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Numerical simulation of stably stratified plane Couette flow: layered structures and the transition to intermittent turbulence

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Direct numerical and large-eddy simulation results for stably stratified Couette flow are discussed. It is shown that besides chaotic irregular turbulent motions the plane turbulent Couette flow exhibits large coherent structures in the whole range of stability: from neutral to extremely stable. The well known counter-rotating rolls found in neutral case become unstable even with small increase in stratification. But for moderate stability tilted layered structures may be identified. It is argued that this layers act as barriers for turbulent mixing of heat without blocking momentum turbulent transfer, which results in increase in turbulent Prandtl number. For very strong stratification the flow becomes intermittent but the turbulence may persist for very high bulk Richardson numbers. Intermittency in the plane Couette flow corresponds to the formation of secondary large-scale structures elongated in the spanwise direction, which define spatially confined alternating regions of laminar and turbulent flow.

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