Abstract View

Volume 27, Issue 2 (February 1997)

**Journal of Physical Oceanography**
Article: pp. 282–290 | Full Text | PDF (177K)

# Shear, Strain, and Richardson Number Variations in the Thermocline. Part II: Modeling Mixing

**Robert Pinkel**

*Marine Physical Laboratory, Scripps Institution of Oceanography, La Jolla, California*

**Steven Anderson**

*Woods Hole Oceanographic Institution, Woods Hole, Massachusetts*

(Manuscript received December 14, 1994, in final form June 18, 1996)

DOI: 10.1175/1520-0485(1997)027<0282:SSARNV>2.0.CO;2

ABSTRACT

Gregg has provided observational evidence that averaged estimates of dissipation, $\epsilon$, vary approximately as the square of the internal wave field energy level $\epsilon \sim E^2$. He notes that the finding is consistent with a specific model for energy transfer in the internal wave field proposed by Henyey et al. If it is also consistent with a purely statistical breaking model, based on the random superposition of independent waves, support for any particular dynamic scenario vanishes.

However, most previous statistical models of the wave breaking process have demonstrated an extreme sensitivity of dissipation to energy level. Doubling $E$ results in an increase of dissipation by a factor of $2 \times 10^5$ in the early model of Garrett and Munk and by $10^3$ in the later model of Desaubies and Smith.

These mixing models are revisited, attempting to reconcile their predictions with the observations of Gregg. An extensive Doppler sonar (5.5-m vertical resolution) and CTD (5400 profiles to 420 m) dataset, obtained from the Research Platform *FLIP* during the SWAPP experiment, is applied to the problem. A model for the probability density function (pdf) of Richardson number is developed (Part I of this work), accounting for both shear and strain variability. This pdf is an explicit function of the vertical differencing scale, $\Delta z$, over which shear and strain are estimated. From this pdf, a related probability density of overturning can be derived as a function of overturn scale and internal wave field energy level. The third moment of this pdf is proportional to the buoyancy flux, which can be related to dissipation, assuming a fixed flux Richardson number.

When this finite difference approach is pursued, dissipation levels are found to vary nearly as $E^2$ for a variety of contrasting internal wave spectral models. Gregg's constant of proportionality is recovered, provided independent

realizations of the Richardson number process are said to occur every 10–14 hours.