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Mixing induced by Faraday surface waves

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We investigate how surface waves enhance mixing across the interface of two miscible fluids with a small density contrast. Imposing a vertical, time-periodic acceleration, we excite Faraday waves both experimentally and numerically. In systems with a shallow density gradient, these standing waves advect the interface and can trigger secondary instabilities.
When driven beyond the linear regime, large Faraday crests collapse to form cavities, injecting bubbles and lighter fluid deep into the heavier layer. Together, these mechanisms gradually homogenize the upper layer, diminish the interfacial density jump, and drive the interface downward until it decouples from surface forcing. We report a non-monotonic
mixing rate—first increasing as the interfacial energy barrier lowers, then decreasing as less energy is injected into the weakened surface—revealing a balance between barrier reduction and energy input.

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