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Resonant forcing of nonlinear internal waves by a density current released into a two-layer fluid BRIAN WHITE, University of North Carolina at Chapel Hill, Marine Sciences, KARL HELFRICH, Woods Hole Oceanographic Institution, Physical Oceanography — The propagation of a density current released by a dam break into a fluid with two-layer stratification is a geophysical fluid dynamics problem relevant to the ocean and atmosphere. Analogous to topographic forcing, a transcritical resonance is observed when the speed of the density current falls within a range, $c_l < c < c_u$, near the linear longwave speed for the two-layer ambient stratification. Within this resonant band, nonlinear solitary waves can be radiated upstream of the front. If the speed of the current is increased beyond this range, by increasing either the height or density of the released fluid, an upstream bore can be generated and is connected to the current front by a rarefaction. This dissipationless bore, also called the conjugate flow, corresponds to the two-layer nonlinear solitary wave solution in the large-amplitude limit, and has speed c_{cs}. As the current speed is increased beyond c_{cs}, steady supercritical flow over the front is observed. The onset of resonance shows qualitative similarities to topographic forcing in the weakly nonlinear limit. However, the upper limit is well-predicted by fully nonlinear theory, with $c_u = c_{cs}$. Unlike the topographic generation problem, the current speed cannot be varied independently, but is determined by the dam height, density, and ambient stratification.

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