Vertical Mixing in the Southern California Bight as Determined from Temperature Dynamics

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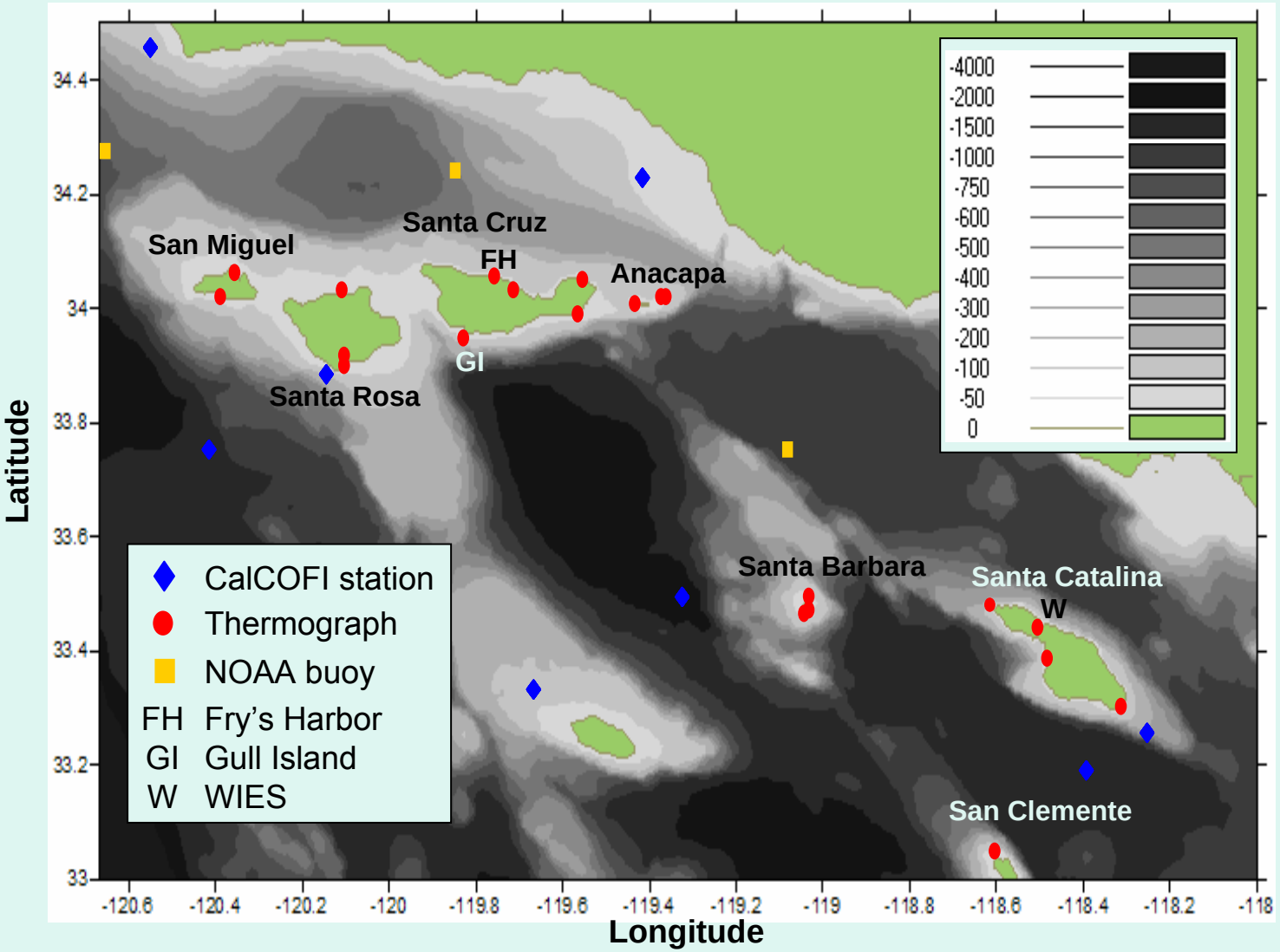
Introduction

