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Dye Dispersion in the Seasonal Thermocline

David P. Vasholz and Larry J. Crawford

The Johns Hopkins University Applied Physics Laboratory, Laurel, MD 20707

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ABSTRACT

A dye dispersion experiment was performed in September, 1979, in the open ocean approximately 180 km off the east coast of Florida. An initially vertical sheet of dye extending from about 60 to 100 meters in depth and about 10 kilometers long was dispensed into the seasonal thermocline. Its subsequent evolution was recorded with an instrumented chain that included 25 fluorometers, which was towed back and forth across the dye sheet by another vessel. The dye sheet was crossed 17 times at ages varying from 6 minutes to slightly less than 4 hours. Two of the most apparent effects in the data were the important of vertical shear and the presence of intermittency in the dye time series. It is found that the depth-averaged width of the dye sheet grows as time to the $3/2$ power. There is good evidence that a shear-diffusion interaction is responsible for this growth, which implies an effective vertical diffusivity of $(1.0 \pm 0.5) \text{ cm}^{-2} \text{ s}^{-1}$. Even though this is an upper-ocean experiment, there is some consistency with predictions based upon the observed “universality” of deep ocean random background internal waves. It is argued that the observed intermittency represents a level of detail that is not accessible from the usual partial-differential-equation approach employing an effective diffusivity.

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Headquarters: 45 Beacon Street Boston, MA 02108-3693
DC Office: 1120 G Street, NW, Suite 800 Washington DC, 20005-3826
amsinfo@ametsoc.org Phone: 617-227-2425 Fax: 617-742-8718
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