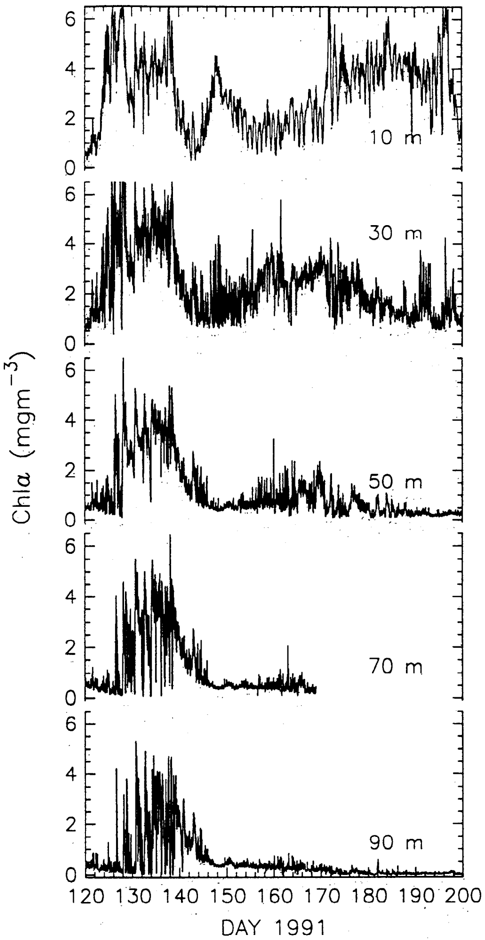

Figure 5. Time series of fluorometrically determined concentrations of chlorophyll a at 10-, 30-, 50-, 70-, and 90-m depths. Part of the 70-m record is missing due to instrument failure.

primary production contour for the MLML experiment shown in Figure 10. This primary production estimate was obtained by applying the Kiefer-Mitchell productivity model [*Kiefer and Mitchell,* 1983] to the Chl *a* and PAR time series shown in Figures 5 and 6. According to the model calculations, primary production at the 50-m and greater depths was relatively low because of the low light intensity. Thus, we suggest that the observed high concentration of phytoplankton in deep waters must be explained by the fact that phytoplankton were effectively mixed down there, from near the surface. This conclusion is based also on the fact that the temporal variations in the temperature record closely resemble those in the fluorescence and c_{660} records. This can be seen in Figure 8 d, where sudden changes in the 50-m water temperature correspond to similar changes in bio-optical signals.

The visual recognition of a strong relationship between water temperature and bio-optical properties is supported by the results of spectral analysis. The coherence and phase functions estimated for the water temperature and c_{660} records at 10 m are shown in Figure 11 (middle panels). To a first approximation, one can interpret our problem as a single-input, single-output physical system, where water temperature is an input and bio-optical properties are the outputs. For the ideal case of a linear system, the coherence function would be unity. Our realistic system has the coherence less than unity, which can result from the nonlinear response or the presence of other inputs that contribute to the output signal (affect bio-optical variability).

It should be noted that, in general, the strong coherence between water temperature and bio-optical properties could arise from both vertical mixing and/or advection of different water masses. Although we cannot completely rule out the latter possibility without measurements taken simultaneously in time and providing some horizontal coverage, we note that there is no evidence for strong advection in the time series of local currents. Furthermore, changes of the water temperature at 10-m depth (Figure 8a) compared with local net heat flux (Figure 8b) indicate that a significant part of the temperature variability is likely to be of local origin. The results of the spectral analysis for the net heat flux and 10-m temperature are shown in Figure 11 (top panels). Highly significant coherence (about 0.75) was found between these two variables, which supports our conclusion.

The second 10-day subset of time series is shown in Figure 9 and represents the conditions of relatively strong thermal stratification of surface waters (days 149-159, which are in period 3, Figure 7). The data presented in Figure 9a indicate that the MLD was less than 20 m, due to intense heating and weak winds. The bio-optical signals (Figures 9c and 9d) show very different behaviors than during period 2 (Figures 8c and 8d). First, high fluorescence and c_{660} signals were restricted to surface waters and their magnitude decreased rapidly with depth.

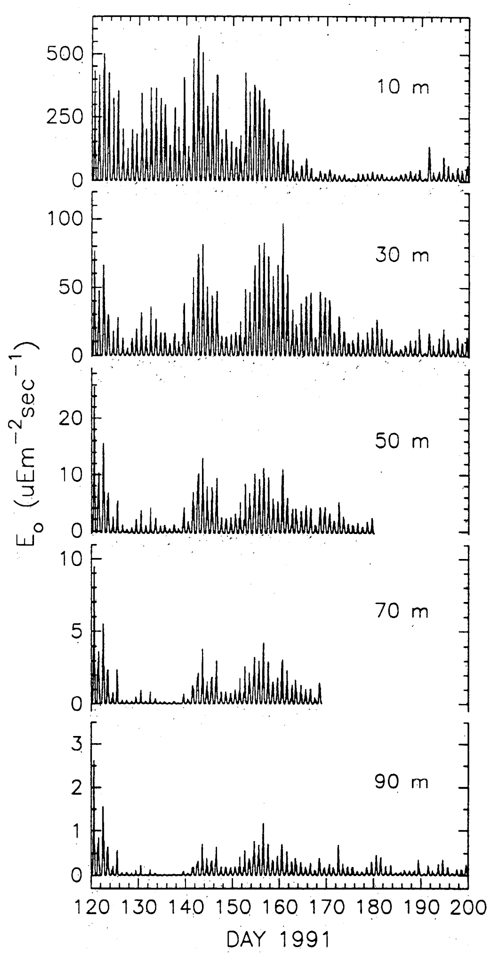

Figure 6. Time series of PAR at 10-, 30-, 50-, 70-, and 90-m depths. Parts of the 50- and 70-m records are missing due to instrument failure.