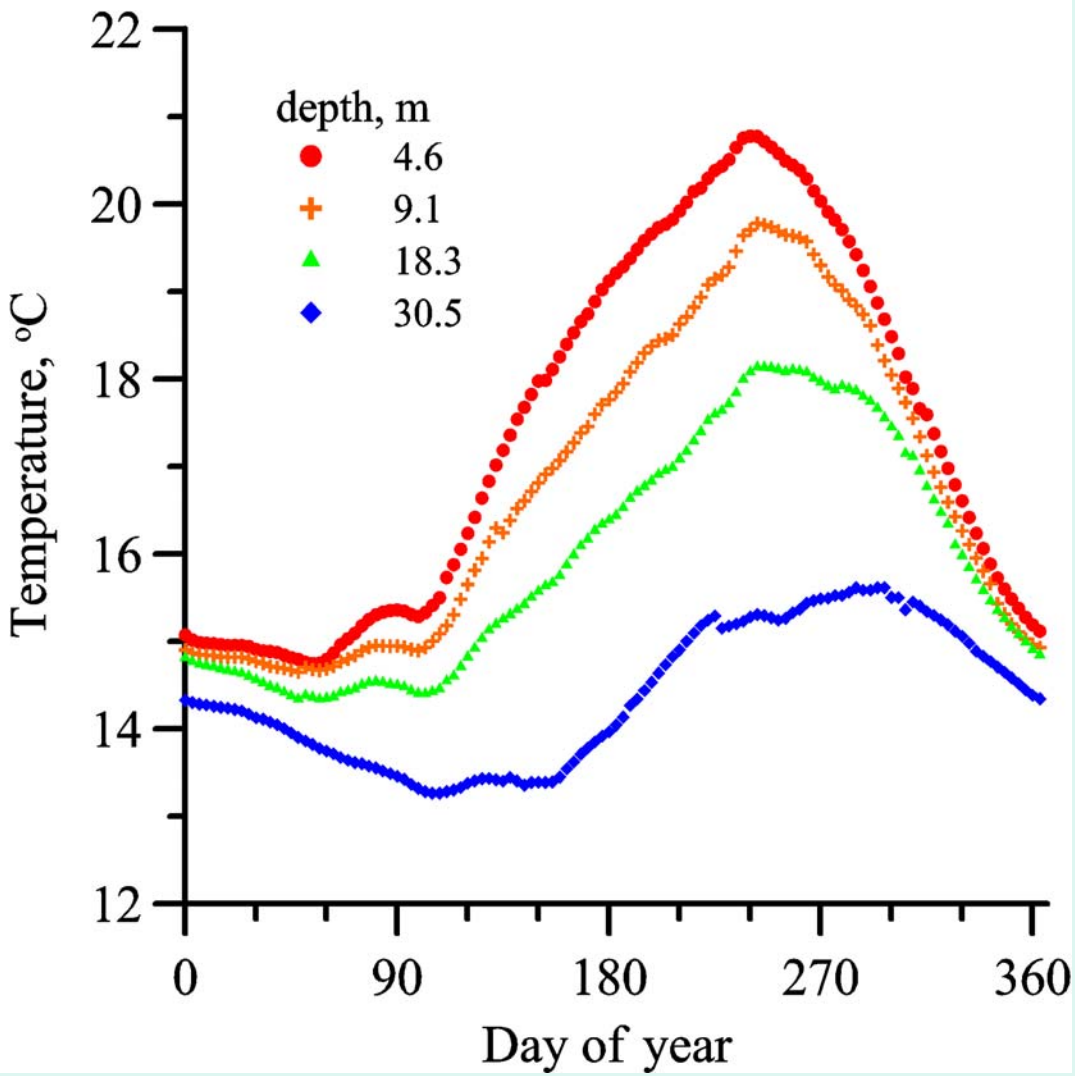
- Catalina Conservancy Divers collected a decade of temperature data in Southern California Bight: 4 depths, 6 sites around Catalina Island
- Augmented with several data sets including CalCOFI, ChINP, NOAA buoys
- Unique, long-term data set analyzed to provide annual temperature variation

