

New approach for using remotely sensed chlorophyll *a* to identify seabird hotspots

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Supplement. Chlorophyll model for calculating frequency of chlorophyll peaks index (FCPI)

The California Current System (CCS) model was parameterized by fitting it to CCS-wide means for each month using least-squares linear regression, including terms for annual (12 mo) and seasonal (6 mo) cycles (Legaard & Thomas 2006) and a linear time trend (Fig. S1). We included a linear term even though a linear trend was not evident in the CCS-wide means (Fig. S1) because significant linear trends were evident in some regions of the CCS. Prior to settling on the final CCS-wide model described above and in ‘Materials and methods’ in the main text, we conducted an exploratory analysis of regions representing the northern, central, and southern CCS (Fig. S2). We used a model similar to the one above (except that it also included a shorter, 3 mo seasonal cycle and initially fit to untransformed chl *a* data) to explore spatial and temporal trends in chl *a* within CCS regions and among bathymetric domains of continental shelf (≤ 200 m depth), shelf break (200 to 1000 m), slope (1000 to 3000 m), and oceanic (>3000 m). Chl *a* in this system generally declines across-shelf from the shoreline to the oceanic domain (Henson & Thomas 2007). Our models did show this cross-shelf pattern, but also that the data contained a linearly increasing trend, which varied by latitude and bathymetric domain (Fig. S3). In summary, there was a linearly increasing trend in surface chl *a* of shelf waters in focal areas off California, but not in the northern CCS. The significant linear trend is also evident in shelf-break and slope waters in the greater of Gulf of the Farallones in the central CCS (Fig. S3). During latter years, the Southern California Bight region also appears to have increased amplitude in the seasonal cycle of shelf waters (Fig. S3). Therefore we retained the linear term in the CCS-wide model that we used for calculation of FCPI. The 3 mo seasonal term was rarely significant and, therefore, not used in the final CCS-wide model.

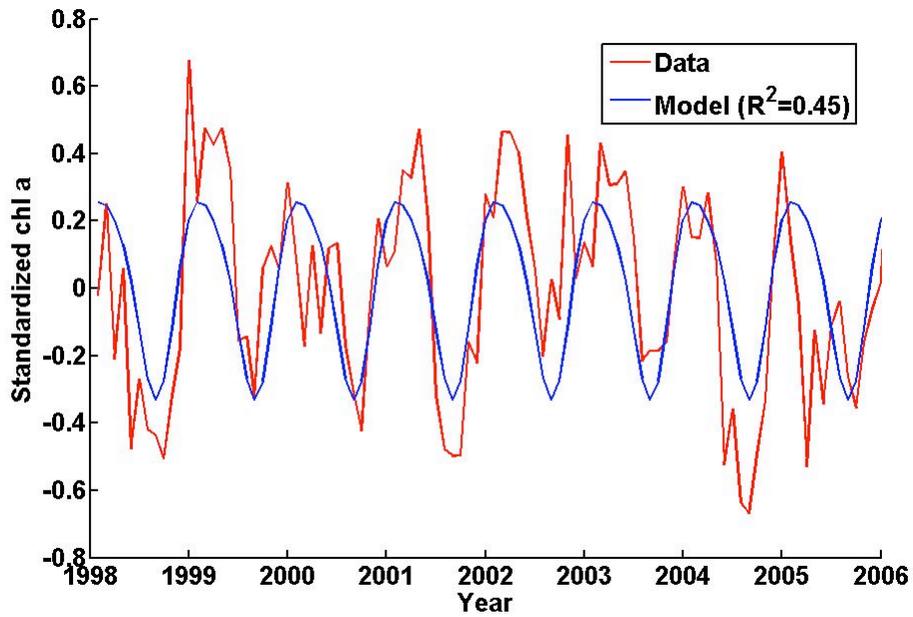


Fig. S1. California Current System scale model (blue) of seasonal and annual variation in chl *a* over a 108 mo time period (1998–2006). The model was fit to California Current System-wide means of chl *a* for each month (red)

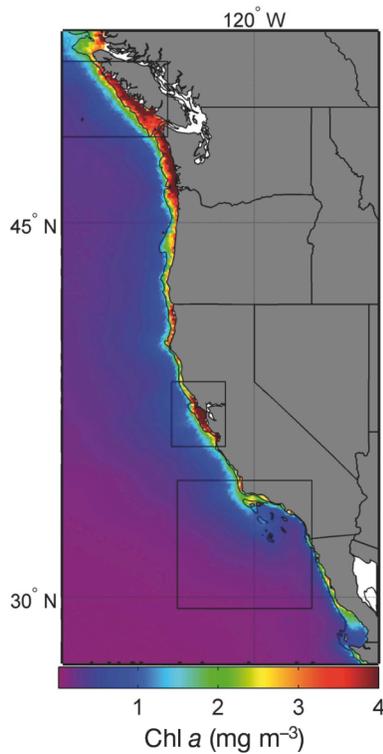


Fig. S2. Nine-year (1998–2006) chl *a* composite for the California Current System showing the 3 regions (black-outlined boxes) where we conducted more detailed chl *a* modeling efforts prior to developing the final California Current System-wide model

