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Penetrative convection induced by a statically unstable density distribution in a very thin central layer RISHAD SHAHMUROV, LAYACHI HADJI, The University of Alabama — Several models of penetrative convection have been studied (Gribov & Gurevich, 1957; Veronis, 1963; Matthews, 1988; Batchelor & Nitsche, 1990; Simitev & Busse, 2010). We consider Rayleigh-Bénard convection with a static density distribution that has a piecewise linear dependence on the vertical coordinate and whose unstably stratified part occupies a central layer of thickness $\epsilon \ll 1$. Some limiting cases corresponding to the linear eigenvalue problem are treated analytically and the results confirmed by a detailed numerical investigation. Steady two-dimensional flow patterns are determined numerically for supercritical Rayleigh numbers in the range $\epsilon \geq 0.06$. For $0.2 \leq \epsilon \leq 0.5$, an analytical nonlinear stability three-dimensional study is undertaken in the case of poorly conducting boundaries. A weakly nonlinear evolution equation for the leading order temperature perturbation is also derived and solved numerically as function of ϵ and Prandtl number. The effect of the boundaries on the flow characteristics diminishes as $\epsilon \to 0$, leading us to study the stability of an unbounded stratified fluid for which similarity type solutions are obtained. Our findings are compared to those of the models mentioned above.

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