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Disruption of the vortex-wave interaction self-sustaining process in stratified plane Couette flow T. S. EAVES, DAMTP, University of Cambridge, C. P. CAULFIELD, BPI & DAMTP, University of Cambridge — Minimal seeds for turbulence, initial conditions of smallest possible energy density $E_0 = E_c$ that eventually transition to turbulence, closely follow the edge manifold in state space before leaving the edge manifold for the turbulent attractor. The trajectories visit a number of coherent states, exact solutions to the Navier–Stokes equations, that are embedded within the edge manifold. In unstratified plane Couette flow these 'edge states' are manifestations of the 'self-sustaining process' (SSP) of Waleffe (1997) or the 'vortex-wave interaction' (VWI) of Hall and Smith (1991). We show that in density stratified plane Couette flow where both a constant, statically stable density difference $2\Delta\rho$ and a constant velocity difference $2\Delta U$ is maintained across a channel of depth $2h$, these states differ from the unstratified states at very small bulk Richardson numbers $Ri_B = g\Delta\rho h/\rho_0\Delta U^2$ (where g is the gravitational acceleration and $\rho_0 \gg \Delta\rho$ is a reference density) and that the new states are not of SSP/VWI type. We present a scaling argument to show this is to be expected for $Ri_B \geq O(1/Re)$, where $Re = \Delta U h/\nu$ and ν is the kinematic viscosity, and investigate the mechanisms through which the SSP/VWI states breakdown.

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