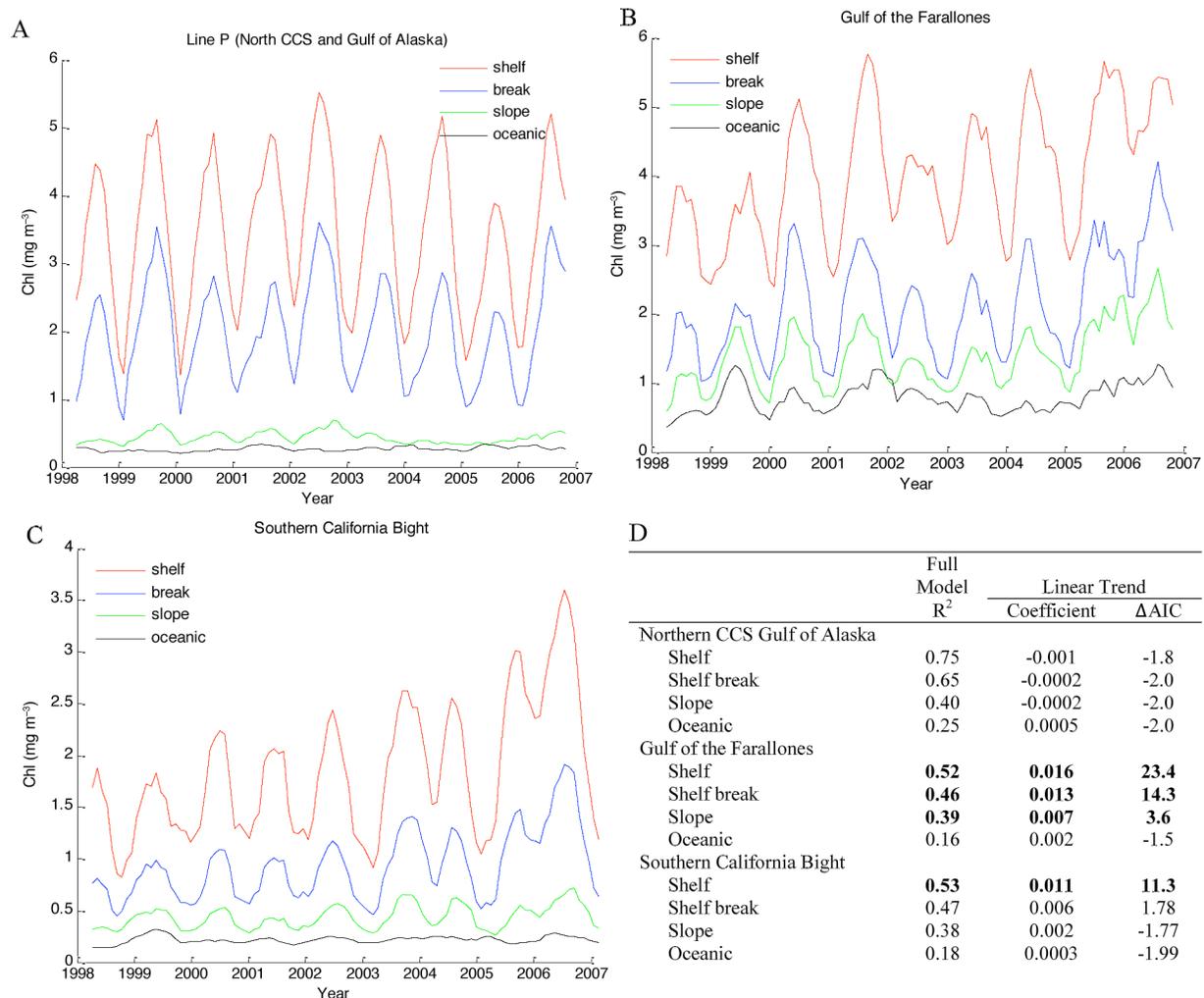


Fig. S3. (A–C) Time series (5 mo running mean) of chl *a* concentration (mg m^{-3} ; untransformed) by bathymetric domain (continental shelf: <200 m, break: 200 to 1000 m, slope: 1000 to 3000 m, oceanic: >3000 m) within 3 regions (Fig. S2): (A) North California Current and Gulf of Alaska, (B) Gulf of the Farallones, and (C) Southern California Bight. (D) Time-series analyses of chl *a* for surface waters overlying bathymetric domains. Model fit (R^2) is for the full model including annual and semiannual harmonics and a linear trend fit to untransformed chl *a* data. Change in Akaike information criterion (ΔAIC) is a comparison of the full model to the same model without the linear trend (values in **bold** indicate significant [$p < 0.05$ and $\Delta\text{AIC} > 2$] model improvement when including the linear trend). CCS: California Current System

LITERATURE CITED

- Henson SA, Thomas A (2007) Phytoplankton scales of variability in the California Current System: 1. Interannual and cross-shelf variability. *J Geophys Res Oceans* 112:C07017 doi:10.1029/2006JC004039
- Legaard KR, Thomas AC (2006) Spatial patterns in seasonal and interannual variability of chlorophyll and sea surface temperature in the California Current. *J Geophys Res Oceans* 111:C06032 doi:10.1029/2005JC003282