THE INHERENT STABILIZING EFFECT OF NON-BOUSSINESQ BAROCLINIC TORQUE ON INTERNAL GRAVITY WAVES

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An approximation that is often made when studying the dynamics of oceanic stratified flows is the Boussinesq approximation. However, in regions of strong vertical density gradients this approximation may not be valid and the baroclinic torque, resulted from such sharp density gradients, can play an important role in altering the propagation and the instability mechanism of internal gravity waves. Here we investigate this phenomena with a special focus on the associated consequences for the mechanistic interpretation of stably stratified shear instability arising from the interaction between vorticity-propagating waves. To illustrate and elucidate the physical effects we consider three examples of increasing complexity: wave propagation supported by a uniform background flow; wave propagation supported on a piecewise-linear shear flow possessing one density jump; and an instability problem of a piecewise-linear shear flow possessing two jumps, which supports the possibility of shear instability. We find that the non-Boussinesq effects introduce a preference for the direction of wave propagation that depends on the sign of the shear in the region where waves are supported. This in turn defects the phase-locking between the waves that is crucial for the wave resonance, and consequently has an inherent tendency for stabilization [1].

References

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