Simulate Gravity-Current by Using Phase-Field Method

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We present high-resolution simulations of gravity currents with phase-field method in the lock-exchange configuration.[1][2] The case of small density differences is considered, where the Boussinesq approximation can be adopted. To capture the details of the foremost part of the front, where no previous high-resolution data were available, we used the high-order numerical methods and phase-field approach.

The numerical methods we used are based on spectral and spectral-element discretizations and compact finite differences. The code, named TURBINS (**TURB**idity currents via **I**mmersed boundary **N**avier-**S**tokes simulations), is second order accurate in space and third order in time, use MPI, and employs a domain decomposition approach. It makes use of multigrid preconditioners and Krylov iterative solvers for the systems of linear equations obtained by the finite difference discretization of the governing equations.[3]

Concentration profile of two fluids is solved by phase-field method, which is based on diffuse-interface model. In this model, the interface between two fluids is described as a diffuse region, and the formula of mixing process is derived from chemical molecule diffuse-energy. By using phase-field based on diffuse-interface model, we can choice the condition of two fluids is miscible or immiscible.[4][5][6][7]

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