Abstract Submitted
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Numerical simulation of shear instabilities in interfacial gravity waves[1] OLIVER FRINGER, MICHAEL BARAD, Stanford University — We present simulations of shear instabilities in solitary-like interfacial gravity waves of depression using a Navier-Stokes solver that employs adaptive mesh refinement. The adaptive technique enables resolution of 0.20 m in a 500 m long wave which allows simulation of meter-scale Kelvin-Helmholtz (KH)-like billows that develop at the interface. In the presence of time-varying shear within the waves, an instability occurs only when a parcel of fluid is subjected to destabilizing shear long enough for KH-type billows to grow. While a necessary criterion for instability suggests that the Richardson number, Ri, must fall below the canonical value of $1/4$, we find that a sufficient condition for instability occurs when $Ri < 0.1$. An alternate criterion for instability is given by a requirement that the growth rate time scale of the instability, τ_i, satisfies $\tau_i < 1.26T_w$, where T_w is the time in which parcels of fluid are subjected to shear and stratification that satisfy $Ri < 1/4$. This criterion can also be stated in terms of the width of the region in which $Ri < 1/4$, L_w, which must satisfy $L_w > 0.86L$ for instabilities to develop, where L is the solitary wave half-width. Under any one of these three criteria, two-dimensional billows form at the wave troughs, and the billows subsequently break down via three-dimensional motions that decay once the wave-induced shear subsides in the trailing edge of the waves.

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