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Gravity current jump conditions, revisited MARIUS UNGARISH, Technion, IIT, Haifa, Israel, ANDREW J HOGG, Un. Bristol UK — Consider the flow of a high-Reynolds-number gravity current of density ρ_c in an ambient fluid of density ρ_a in a horizontal channel $z \in [0, H]$, with gravity in $-z$ direction. The motion is often modeled by a two-layer formulation which displays jumps (shocks) in the height of the interface, in particular at the leading front of the dense layer. Various theoretical models have been advanced to predict the dimensionless speed of the jump, $Fr = U/\sqrt{g'h}$; g', h are reduced gravity and jump height. We revisit this problem and using the Navier-Stokes equations, integrated over a control volume embedding the jump, derive balances of mass and momentum fluxes. We focus on understanding the closures needed to complete this model and we show the vital need to understand the pressure head losses over the jump, which we show can be related to the vorticity fluxes at the boundaries of the control volume. Our formulation leads to two governing equations for three dimensionless quantities. Closure requires one further assumption, depending on which we demonstrate that previous models for gravity current fronts and internal bores can be recovered. This analysis yield new insights into existing results, and also provides constraints for potential new formulae.

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