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A generalized shallow-water analysis of gravity currents in various cross-area channels for Boussinesq and non-Boussinesq systems MARIUS UNGARISH, Technion, Haifa — The propagation of a high-Reynolds-number gravity current in a horizontal channel along the horizontal coordinate x is considered. The bottom and top of the channel are at $z = 0, H$, and the cross-section is given by the quite general $-f_1(z) \le y \le f_2(z)$ for $0 \le z \le H$. A shallow-water formulation is presented and used for the solution of the dam-break problem. The dependent variables are the position of the interface, $h(x,t)$, and the speed (averaged over the area of the current), $u(x,t)$. The non-rectangular cross-section enters the formulation via $f(h)$ and integrals of $f(z)$ and $zf(z)$, where $f(z) = f_1(z) + f_2(z)$ is the width of the channel. For a given geometry $f(z)$, the input parameters in the lock-release problem are the ratios of height H/h_0 and density ρ_a/ρ_c, of ambient to lock fluids. The dam-break problem can be solved by the method of characteristics, but complications (jumps, critical restrictions) appear when the return flow in the ambient is significant; these features are not captured by a one-layer model, and hence a two-layer model solution is introduced. A strong generalization is achieved: the standard classical solutions for a rectangular or unbounded channel are particular cases of the present theory.

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