Abstract View

Volume 8, Issue 4 (July 1978)

Journal of Physical Oceanography
Article: pp. 582–599 | Abstract | PDF (1.34M)

Observation and Simulation of Storm-Induced Mixed-Layer Deepening

James F. Price, Christopher N.K. Mooers, and John C. Van Leer

Rosenstiel School of Marine and Atmospheric Science, University of Miami, Miami, FL 33149

(Manuscript received September 27, 1976, in final form March 23, 1978)

DOI: 10.1175/1520-0485(1978)008<0582:OASOSI>2.0.CO;2

ABSTRACT

Two observed cases of mixed-layer (ML) deepening due to storms are analyzed and simulated. The primary goal is to learn whether the relevant scale velocity in the parameterization of wind-driven deepening is U_*, the wind stress friction velocity, or δV, the magnitude of the horizontal mean velocity difference across the base of the ML. ML deepening is isolated from air–sea exchange and horizontal advection by diagnosing the entrainment tendency of ML temperature.

ML deepening is found to be highly intermittent on the storm time scale. Deepening in response to a wintertime atmospheric cold front occurred as δV was accelerated during the initial rise in wind stress. Deepening abruptly ceased as wind stress began to decelerate δV, though the stress magnitude continued to increase. A similar relationship between wind stress δV and ML deepening was also observed in a summertime case and is evidence that the relevant scale velocity is δV not U_*.

In both cases the observed phase and extent of ML deepening are simulated realistically by the parameterization of Pollard *et al*. (1973) in which an overall Richardson number, $\mathrm{Rv} = g'h/\delta V^2$, where g' and h are the ML buoyance and thickness, sets a lower bound on the ML thickness. The value of Rv is $\cong 0.65$.