Abstract View

Volume 16, Issue 1 (January 1986)

Journal of Physical Oceanography
Article: pp. 25–38 | Abstract | PDF (1.11M)

Heat and Energy Balances in the Upper Ocean at 50°N, 140°W during November 1980 (STREX)

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(Manuscript received March 15, 1985, in final form July 16, 1985)

DOI: 10.1175/1520-0485(1986)016<0025:HAEBIT>2.0.CO;2

ABSTRACT

Subsurface temperature data and surface meteorological data are analyzed from thermistor chain moorings deployed near 50°N, 140°W during the Storm Transfer and Response Experiment (STREX). The upper-ocean heat and potential energy (PE) contents to 90 m are examined for an 18-day period and their changes compared to the sources and sinks of heat and turbulent kinetic energy (TKE). Heat and TKE do not balance in the vertical dimension alone. The heat content change, for example, averages −200 W m^{-2} while the net cooling at the surface, estimated from bulk formulas for latent and sensible heat fluxes and radiation measurements, averaged only −86 W m^{-2}. Advection of heat and PE, in either the vertical or horizontal, play major roles in the budgets of this area. We describe a method for using the large-scale wind stress and SST data around the site to compute the advection in the Ekman layer and close the heat (to 23%) and TKE (to 24%) budgets.

Though the heat and PE contents exhibit long-term trends, there are two marked events associated with storms on 15 and 27 November 1980 that account for much of the overall cooling and PE change. The advection estimates mimic the episodic character of the heat and PE contents and are clearly important on the short, storm time scale. The relative contributions of horizontal and vertical advection are quite different for the two storms, showing that the upper-ocean response very much depends on the proximity and orientation of the storm as it moves past the observational site.

The TKE budget is complex, and some terms can only be estimated by uncertain parameterizations so that the relative importance of surface production, shear production, and advection is unclear. Still, the fact emerges that mixed layer deepening is dominated by wind-forcing even during the season of significant cooling.

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