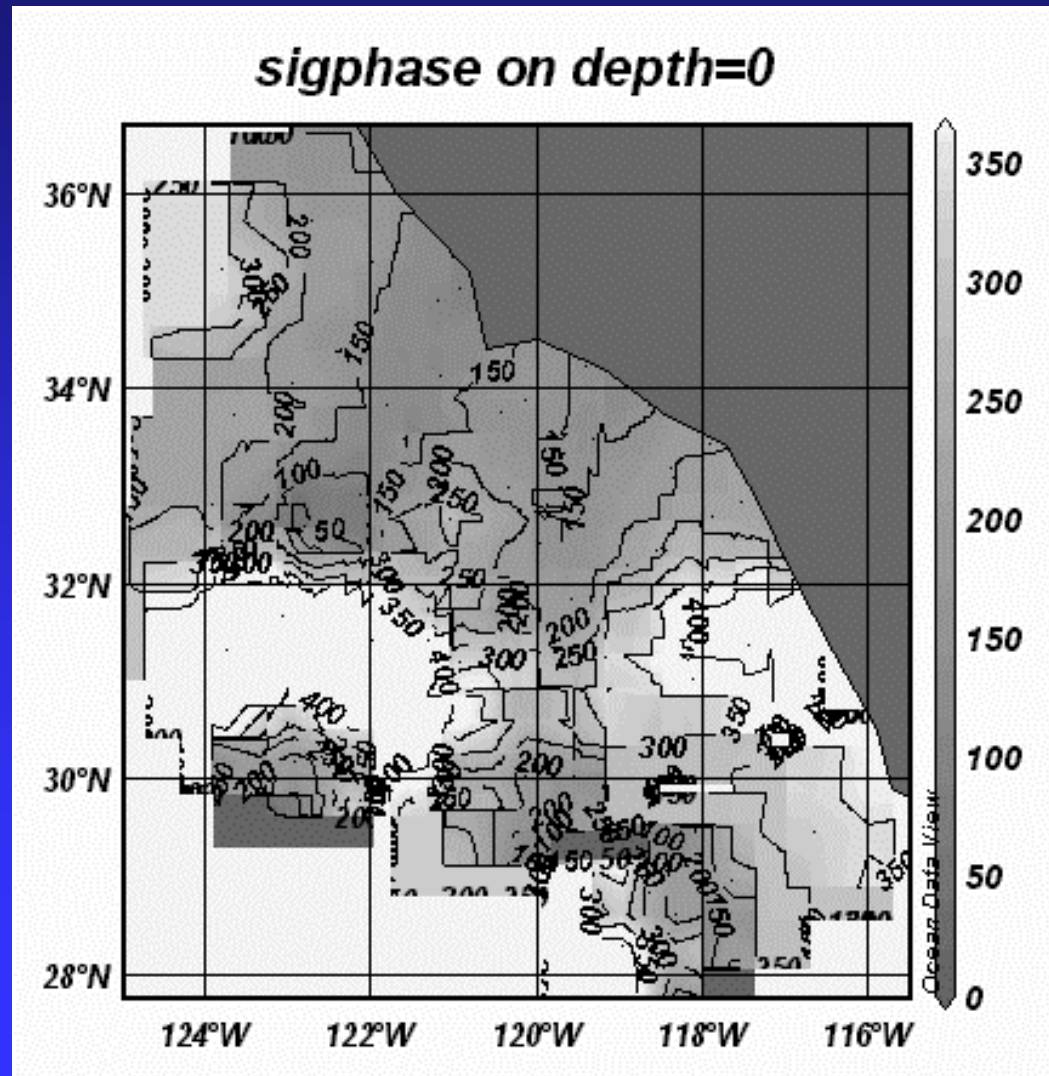
sigphase on depth=0



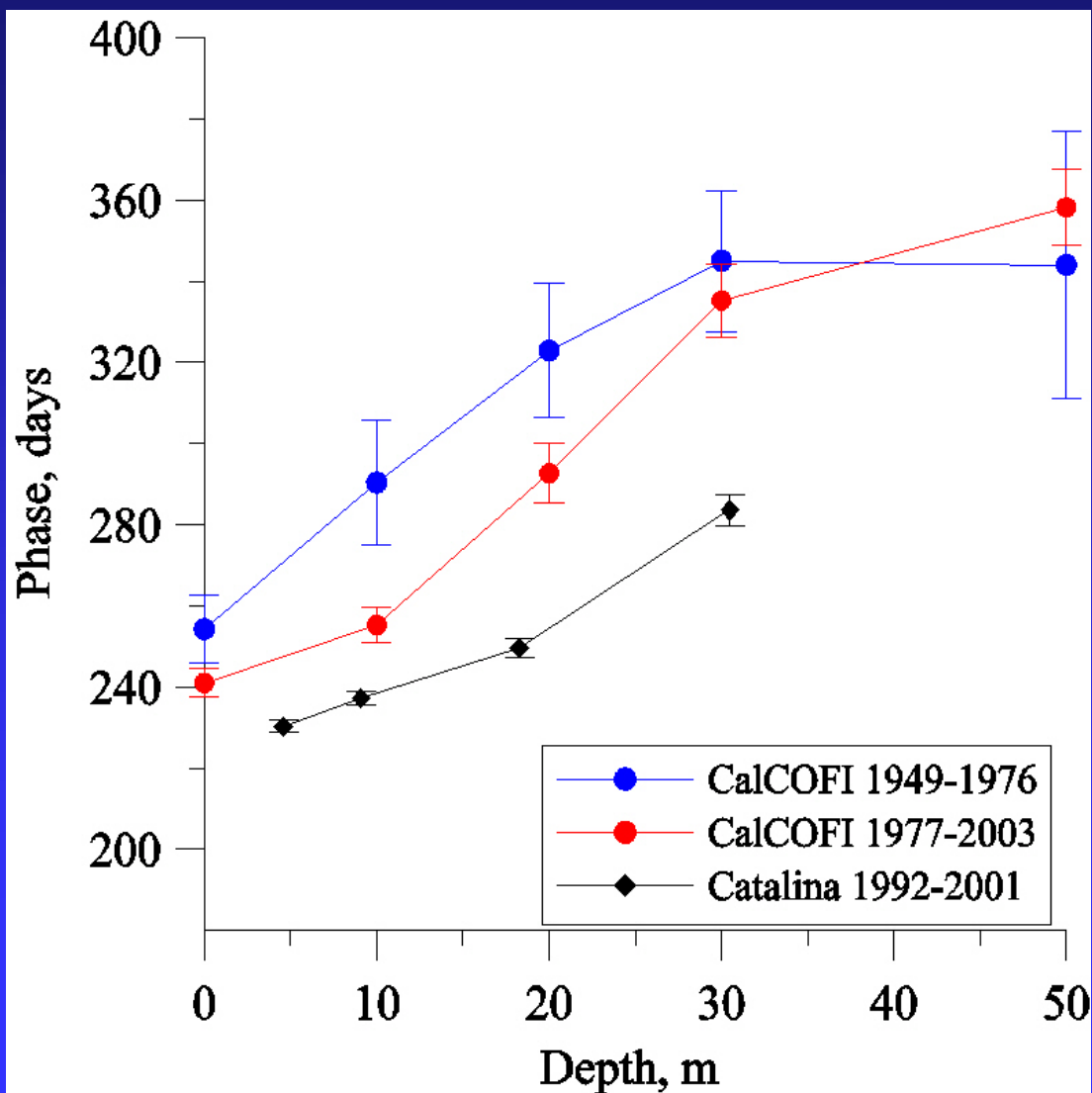
Salinity, Line 90 Station 33 all years



