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Self-similar mixing in stratified plane Couette flow for varying Prandtl number C. P. CAULFIELD, BPI/DAMTP, U. of Cambridge, QI ZHOU, JOHN TAYLOR, DAMTP, U. of Cambridge — We investigate fully developed turbulence in statically stable stratified plane Couette flows (the flow between two horizontal plates a distance $2h$ apart moving at velocities $\pm U_0$ and held at densities $\rho_a \mp \rho_0$) using direct numerical simulations at a range of Prandtl numbers $Pr \equiv \nu/\kappa \in \{0.7, 7, 70\}$ and Reynolds numbers $Re \equiv U_0 h/\nu \in [865, 280000]$. We observe significant effects of Pr on the heat and momentum fluxes across the channel gap and on the mean temperature and velocity profile, which can be described through a mixing length model using Monin-Obukhov (M-O) similarity theory. We employ M-O theory to formulate similarity scalings for various flow diagnostics in the gap interior. The mid-channel-gap gradient Richardson number Ri_g is determined by the length scale ratio h/L, where L is the Obukhov length scale. When $h/L \gg 1$, Ri_g asymptotes to a maximum characteristic value of approximately 0.2, for very high Re and for a range of Pr and bulk Richardson number $Ri = g\rho_0 h/(\rho_a U_0^2)$. The flux Richardson number $Ri_f \simeq Ri_g$, implying that such turbulent flows do not access the (strongly) 'layered anisotropic stratified turbulence' regime, and that the turbulent Prandtl number is approximately one.

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