

## **Gravity current intruding a two-layer fluid: A theory on the front speed**

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If a fluid, under gravity, has horizontal variations in density, it always flows and the form of the flow is known as a gravity current. If the fluid also has vertical density stratification, then intrusive gravity currents are formed. A beautiful and classical example is the Morning Glory in northern Australia in late October. A simple model for this phenomenon is an Intrusive Gravity Current (IGC) where fluid of one density propagates along an interface between two homogeneous layers. Although this is a very simple flow it has not been possible to predict its speed of propagation, a crucial property in the formation of the Morning Glory. In this paper we present, based on simple energy arguments, a theory to predict the front speed in terms of the interface-height and density-difference. We carried out the numerical simulations and laboratory experiments and have shown that they are in good agreement with the theory. One of the regimes of the front-speed map, which is characterized by the lower interface-height and larger density-difference, is found to be closely related with the dynamics of the Morning Glory which is developed by the intrusion.