primary productivity were made each year prior to JGOFS; hence these were previously our only basis for annual estimates of chlorophyll and primary production for the expansive equatorial Pacific waveguide.

In order to study the temporal variability of the biogeochemistry of the central equatorial Pacific, MVMSs (described above) were added during the JGOFS intensive study to the TAO physical mooring at 0°, 140°W for an eighteen-month period in 1992 and 1993 (Foley et al., 1998). This sampling period was most opportune in that our observations spanned both El Niño and "normal" phases (Figure 12). During the El Niño phase, the mixed layer, the thermocline, and a very weak equatorial undercurrent (EUC) were very deep (at times greater than 150 m) and Kelvin waves (~60 day period) propagated eastward past the site (with depressions of the thermocline). Time series of key physical and bio-optical variables obtained from instruments deployed on the 0°, 140°W mooring are shown in Figure 12. Light levels were high. However, relatively high concentrations of nutrients including iron were deep while surface concentrations were low. As a result, measured chlorophyll *a* concentrations in the upper layer were low. However, as "normal conditions" returned, Kelvin waves ceased and the thermocline and a strong EUC shoaled and thus allowed the transport of nutrients into the euphotic layer. Importantly, westward propagating tropical instability waves (TIWs with periods of ~20 days) also contributed to large vertical upwelling cycles. TIWs are easily seen in the meridional current records and appear to be manifest in the chlorophyll *a* time series with values doubling and at times tripling those observed during the El Niño period (Figure 12). Importantly, strong, though highly complex, coupling is evident between the physical processes (El Niño, Kelvin waves, and TIWs) and the phytoplankton biomass and primary productivity of the equatorial Pacific. It is worth noting that the TAO array of physical instruments along with specially focused JGOFS ship-based sampling (ship–based mapping of biogeochemistry in space, ships on station for time series, sediment traps, etc.) provided a relatively comprehensive, though coarse 3-dimensional biogeochemical time series for the region. Subsequent time series studies in this region (Chavez et al., 1998, 1999) support the conclusions described here.