Episodic vertical nutrient fluxes and nearshore phytoplankton blooms in Southern California

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ABSTRACT: Three distinct phytoplankton blooms lasting 4–9 d were observed in approximately 15-m water depth near Huntington Beach, California, between June and October of 2006. Each bloom was preceded by a vertical NO_3 flux event 6–10 d earlier. NO_3 concentrations were estimated using a temperature proxy that was verified by comparison with the limited NO_3 observations. The lower–water-column vertical NO_3 flux from vertical advection was inferred from observed vertical isotherm displacement. Turbulent vertical eddy diffusivity was parameterized based on the observed background (< 0.3 cycles h^{-1}) stratification and vertical shear in the horizontal currents. The first vertical nitrate flux event in June contained both advective and turbulent fluxes, whereas the later two events were primarily turbulent, driven by shear in the lower part of the water column. The correlation between the NO_3 flux and the observed chlorophyll *a* (Chl *a*) was maximum (r^2 = 0.40) with an 8-d lag. A simple nitrate–phytoplankton model using a linear uptake function and driven with the NO_3 flux captured the timing, magnitude, and duration of the three Chl *a* blooms (skill = 0.61) using optimal net growth rate parameters that were within the expected range. Vertical and horizontal advection of Chl *a* past the measurement site were too small to explain the observed Chl *a* increases during the blooms. The vertical NO_3 flux was a primary control on the growth events, and estimation of both the advective (upwelled) and turbulent fluxes is necessary to best predict these episodic blooms.