Abstract View

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Microstructure Patches in the Thermocline

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ABSTRACT

Profiles of temperature microstructure have been found to exhibit strong intermittence in the distribution of χ, the rate of diffusive smoothing of temperature fluctuations. Records from the main thermocline in the subtropical gyro of the Pacific have been examined to determine the thickness of patches of microstructure activity. Since these profiles have few thermohaline intrusions, the small-scale structure must be generated by the “breaking” of internal waves or by salt fingering. The variations in the intensity of the microstructure thus reflect the irregularity in time and space of the occurrence of these processes. In addition, there is an intermittence of the microstructure due to variations in intensity of the microstructure within individual mixing events. Much of this internal variation is due to modulation of the amplitude of the microscale temperature fluctuations by the larger scale finestructure.

In an attempt to compensate for the second type of intermittence, zero-crossings between positive and negative gradients were used as indicators of activity. The regions with zero-crossings account for most of the activity in those records having large Cox numbers. Individual negative gradients appear to be static instabilities that are no more than 5 cm thick, giving maximum lifetimes much less than N^{-1} if the temperature structures are no longer accompanied by velocity fluctuations over corresponding scales. Hence the patches are active and are not the decayed fossils of previous events, The fractions of the profiles containing activity varied from 7 to 36%, and may be underestimates by a factor of 2. While many of the patches were 2 m or less in thickness, some that appeared continuously active for 30 m were found. The regions containing zero-crossings were distributed independently of the finestructure.

The patterns of microstructure are not consistent with those expected if salt fingering is the dominant process in the upper thermocline, which is diffusively unstable. Neither, in most cases, are they indicative of Kelvin-Helmholtz instabilities occurring preferentially in high-gradient regions. The relatively short scales of possible overturns in comparison with the thickness of many of the patches suggest that the thicker patches may be due to a sequence of vertical overturns rather than one large overturn.

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