# Large-scale spatial and temporal patterns of SST and Chl in Southern California

According to Kahru et al. (750) ocean color satellites is an important aspect in detecting the concentration of chlorophyll (Chl). As such, in southern California, geostationary satellite data is a very important tool for studying Sea-surface temperature (SST) fronts. Kahru et al. et al. (750) observe that seasonal development of coastal upwelling patterns could be used to detect SST and Chl fronts. The study further asserts that SST peaked during summer and lowest in winter. In addition, there is decreased localized SST patterns off southern California extending to larger marine ecosystem.

Otero and Siegel (1134) assert that the correlation of SST with upwelling winds and large-scale variability on an international scale are quite higher compared to those with Chl. Besides, the monthly-temporal Chl patterns show that major Chl fronts have regular space thus, one can follow their movements by adjacent quasi-parallel curves. Besides, studies conducted by Kahru et al. (751) show that Chl and SST fronts distribution covered around 1-2 kilometers of mapped MERIS and MODISA where major Chl fronts are characterized with upwelling filaments which arise from coastal upwelling of Southern California. The rapid growth of phytoplankton in the coastal waters, rich in nutrients, enable enriching of filaments with Chl. As such, the high-Chl filaments moves towards south-western and southern directions where most often, Chl fronts and major SST fronts coincide to form a pattern. However, the variability through a front may differ for Chl and SST, thus not all Chl fronts are identified as SST fronts. It is also important to note that monthly composition of SST fronts seems noisier than the equivalent Chl fronts in Southern California.

## Effects of strong ENSO events on SST and Chl in Southern California

El Nino and the Southern Oscillation (ENSO) refers to a periodic fluctuation in the air pressure of the overlying atmosphere and SST across the equatorial Pacific Ocean. Strong ENSO causes increase in coastal Kelvin wave and physical atmospheric wind forcing upwelling and tidal mixing and the topographical characteristics of the gulf affecting SST and the Chl. However, Herrera-Cervantes et al. (346) further notes that high ENSO results to an inverse relationship of decreasing Chl coupled with an increase in SST, emphasizing the eminent role of climate variations over southern California that affect SST and Chl concentration.

Moreover, ENSO influences the inter-annual variability of Chl pigment concentration in southern California. As such, Gulf of California also plays an important role in the poleward propagation of ENSO-related coastal waves. Furthermore, during strong ENSO events, coastal trapped waves reach Southern California accompanied with meandering poleward flow where there is a positive increase in SST anomalies on the sea surface height. This, in turn, deepens nitric-line thus reducing the availability of nutrients to the euphotic zone (Herrera-Cervantes et al., 352). Reduction of nutrients further affects the concentration of Chl. The correlation pattern indicates that different biological-physical response to ENSO events of 2015-2016 oscillations often rises from a combination of physical and ecological dynamics of southern California.

### Otero, Mark Pumarino, and D. A. Siegel. *Spatial and temporal characteristics of sediment plumes and phytoplankton blooms in the Santa Barbara Channel*. Deep Sea Research Part II: Topical Studies in Oceanography 51.10 (2004): 1129-1149.

Research by Otero and Siegel assesses the use of SST and satellite ocean-color in measuring phytoplankton blooms in southern California. It was coupled with a wide range data analysis over a three-year period on chlorophyll (Chl), SST, and water-leaving variance. Findings of the research show that plumes occur episodically whereas blooms occur regularly which covers up to 95% of southern California waters. Moreover, Otero and Siegel notes that terrestrial runoff and coastal upwelling that orchestrate processes regarding Chl and SST which dominate phytoplankton biomass and water turbidity in southern California.

### Kahru, Mati, et al. *Spatial and temporal statistics of sea surface temperature and chlorophyll fronts in the California Current.* Journal of plankton research 34.9 (2012): 749-760.

Kahru et al., brings to our understanding how chlorophyll and sea surface temperature fronts patterns develop in southern California. The study employed temporal and spatial statistical analysis which reveal that SST peaks during summer and was lowest in winter and that observing SST fronts statistics for long help show trends how associated physical dynamics and SST influence the biology of Southern California currents. Moreover, the study elaborates on the movement of Chl filaments and how the patterns by a form in southern California.

### Herrera-Cervantes, H., et al. *Interannual correlations between sea surface temperature and concentration of chlorophyll pigment off Punta Eugenia, Baja California, during different remote forcing conditions.* Ocean Science 10.3 (2014): 345-355.

This study elaborates more on the effects of ENSO on SST and concentration of chlorophyll. In particular, the research reveals how strong ENSO results to increase in coastal Kelvin wave and physical atmospheric wind forcing upwelling and tidal mixing and the topographical characteristics of the gulf affecting SST and the Chl more so high ENSO results to an inverse relationship of decreasing Chl coupled with an increase in SST. Besides, the study shows the relationship between the concentration of Chl and inter-annual in southern California during different remote forcing conditions.

## Works cited

Herrera-Cervantes, H., et al. *Interannual correlations between sea surface temperature and concentration of chlorophyll pigment off Punta Eugenia, Baja California, during different remote forcing conditions.* Ocean Science 10.3 (2014): 345-355.

 http://www.ocean-sci.net/10/345/2014/os-10-345-2014.pdf

Kahru, Mati, et al. *Spatial and temporal statistics of sea surface temperature and chlorophyll fronts in the California Current*. Journal of plankton research 34.9 (2012): 749-760.

 http://ocean.eas.gatech.edu/manu/papers/PDFs/Kahru-2012-Spatial-and-temporal.pdf

Otero, Mark Pumarino, and D. A. *Siegel. Spatial and temporal characteristics of sediment plumes and phytoplankton blooms in the Santa Barbara Channel.* Deep Sea Research Part II: Topical Studies in Oceanography 51.10 (2004): 1129-1149.

 https://ic.ucsc.edu/~kudela/OS290H/readings/OteroSiegel\_DSR2\_2004.pdf