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Turbulence and mixing from optimal perturbations to a stratified shear layer ALEXIS KAMINSKI, DAMTP, University of Cambridge, C.P. CAULFIELD, BPI & DAMTP, University of Cambridge, JOHN TAYLOR, DAMTP, University of Cambridge — The stability and mixing of stratified shear layers is a canonical problem in fluid dynamics with relevance to flows in the ocean and atmosphere. The Miles-Howard theorem states that a necessary condition for normal-mode instability in parallel, inviscid, steady stratified shear flows is that the gradient Richardson number, Ri_g is less than 1/4 somewhere in the flow. However, substantial transient growth of non-normal modes may be possible at finite times even when $Ri_g > 1/4$ everywhere in the flow. We have calculated the "optimal perturbations" associated with maximum perturbation energy gain for a stably-stratified shear layer. These optimal perturbations are then used to initialize direct numerical simulations. For small but finite perturbation amplitudes, the optimal perturbations grow at the predicted linear rate initially, but then experience sufficient transient growth to become nonlinear and susceptible to secondary instabilities, which then break down into turbulence. Remarkably, this occurs even in flows for which $Ri_g > 1/4$ everywhere. We will describe the nonlinear evolution of the optimal perturbations and characterize the resulting turbulence and mixing.

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