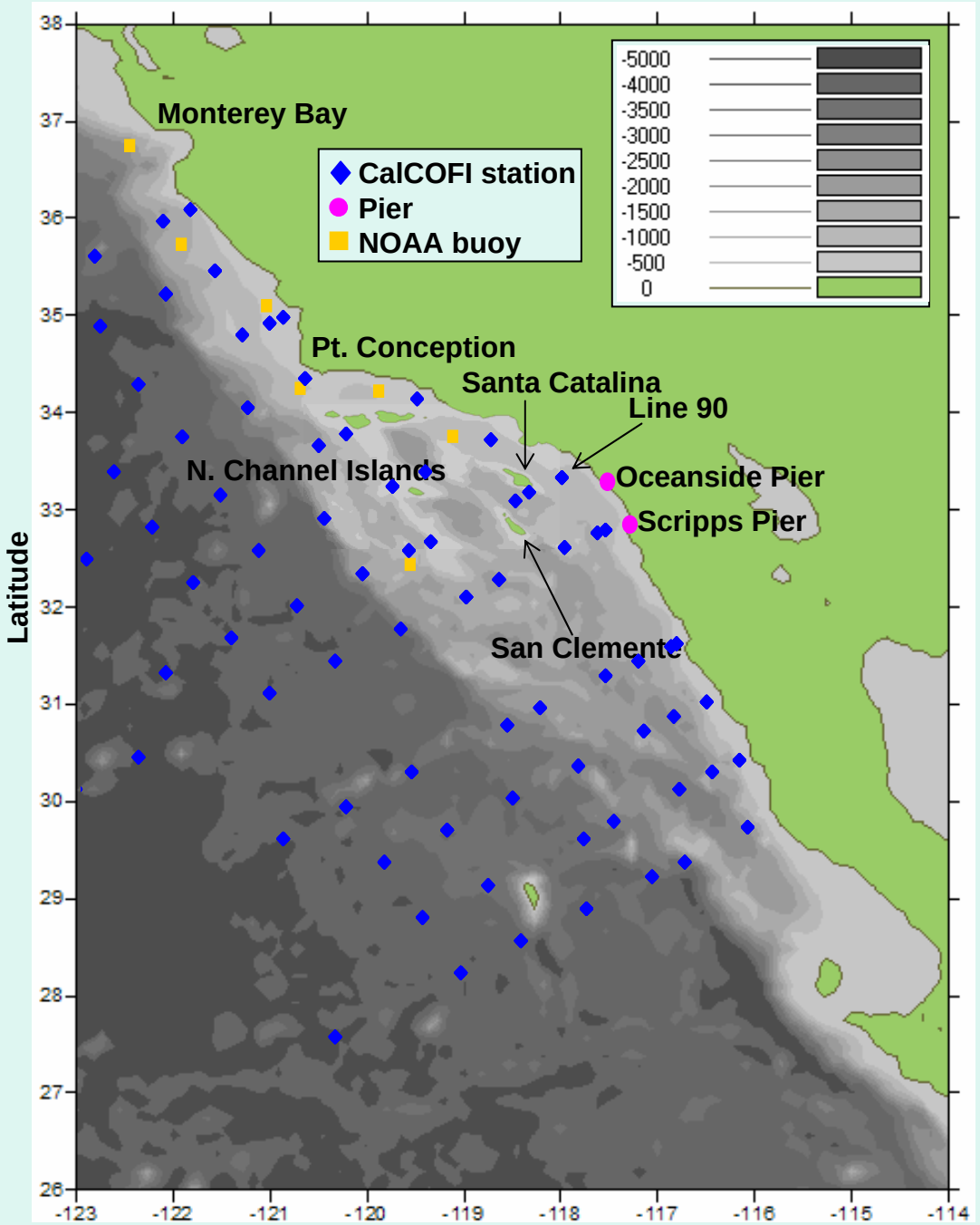
Southern California Bight

Thermograph stations



Catalina Island Temperatures





