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Lattice Boltzmann simulations of gravity currents

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Abstract

This paper is aimed at assessing the ability of the Lattice-Boltzmann Method (LBM) in reproducing the fundamental features of lock-exchange gravity currents. Both two- and three-dimensional numerical simulations are presented at different Reynolds numbers ($1000 \leq Re \leq 30000$). Turbulence has been accounted for by implementing an equivalent Large Eddy Simulation (LES) model in the LBM framework. The advancement of the front position and the front velocity obtained by LBM numerical simulations are compared with laboratory experiments appositely performed with similar initial and boundary conditions and with previous results from literature, revealing that the dynamics of the gravity current as a whole is correctly reproduced. Lobes and clefts instabilities arising in three-dimensional simulations and the entrainment parameter are also analysed and comparisons with previous studies are presented.

Keywords: Buoyancy-driven flows, Computational methods in fluid dynamics, Lattice-Boltzmann Method,

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