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1-9 Understanding Large, Slow Changes in Tropical Pacific Chlorophyll through a 51-Year Statistical Reconstruction

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Understanding decadal-scale biological variability in the oceans has been hindered by lack of spatial coverage by direct measurements and lack of temporal coverage by satellite remote-sensing observations. Ocean surface chlorophyll, a proxy for phytoplankton standing stock, has been derived from ocean color satellites for over a decade. With these measurements, the strong connection between ocean physics and biology became clear and provided new insights about what drives seasonal and interannual biological processes. Taking advantage of the finding that physical forcing primarily controls biological primary production in the tropical Pacific, especially during El Niño, the most closely correlated physical variables are used as predictors in a statistical reconstruction to extend monthly chlorophyll anomalies to five decades between 1958-2008. After evaluating the reconstructed chlorophyll for locations of highest skill, several patterns are revealed in these new data. The most dominate climate pattern to emerge from the reconstruction is associated with the interannual El Niño. There is a striking difference in biological patterns between the east Pacific El Niño events and central Pacific El Niño events. Low frequency chlorophyll patterns associated with the Pacific Decadal Oscillation are also apparent in the reconstruction. The overall pattern was consistent with what is known about the impact of ENSO on biology with the PDO primarily serving to amplify or dampen ENSO. Yet a narrow equatorial band frequently displayed the opposite chlorophyll pattern compared to the rest of the equatorial cold tongue. This anomaly is linked to a long-term trend in the depth of the Equatorial Undercurrent that transports iron to the high-nutrient, low-chlorophyll east Pacific. These results demonstrate the feasibility and utility of reconstructing ocean color chlorophyll to address open questions about large-scale, low frequency primary production in the tropical Pacific.