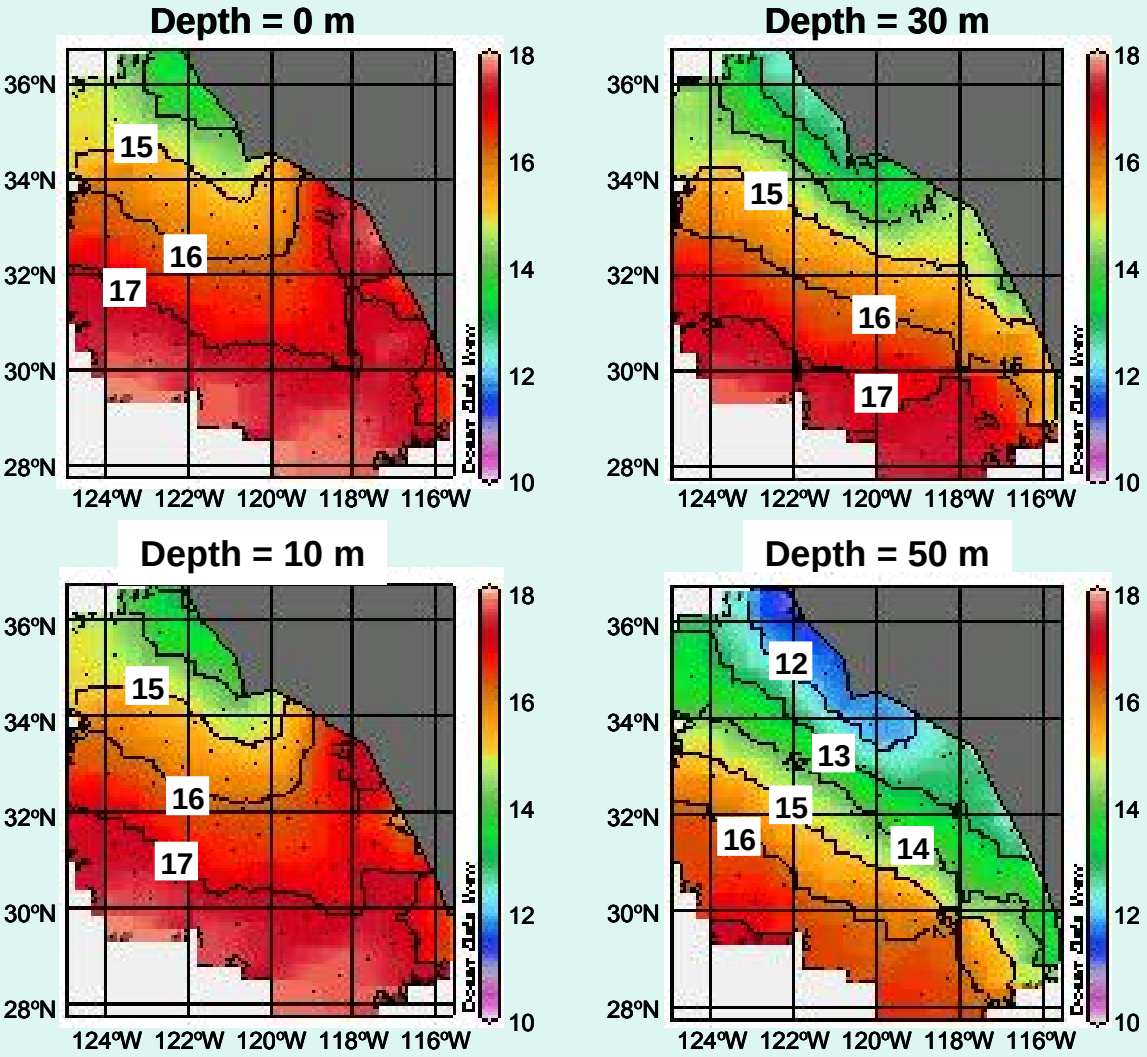
CalCOFI stations, NOAA buoys and piers

Data Reduction

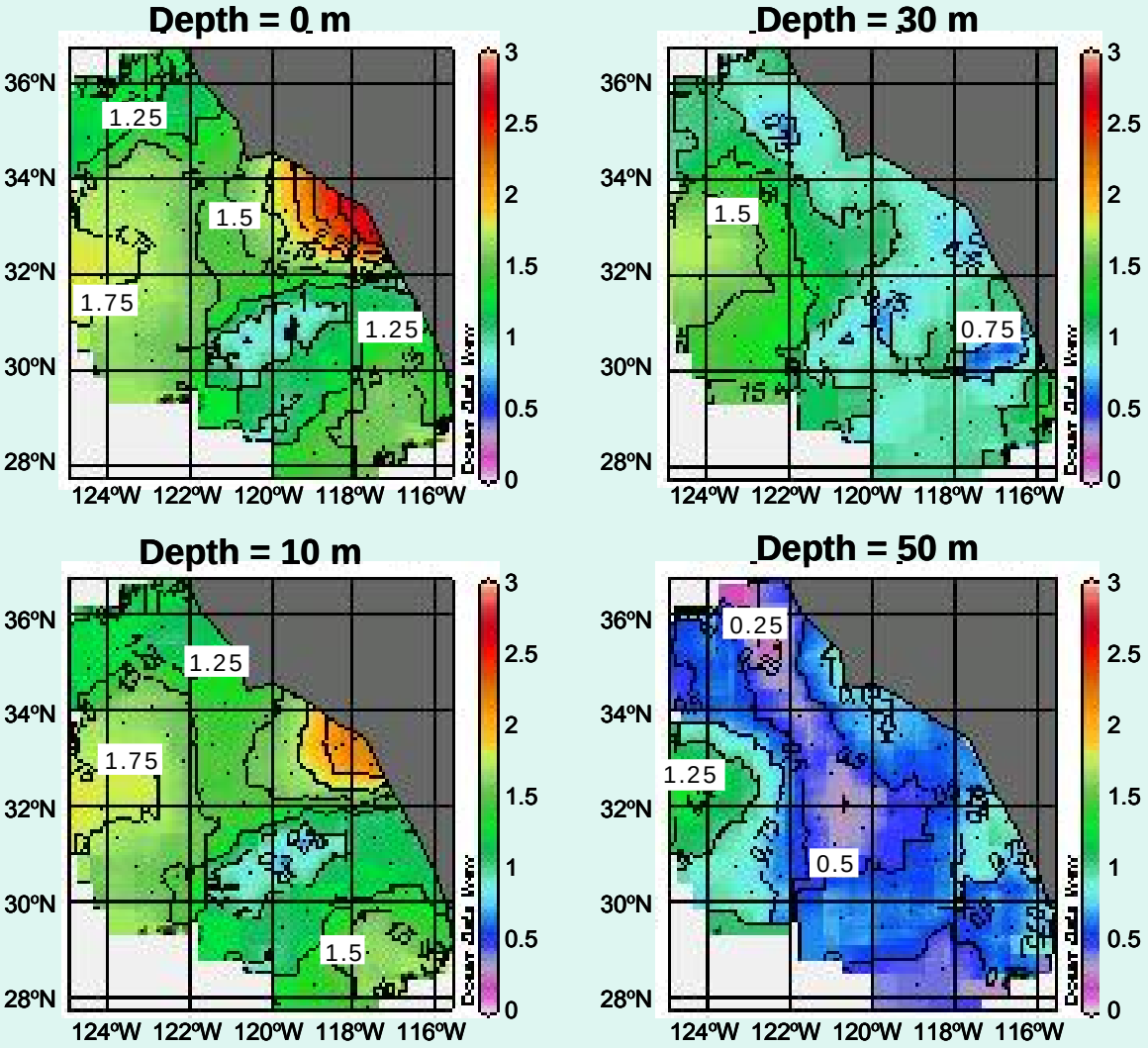
- Computed daily averages of temperature and salinity
- Fit a sinusoid to the data as a function of depth

