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A settling-driven instability in two-component, stably stratified fluids AHMAD ALSINAN, ECKART MEIBURG, UC Santa Barbara, PASCALE GARAUD, UC Santa Cruz — We analyze the stability of stably stratified fluids whose density depends on two scalar fields, for situations where one of the scalar fields is unstably stratified and involves a settling velocity. Such conditions may be found, for example, in flows involving the transport of sediment and heat or salt. A linear stability analysis for constant-gradient base states demonstrates that the settling velocity generates a phase shift between the perturbation fields of the two scalars, which gives rise to a novel instability mode. This instability mechanism favors the growth of waves that are inclined with respect to the horizontal direction. It is active for all density and diffusivity ratios, including for cases in which the two scalars diffuse at identical rates. If the scalars have different diffusivities, the new instability mechanism competes with the dominant elevator mode of the classical double-diffusive instability. We present linear stability results as a function of the governing dimensionless parameters, including for lateral gradients of the base state density fields that result in predominantly horizontal intrusion instabilities. Highly resolved direct numerical simulation results serve to illustrate the nonlinear competition of the various instabilities for such flows in different parameter regimes.

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