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Gravity currents penetrating into a sheared and stratified ambient fluid MOHAMAD M. NASR-AZADANI, AMIN KHODKAR, ECKART MEIBURG, University of California Santa Barbara — We have developed a circulation-based theoretical model to study gravity currents penetrating into a sheared and stratified ambient fluid. Unlike previous theories, our circulation model, which employs the vorticity equation, does not require any assumptions regarding headloss along a specific streamline in the flow. Our theoretical framework enables us to identify the existence of gravity currents penetrating into ambient environments having arbitrary velocity and/or density profiles across the channel height by means of a headloss analysis. First, we investigated a two-layered free stream configuration, where we observed excellent agreement between our theoretical model and DNS results. For various shear magnitudes, we demonstrated the existence of gravity currents of more than half of the channel height, which are not physically possible in the classical gravity current setup without any shear. Furthermore, we investigated the influence of stratification on the behavior of gravity currents. We identified the regions of physically feasible solutions. We also observed situations that produced internal waves and/or rarefaction waves.

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