$$T_s(t,z) = T_{0s}(z) + A_s(z)\cos(\omega t - \varphi_s(z))$$

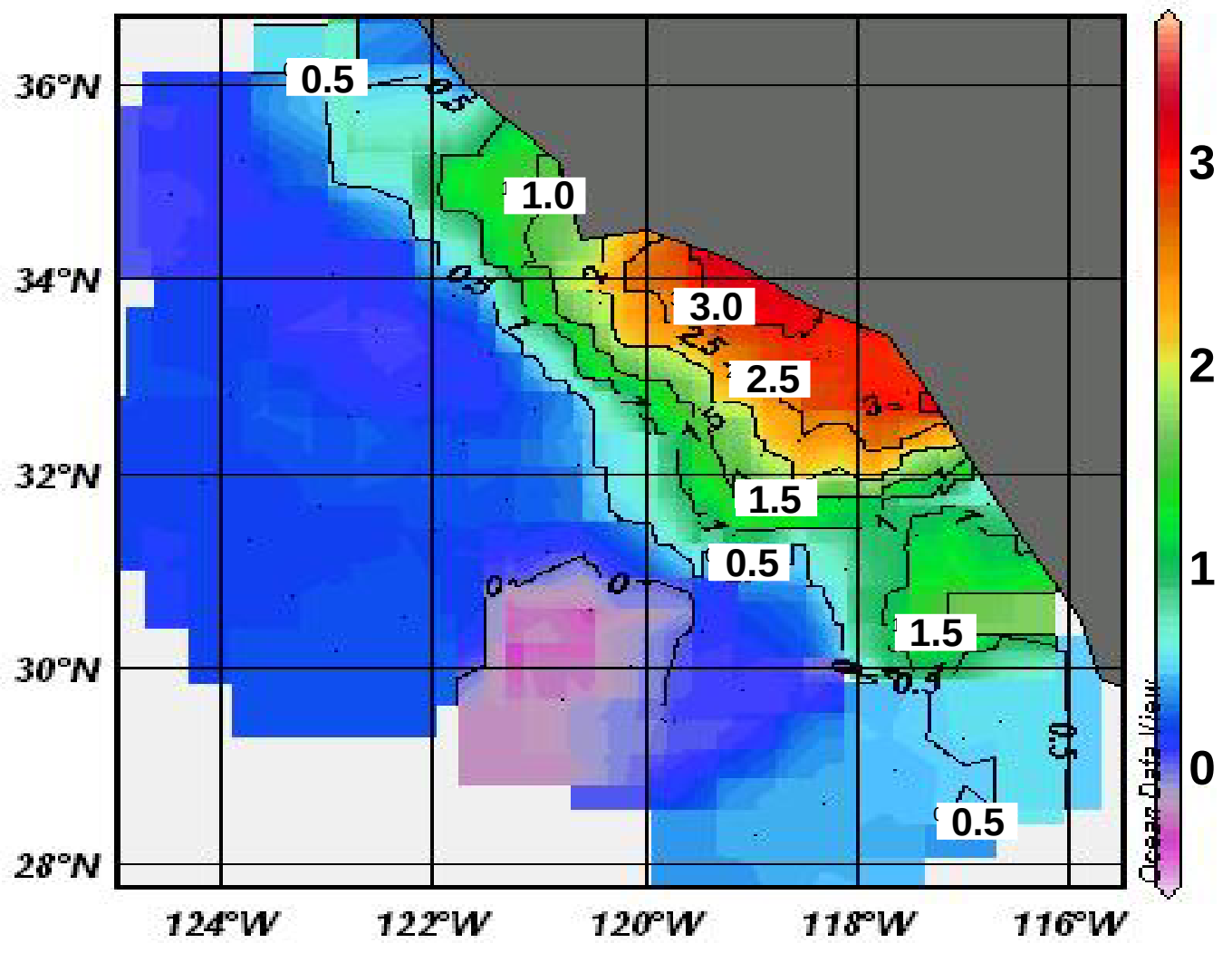
SCB Mean Temperature



Annual Amplitude in Bight



Phase Gradient, days/meter



1-D Diffusion Model and Solar Insolation

$$T(z,t) = T_0(z) + T_1(z,t)$$

$$\frac{\partial T_1}{\partial t} - \kappa \frac{\partial^2 T_1}{\partial z^2} = Ce^{-\beta z} e^{-i\omega t}$$

$$T_1(z,t) = \frac{C'}{2i\alpha}\left[\frac{e^{-\beta z} - e^{i\alpha z}}{(i\alpha + \beta)} + \frac{e^{-\beta z}}{(i\alpha - \beta)}\right] e^{-i\omega t}$$

