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Effect of Baroclinicity on Double-Diffusive Interleaving

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ABSTRACT

Although ocean fronts are often baroclinic, existing models of double-diffusive interleaving have ignored such baroclinic effects as velocity shear and horizontal density gradients. To determine the importance of these effects, the authors have formulated a linear instability analysis applicable to baroclinic fronts. Two limiting cases are considered: one for fronts with strong vertical and/or horizontal shear, the other for fronts with weak shear.

In both limits, double-diffusive interleaving can be enhanced or suppressed by baroclinicity. Interleaving motion is enhanced if isopycnals rise toward the fresh side of the front. Conversely, interleaving is suppressed if isopycnals slope downward across the front. A significant result is that the salinity gradient along isopycnals is not a good indicator of interleaving strength.

As an example, the model is applied to a Mediterranean salt lens. The effect of baroclinicity is significant: the predicted growth rates are increased by 35%–90%. The large-scale velocity and hydrographic fields indicate that Meddy Sharon lies somewhere between the high- and low-shear limits. Nevertheless, the model predictions agree reasonably well with the observed interleaving characteristics.

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