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Linear optimal perturbations of a stratified shear layer ALEXIS KAMINSKI, JOHN TAYLOR, DAMTP, University of Cambridge — Stratified shear flows are ubiquitous features of the ocean and atmosphere, and a large literature is devoted to describing their stability and mixing properties. A classical example is the Kelvin-Helmholtz instability that is possible when the gradient Richardson number is less than 1/4 somewhere in the flow. Here, we use numerical simulations to seek the three-dimensional "optimal perturbations" which maximize the growth of perturbation energy over a finite time interval T. In the limit of a long time interval, we expect to recover the fastest growing linear normal mode. However, for shorter time intervals, enhanced transient growth is possible due to the non-normality of the governing equations. The Reynolds, Richardson, and Prandtl numbers of the flow are varied in our analysis, and the resulting optimal perturbations compared to predictions from theory and past work. Enhanced growth rates are observed for short times in both the linearly stable (i.e. $\mathrm{Ri} > 1/4$) and unstable cases, and the optimal perturbations found have more structure than the most unstable mode predicted by normal-mode stability theory.

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