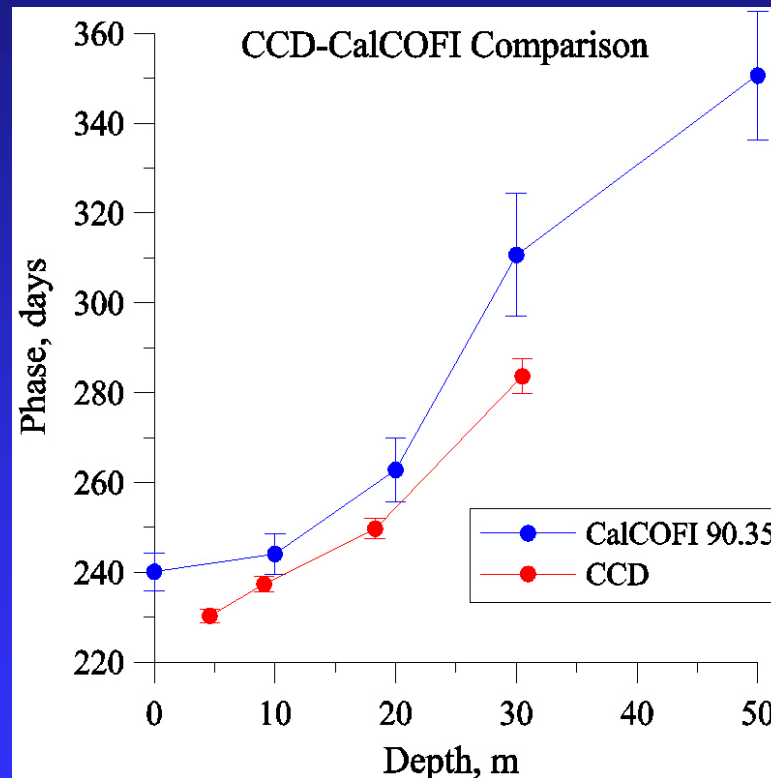
Salinity phase uncertainty



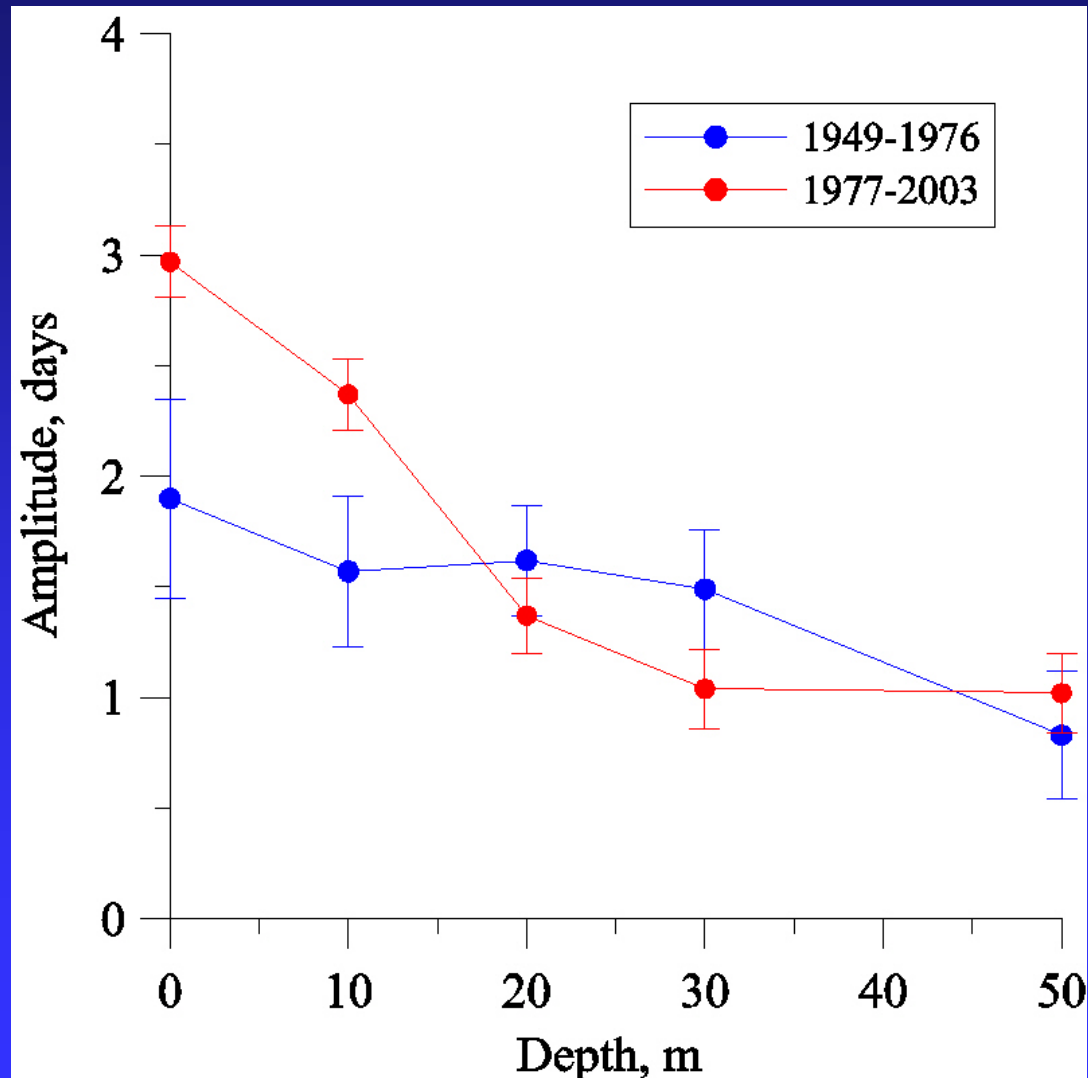
Regime Shift Seasonal Phase



Same years Catalina-CalCOFI



Regime Shift Seasonal Amplitude



Regime Shift Mean Temperature