κ diffusion coefficient

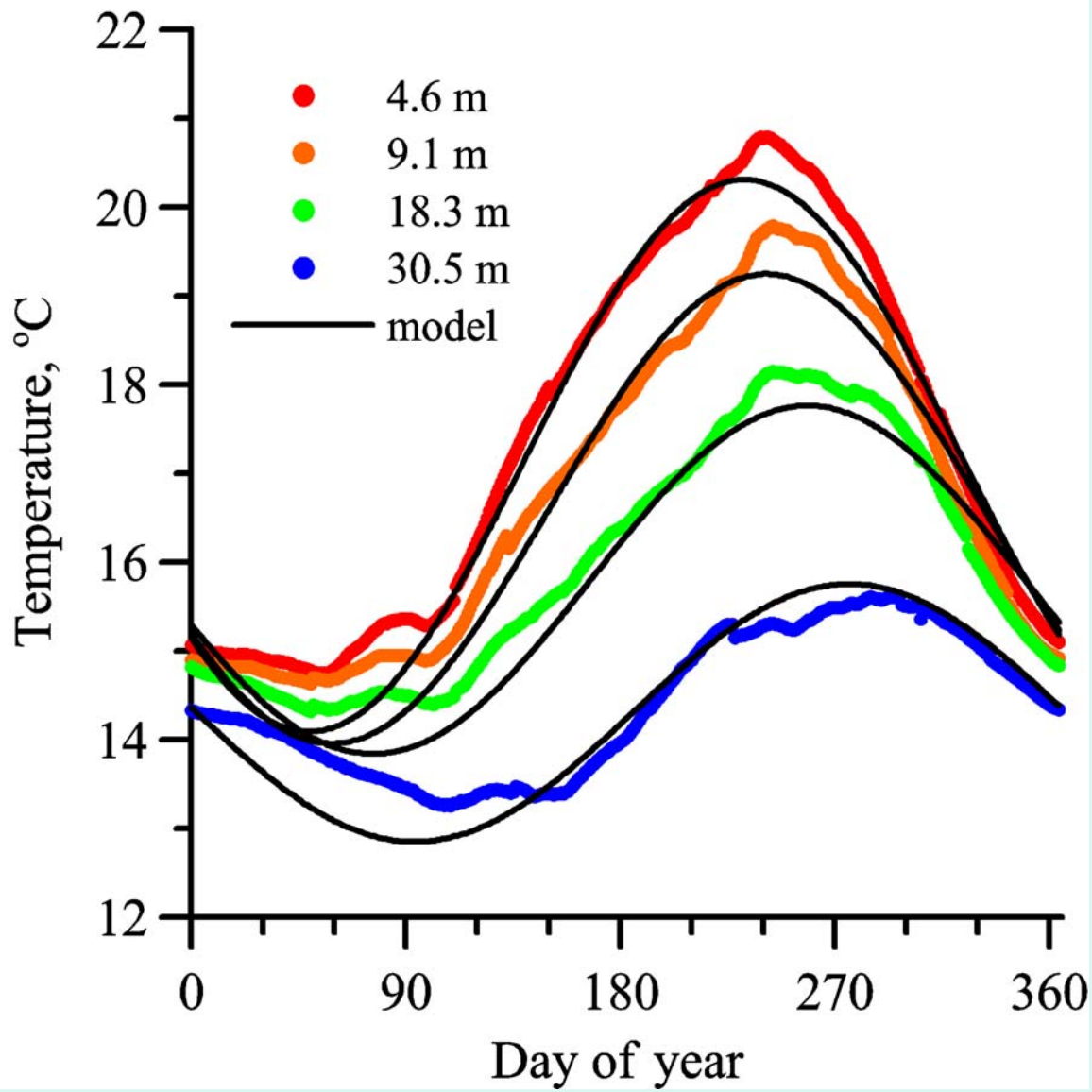
β extinction coefficient

ω annual angular freq.

$\alpha^2 = i\,\omega/\kappa$

$C' = C'(L_1)$

Catalina Data and Model



Conclusions

- Annual temperature variations in the inner SCB indicate
  - Little advection but significant vertical eddy diffusion
  - Vertical diffusion coefficient is 10^{-4} m^2 s^{-1}
  - Horizontal eddy field deduced