VARIATIONS OF THE NEAR-SURFACE HEAT CONTENT IN THE CENTRAL NORTH PACIFIC OCEAN

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ABSTRACT

The heat budget of the upper ocean was studied to investigate the relationship between surface heat exchange and heat storage. Bathythermograph and surface heat exchange data were obtained for the period 1971 to 1977 from a volume in the North Pacific Ocean extending from 160° to 170°, from 30° to 50°N and to 300 meters depth. Heat storage was calculated from the bathythermograph data and compared to the surface heat exchange. Heat storage anomalies, measured as the difference from the mean annual cycle, persist for several months, while those of the surface heat exchange usually last only a month. The phase of the heat storage generally lags the phase of the surface heat exchange by three months.

The monthly change in heat storage, ΔH, was calculated and compared to the surface heat exchange, Q. Phases of H and Q coincide, while the amplitude of ΔH is nearly always larger. The interannual variation of ΔH is substantial while that of Q is small, indicating that other heat transporting mechanisms vary considerably from year to year and/or the errors in the heat storage are large.

The heat conservation equation was simplified to include only the time change in heat storage, the surface heat exchange and a residual. The residual, containing the effects of advection, mixing, and errors, has been separated into individual components by several investigators. Errors in the residual are due to the combined uncertainty in ΔH and Q. Three methods were used to estimate the errors in the heat storage. These estimates ranged from 14% to 35% of the mean annual variation within the 68% confidence interval. Estimates of the error in the surface heat exchange were obtained from the literature and are negligibly small by comparison. Thus, the error in the residual is mostly determined by the heat storage errors. Approximatly 50% of the mean annual variation of the residual can be attributed to error (68% C.I.). Consequently, without further refinements in the heat storage measurements little information is left for determination of the other components in the residual.