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Energy dissipation in shallow-water models for high-Re gravity currents MARIUS UNGARISH, Technion, Haifa, Israel — The motion of a 2D gravity current, released from a lock in a horizontal channel is considered. Attention is focused on the energy transfers (between forms and fluids) and dissipation. The analysis uses the two-layer inviscid shallow-water (SW) formulation (with nose Froude numbers, Fr, given by Benjamin's and other formulas) and is backed by numerical Navier-Stokes results. We show that the current performs significant work on the ambient. In general, the increase of kinetic energy of the inviscid SW (or similar two-layer vertically-averaged) system cannot fully recover the decay of potential energy. This imbalance reproduces the classical dissipation predicted by Benjamin's steady-state analysis. We call this "averaged flow dissipation". This dissipation typically increases with the depth ratio of ambient to lock, and hence all deep SW currents (in particular the one-layer SW model predictions) with finite positive Fr are dissipative. However, the link between the "averaged flow dissipation" and the irreversible loss of energy in a real gravity current is missing. The implications on the validity of the SW predictions are discussed.

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