DIAPYCNAL DIFFUSIVITIES IN THERMOHALINE FRONTS

A. Rodríguez-Santana, A. Martínez-Marrero

Departamento de Física, Edificio de Ciencias Básicas, Universidad de Las Palmas de Gran Canaria, 35017, Las Palmas de Gran Canaria; arodriguez@dfis.ulpgc.es.

Introduction

In a thermohaline front, the boundary area between two water masses can increase by lenses and intrusions produced by interleaving. These zones with large temperature and salinity differences may enhance the possibility of diapycnal mixing through double diffusion processes. But another mixing mechanism induced by vertical shear of the current may act in these frontal systems. Kunze (1995) argue that the intermittent turbulence patches lasting about a buoyancy period and arising every 10-20 buoyancy periods in the ocean reduces fingering fluxes for density ratios $R_\rho > 2$ and may help explain why thermohaline staircases are only found at density ratios less than two. The downgradient buoyancy-fluxes associated with instabilities induced by vertical shear may act to smooth vertical finestructure in contrast to the tendency for countergradient double-diffusive fluxes to sharpen finestructure. In this work we estimate diapycnal diffusivities relate with double diffusion and vertical shear instabilities to compare its importance in different places of the front.

Data and Metodology

Our data consist of 21 stations that form a transect West-East, at 20º N, from 26º W to 17º W, equidistant 55 km between stations, in Cabo Verde frontal system. We have used CTD (Conductivity Temperature Depth) and ADCP (Acoustic Doppler Current Profiler) data to estimate distributions of potential density, density ratio, Brunt-Väisälä frequency, vertical shear and gradient Richardson number. In the next step we estimate diapycnal diffusivities due to double diffusion (Schmitt, 1988; Kelley, 1990) and shear instabilities (Gregg, 1989).

Results

We find negative diffusivities for double diffusion process (mainly salt-finger mode) in various stations between $10^{-3} – 10^{-6}$ m^2 s^{-1} with maxima values up to 10^{-3} m^2 s^{-1} in stations with North and South Central Waters with interleaving processes. Also we find in these stations, in different depths, low gradient Richardson numbers with positive diapycnal diffusivities about $10^{-4} – 10^{-7}$ m^2 s^{-1} with maxima on 10^{-3} m^2 s^{-1}.

Conclusions

Our results support the hypothesis that the study of the diapycnal mixing in thermohaline fronts has to account not only double diffusions processes but too instabilities due to vertical shear that with positive diffusivities may act against of salt fingering fluxes.

References

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