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Inertial gravity currents from edge drainage[1] MOSTAFA MOMEN, Stanford University, ZHONG ZHENG, Cambridge University, ELIE BOU-ZEID, HOWARD STONE, Princeton University — Gravity currents are formed due to a density gradient in the horizontal direction between the current and an ambient fluid. In this work, we present theoretical, numerical, and experimental studies of the release of a finite volume of fluid instantaneously from the edge of a rectangular domain for high-Reynolds-number flows. The setup is relevant in geophysical and engineering applications such as open channels, and dam-break problems. For the cases we considered, the results indicate that about half of the initial volume exits during an early adjustment period. Then, the inertial gravity current reaches a self-similar phase during which about 40% of its volume drains and its height decreases as τ^{-2}, where τ is a dimensionless time that is derived with the typical gravity wave speed and the horizontal length of the domain. Based on scaling arguments, we reduce the shallow-water PDEs into two nonlinear ODEs, which are then solved analytically. The new self-similar solutions are in good agreement with the performed experiments and direct numerical simulations for various geometries and fluid densities. This study provides new insights into the dynamical behavior of edge drainage flows, particularly during the inertial regime.

[1]The simulations were performed on the Della computer clusters of Princeton University.

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