



Figure 13. (a) Modeled time series of water temperature. (b) Modeled time series of Chl *a* concentration. Curves are shown for 2, 11, 33, 41, 50, 60, 76 m. (c) Model estimate of the biomass export from the 50-m deep surface layer due to vertical mixing. It has been calculated as the ratio of the net turbulent flux of the Chl *a* at 50-m depth to the total production of Chl *a* in the water column, both integrated over a day.

and their depth would change very little with time due to low sinking rates. They would thus contribute to the deep phytoplankton maximum. It was further suggested that some of the cells may be reentrained by the next nighttime convection back into the mixed layer. It was also suggested that, in a similar way, spring storms may provide a mechanism for returning the phytoplankton to near the surface.

While this description of the phytoplankton fate may be appropriate in some circumstances (deep biomass maximum), the explanation for our observations seems different. We believe that intermittent mixing due to synoptic wind forcing and large-amplitude diurnal changes in mixed layer thickness in the spring acted to remove phytoplankton from surface waters. This is in agreement with the fact that both primary production and phytoplankton concentration were much higher in surface waters than at depth during our experiment. Thus the net flux of particles by vertical mixing had to be directed downward. Such an effect of the mixing on the particle removal has been suggested before [Gardner *et al.*, 1993; Stramska and Dickey, 1994]. Interestingly, after the fast increase of the biomass in

deep waters due to each mixing event, our data show slow but persistent decreases in the Chl *a* and *c*₆₆₀ with time. If a quiescent flow is assumed in deep waters, then such a decrease of biomass cannot be explained only by the low cell sinking rates. In the actual ocean, the dispersion of particles is probably more efficient because of the role of processes not included in the model. These may include mixing induced by internal wave breaking and oceanic fronts, or aggregate formation [e.g., Holligan *et al.*, 1985; Hill, 1992].

Finally, if our interpretation is correct, then the bio-optical properties in the open ocean may be highly variable on relatively short time scales due to local dynamical processes (twofold changes within a few hours at 10-m depth). This variability is a consequence of the critical dependence of biomass on mixing. Large errors in the interpretation of the data may be induced if physical conditions are not well known, or if the data collected in the sea have inadequate temporal resolution [Wiggert *et al.*, 1994].

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